14660 - TGRO-S2P17 - Computer Graphics

Coordinating unit: 340 - EPSEVG - Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú
Teaching unit: 717 - EGE - Department of Engineering Presentation
Academic year: 2011
Degree: (ENG) ENG.TÈCN.DE TÈLE., E.EN SIST. ELECTRÒN., PLA 95 (Syllabus 1995). (Teaching unit Optative)
(ENG) ENG.TÈCN.IND., ESP. EN ELECTRICITAT, PLA 95 (Syllabus 1995). (Teaching unit Optative)
(ENG) ENGINYERIA EN AUTOMATICA I ELECTRONICA INDUSTRIAL (Syllabus 2003). (Teaching unit Optative)
(ENG) ENG.TÈCN.IND., ESP. EN QUÍMICA INDUSTRIAL, PLA 95 (Syllabus 1995). (Teaching unit Optative)
(ENG) ENG.TÈCN.IND., ESP. EN ELECTRÒNICA IND., PLA 95 (Syllabus 1995). (Teaching unit Optative)
Credits: 4.5  Teaching languages: Catalan, Spanish, English

Teaching staff

Others: Manuel Lopez Membrilla

Learning objectives of the subject

Content

Studies:

Description:
Objectives
- To equip the student with the capacity to graphically represent different elements or components in a graphical language by means of the support from CAD.
- Knowledge of the norm UNE of graphical representation.
- Introduction to basic CAD systems and their orders.
- Drawing and standard representation of different components and schemes.

Contents
- Introduction to the computer-assisted drawing.
- Basic elements of a CAD system.
- Standard graphical Representation according to the UNE norm of parts and symbols.
- Basic Orders of CAD:
- Drawing, editing and consulting orders
- Visualization of the drawing and management of layers
- Blocks, attributes and boundaries
- Practical Applications
Laboratory

**Description:**
Objectives
To apply the knowledge acquired in the practical sessions using CAD programs

Contents
- Exercises proposed by the teacher

Qualification system

Continuous Evaluation with the final practical exercises. ¿The Evaluation is still pending¿

Bibliography
14670 - FPRO-S2P23 - Fundamentals of Programming

- To improve the capacity of the student to reason with rigor and elegance respect to the correction and efficiency of the programs.
- To learn to relate the recursive structures to the design of iterative programs.
- To present to the student the main structures of data, as well as the ability to identify the most suitable algorithms on these structures.

Others:  
Angels Hernandez Gomez

Learning objectives of the subject

Teaching languages:  
Catalan, Spanish, English

Coordinating unit:  
340 - EPSEVG - Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú

Teaching unit:  
723 - LSI - Department of Software

Academic year:  
2012

Degree:  
(ENG) ENG.TÈCN.DE TELEC., E.EN SIST. ELECTRÒN., PLA 95 (Syllabus 1995). (Teaching unit Optative)  
(ENG) ENG.TÈCN.IND., ESP. EN ELECTRICITAT, PLA 95 (Syllabus 1995). (Teaching unit Optative)  
(ENG) ENG.TÈCN.IND., ESP. EN ELECTRÒNICA IND., PLA 95 (Syllabus 1995). (Teaching unit Optative)  
(ENG) ENG.TÈCN.IND., ESP. EN QUÍMICA INDUSTRIAL, PLA 95 (Syllabus 1995). (Teaching unit Optative)  
(ENG) ENGINYERIA EN AUTOMATICA I ELECTRONICA INDUSTRIAL (Syllabus 2003). (Teaching unit Compulsory)  
(ENG) ENG.TÈCN.IND., ESP. EN MECÀNICA, PLA 95 (Syllabus 1995). (Teaching unit Optative)

Credits:  
7,5
Content

Theory

Description:
Objectives
The methodology of programming provides a range of techniques that enable more complex actions from the simplest, as well as build and work with more complex objects from the simplest. These techniques help to complete these tasks properly, comfortable and comprehensively.
In the case of shares, the most naked eye so far is the use of structures to build algorithmic actions not elementary: decomposition sequential and iterative alternative.
This course will be reviewed and other techniques such as:
- Design by means of sequences
- Topdown design

With respect to the objects, until now also the constructors of following types have seen themselves:
- Table: Union of homogenous objects (of the same type)
- Tuple: Union of heterogenous objects.

As new techniques, is seen as defining new types of data, specifying the operations that can be done. We will work to specify a type of data, its possible implementations and its use since certain algorithms.

Contents
1. Algorithmic schemes
  1.1. Introduction
  1.2. Abstraction and Sequences
  1.3. Scheme of Route
  1.4. Scheme search
  1.5. Scheme search in tables
2. Descendant analysis
  2.1. Introduction
  2.2. Problem example 1
  2.3. Problem example 2
  2.4. Problem example 3
3. Introduction to the Structures of Data
  3.1. Introduction
  3.2. Matrices. Specification and implementation
  3.3. Dispersed matrices
  3.4. Tables of Frequencies
4. Pointers and Dynamic Memory
  4.1. Pointers
  4.2. Dynamic management of memory
  4.3. Pointers to pointers. Tables of pointers.
  4.4. Semidynamic matrices
5. Applications to the Numerical Calculation
  5.1. Resolution of Systems of Linear Equations.
  5.2. Method of Gaussian
  5.3. Iterative methods
14670 - FPRO-S2P23 - Fundamentals of Programming

Laboratory

Description:
Objectives
- To deepen understanding of the programming language C. It will deepen the understanding of this language classes through the practices and development of small exercises.

Contents
(7 sessions of two hours)
S1: Review of Language C.
S2: Compilation: To develop practice 9 of Practices of laboratory.
S3: Bookstores: To develop practice 10 of Practices of laboratory S4 S5 S6 S7: Practical

Qualification system

From two controls C1 and C2 the Mark of Theory of the following way calculates: MAX ((C1+C2/2, c2) and the mark will be: (0,8 Theory Mark + 0,2 Practical Mark)

Bibliography
Learning objectives of the subject
Module 1

**Description:**

Objectives

In recent decades there is a growing global concern regarding issues related to the generation, storage, transportation and consumption of energy. Broadly speaking it can be argued that this concern is primarily due to two different aspects. The first is associated with the gradual decline of existing reserves of fossil fuels against a growing demand for energy, while the second is related to the polluting effects on the environment of treatment of these primary sources.

As the main alternative to the treatment of primary sources consisting of fossil fuels emerge forcefully renewable energy, sustainable and ecological. The advantages of renewable energy are well known and can be highlighted among these:

- Its ability to preserve the primary sources to be sustainable.
- The security of the power provision due to the diversity of renewable energy sources.
- Its little or null environmental impact, contributing in this way to the protection of the environment.
- A clear tendency to the loss in costs of the equipment renewable energy converters.
- The use of technology of a modular and distributed type that allows to extend and to develop the infrastructure gradually and according to the requirements of the consumption.

The subject tries to introduce to the student in the processing of alternative energies for its storage or distribution in the mains. Within this ample concept the matter concentrates in the description, analysis and design of the systems power converters, without losing of view the economic and environmental aspects. Within this generic description the following points can be detailed:

They appear, in the first subject, diverse systems of renewable energy as they are Aeolian, photovoltaic, hydraulic or the biomass, although the subject concentrates, later, in the photovoltaic-electrical conversion (subject 2) and the Aeolian-electrical one (subject 3). the ways of operation, as well as the components are described, of the conversion systems. The associate ones to each of these systems appear problematic and are the tools for their analysis.

It details the power converters and machines required for the realization of energy conversion. drivers are designed to guarantee a smooth operation during storage or delivery of energy to the electricity grid. examples and exercises are conducted Dimensioning and budgeted for energy conversion systems installer level.

**Contents**

Program of the subject

Item 1. Systems of renewable energy.

1.1. Renewable energy sources. Basic concepts.
1.2. Distributed systems of energy.

Item 2. Electronic systems of power applied to the photovoltaic energy.

2.2. Modules and photovoltaic groupings. Radiation pattern. Shades and pursuit of the point of maximum power.
2.3. Composition of a photovoltaic system.
2.4. Isolate photovoltaic systems and connected systems to mains.
2.5. Voltage regulators, batteries and shippers of batteries.
2.6. Quality factors in the connection to mains. Investors.
2.7. Norm and legislation in photovoltaic facilities.
2.8. Design, determine the proportions, assembly and maintenance of systems of electrical-photovoltaic conversion.

Item 3. Electronic systems of power applied to the Aeolian energy.

3.3. Asynchronous and synchronous machines.

**Qualification system**

Final = 0.2 * Laboratory mark + 0.8 * Evaluation theory

Where:

Theory mark = MAX (0.7 * Final Test Mark + 0.3 * Partial Test Mark, Final Test Mark)

**Bibliography**

**Basic:**


**Complementary:**

16200 - ELIN-U1T10 - Industrial Electronics

Coordinating unit: 340 - EPSEVG - Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2012
Degree: (ENG) ENGINYERIA EN AUTOMATICA I ELECTRONICA INDUSTRIAL (Syllabus 2003). (Teaching unit Compulsory)
Credits: 6
Teaching languages: Catalan, Spanish, English

Learning objectives of the subject

Content

Theory

Description:
Objectives
This subject orients to the study of converters and systems of the power electronics. Its main assignment is the design of converters and systems of power, starting off of its static analysis and dynamic. One tries at the same time as sufficient knowledge for the practical design of power converters, that is to say, the election and design of magnetic components are acquired, and the design of control circuits and protection of active devices.

Contents
1) Introduction. Types of converters. Analysis in stationary regime.
2) Rectifiers with high factor of power
3) Modeled and control of converters. Application to exchanged sources
4) Converters of resonant structure

Laboratory

Description:
Objectives
The basic objective consists of complementing at experimental level the distributed theoretical bases in the subject.

Contents
1rt practical: Introduction to the Simulink: Simulation of converters DC-DC.
2nd practical: Simulation of a Boost rectifier with high factor of power.
One is a progressive evaluation of the subject, with a test of theory and problems (TEO) and the accomplishment of a work in group (TRA). The practices of the subject will be part of the final evaluation (LAB). The final mark will calculate by means of the expression:

$$N_{FINAL} = 0.3 \times TEO + 0.4 \times TRA + 0.3 \times LAB$$

**Bibliography**
16201 - SIED-U1T10 - Electronic Digital Systems

Coordinating unit: 340 - EPSEVG - Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2012
Degree: (ENG) ENGINYERIA EN AUTOMATICA I ELECTRONICA INDUSTRIAL (Syllabus 2003). (Teaching unit Compulsory)
Credits: 6  Teaching languages: Catalan, Spanish, English

Teaching staff
Others: Mariano Lopez Garcia

Learning objectives of the subject

The basic objective of this subject is to introduce to the student in the design and the implementation of complex digital systems of industrial application. The subject concentrates in the design based on languages of description hardware (HDL) and on systems microprocessors. Emphasis in the physical implementation takes control of the systems and of the related problems hardware.
### Subject 1: Introduction to the digital electronic systems

**Description:**

**Objectives**

This first introductory subject tries that the student acquires a general vision on the design of digital systems and its application to the industrial world. The concepts and the habitually used terminology, as well as some examples are also introduced that help to locate and to define the thematic contents of the subject.

**Contents**

1. Introduction.
2. Stages, criteria and alternatives of design.
3. Definition of basic concepts and software tools.
4. Examples of digital electronic systems applied to the industrial surroundings.

**Activities, knowledge, abilities, aptitudes**

When finalizing this subject the student will have to be able of:

- To assimilate the complexity and to know the evolution that has undergone the design of digital systems in the last decades.
- To understand the different phases involved in the processes of design at the moment used.
- To know the definition concepts and used terminology, as well as the software tools, jointly with its main advantages and limitations.
- To include/understand the necessity of the digital electronic systems in the scope of the robotics, the communications, the control and like solution for an ample fan of industrial applications.

**Planning**

1 of presentation of subject + 3 hours

**Commentaries**

The contents are developed following the chapters introductory of the bibliographical references [1], [2] and [3].
Subject 2: Alternatives hardware in industrial applications

Description:

Objectives
The objective of this thematic block is that the student acquires criteria to select the optimal platform hardware as solution to a specific problem of digital design. The different alternatives that exist, as well as the most important benefits are described resumidamente that they offer each of them. Emphasis in the diversity of solutions and its suitability based on the specific characteristics of each application becomes.

Contents
2.1 Introduction.
2.2 Digital microprocessors and microcontrollers.
2.3 Digital processors of signal (DSP).
2.4 PLD (CPLD and FPGA)
2.5 Comparative of benefits: Complexity, price, speed, consumption, immunity to the noise, etc.

Activities, knowledge, abilities, aptitudes
When finalizing this subject the student will have to be able of:
- To know the different used platforms hardware in digital design.
- To meet the generic benefits each of them, as well as the particular aspects and differentiators in the programmable case of the microprocessors and devices.
- To enable the student to select the alternative of design adapted for a concrete casuistry.

Planning
4 hours.

Commentaries
The contents are developed following different chapters from the bibliographical references [4], [5] and [6].
Subject 3: Synthesis of high level of digital systems

Description:
Objectives
In this subject an introduction to language VHDL becomes, as basic tool of design that allows to describe complex digital systems with a high-level language. The structures and suitable styles of description are introduced more according to the casuistry, as well as you rule to follow for being able to secure a clear and structured programming. The subject finalizes presenting/displaying different alternatives from design, where the most important aspects are put of relief that they allow to obtain a correct synthesis.

Contents
3.1 Introduction: the description languages hardware of high level.
3.2 Language VHDL.
3.2.1 Basic examples and styles of description.
3.2.2 Syntactic elements of the language. Sequential and concurrent programming.
3.2.3 Description of data flow.
3.2.4 Algorithmic behavioral description.
3.2.5 Structural description.
3.2.6 Packages and libraries.
3.3 Examples of design.

Activities, knowledge, abilities, aptitudes
The student will have to be able of:
- To describe digital systems of form structured with a high-level language like VHDL.
- To know the different styles from description that provides VHDL.
- To evaluate the suitability and utility of each of them, dependant of the complexity and the stage implied in the design.
- To take advantage of and to apply methodology of hierarchic design. To describe systems by means of VHDL that allow to their reusability forming part of other more complex systems.

Planning
12 hours of theory + 2 hours of problems.

Commentaries
The contents are developed following the chapters of the bibliographical references [1] - [3] and [12]. Even so in these same references examples and exercises can be found.
Subject 4: Oriented language VHDL to synthesis and simulation

Description:
Objectives
The objectives of this subject are several. On the one hand it is tried that the student assimilates certain rules and styles of programming that facilitate the work and avoid errors in the synthesis process. The description stands out especially to obtain combinacionales and sequential circuits. Even so, a speech point is dedicated on the design of synchronous and asynchronous systems, emphasizing, by means of some examples, the associate problems and their solution. On the other hand language VHDL like tool is simulation for digital circuits. Elements are introduced that solely have meaning in simulation surroundings: retardations, signalings, proving stands, etc.

Contents
4.1 Introduction.
4.2 Basic restrictions and structures.
4.2.1 Combinacional logic.
4.2.2 Sequential logic.
4.3 Synchronous and asynchronous systems.
4.4 Description of a machine of states.
4.5 Simulation and proving stands.

Activities, knowledge, abilities, aptitudes
The student will have to be able of:
- To describe in VHDL circuits that the sintetizador can interpret without ambiguities like sequential combinacionales or.
- To include/understand the importance of the synchronous designs to avoid real problems of operation (metaestabilidade, clock skew, etc.).
- To know the description correct you scheme of finite states (FMS) in VHDL. To know how to interpret when a digital circuit can be focused and be designed like so.
- To use the elements that the language allows to verify the operation of the circuit in simulation.
- To use the proving stands for the functional test of designs VHDL.

Planning
8 hours + 2 hours of problems + 6 hours intervention of groups.

Commentaries
The contents are developed following the references bibliographical [1] - [3] and [7]. Even so in these same references examples and exercises can be found.
Subject 5: Concepts advanced in digital design

Description:
Objectives
This last chapter has a double objective. In the first place that the student knows the present subjects in the digital design microelectronic, and on the other hand to serve as platform for those students who want to attend the optative subject of advanced Digital Design. In particular, the subject begins dynamically presenting/displaying the reconfigurable FPGA; device that allows to increase the densidad functional of an application makes specific (processed by area unit) in comparison with a static implementation on a ASIC or nonreconfigurable device. In the following point the nuclei (IP) re-usable are introduced, like resource that allows to approach complex digital designs without an increase of the time of development (fast prototype). In order to finish, Chip, that is to say, circuits formed by several subsystems integrated in a same chip is described to the System on (FPGA, micros, coprocessors, encriptadores, etc.) that developing very specific tasks of concurrent form.

Contents
5.1 Introduction.
5.2 Dynamic Reconfigurabilidad.
5.3 Modules IP (Intellectual propety).
5.4 Systems in a chip (System where Chip)
5.5 Example of system: Smart cards for restricted access.

Activities, knowledge, abilities, aptitudes
The student will have to be able of:
- To have a clear vision of the present state of the digital microelectronic design, and to know towards where he is evolving.
- To assimilate the utility of the software modules in complex designs.
- To dynamically understand the integrated potentiality of the reconfigurable devices, systems and to identify its applications in the industrial world.

Planning
3 hours.

Commentaries
The contents are developed following 6 4 the references bibliographical [] and [].
The qualification of the subject considers all the work carried out throughout the course, and simultaneously it gives a final opportunity to those students who have not followed the course with the sufficient dedication. In particular, the qualification is obtained choosing the maximum of 0.7 \( C_5 + 0.15 \ C_3 + 0.15 \ C_4 \) and

\[0.7 \left( C_1 \times 0.25 + C_2 \times 0.25 + C_5 \times 0.5 \right) + 0.15 \ C_3 + 0.15 \ C_4\]

where:
- \( C_1 \) = mark of the first partial test.
- \( C_2 \) = mark of the second partial test.
- \( C_3 \) = mark of the work to present/display in class.
- \( C_4 \) = mark of the practices.
- \( C_5 \) = mark of the final test.

### Practices

**Description:**
- **Objectives:**
  The practices of the subject try that the student gets worse the knowledge obtained in the theory classes. The content of the program of practices has been oriented to the design in VHDL of digital systems of average complexity. One has chosen like work surroundings the software tools of Graphics Mentor and the plates hardware of Digilent for the programming of FPGA and CPLD as well as the plate of 2 development PICDEM extra.

- **Contents**
  - Practice 1. Introduction to the tool software FPGA Advantage and language VHDL (2 sessions)
  - Practice 2. Design and implementation of a digital chronometer (2 sessions)
  - Practice 3. Control of a screen LCD (2 sessions)
  - Practice 4. Design of a splitter using a microcontroller PIC (1 session)

- **Activities, knowledge, abilities, aptitudes**
  The student will have to be able of:
  - To know and to use of effective form the software tools that Mentor offers for the programming of programmable devices. To begin in the design of moderately complex digital systems in VHDL. To reinforce the knowledge on the internal structure and principle of operation of the microprocessors.

- **Commentaries**
  The bibliographical material to realize these practical ones is the same that the described one for the theory program. In addition the bibliographical references and the material can be used that appears in the educational guide for the subject of Digital Systems II of the degree electronic Systems.

### Qualification system

The qualification of the subject considers all the work carried out throughout the course, and simultaneously it gives a final opportunity to those students who have not followed the course with the sufficient dedication. In particular, the qualification is obtained choosing the maximum of 0.7 \( C_5 + 0.15 \ C_3 + 0.15 \ C_4 \) and

\[0.7 \left( C_1 \times 0.25 + C_2 \times 0.25 + C_5 \times 0.5 \right) + 0.15 \ C_3 + 0.15 \ C_4\]

where:

- \( C_1 \) = mark of the first partial test.
- \( C_2 \) = mark of the second partial test.
- \( C_3 \) = mark of the work to present/display in class.
- \( C_4 \) = mark of the practices.
- \( C_5 \) = mark of the final test.
16201 - SIED-U1T10 - Electronic Digital Systems

**Bibliography**

**Basic:**


**Complementary:**

The subject â€œEngineering of Controlâ€ 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.
## Content

### Automatic control in the space of states. Continuous systems

<table>
<thead>
<tr>
<th><strong>Description:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objectives</strong></td>
</tr>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

### 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

**Description:**

**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**
The pupils will have to be able of:
- 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. Discrete 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**
The pupils will have to be able of:
- To formulate the control systems in discrete time by the route of state variables.
- To solve equations of state for systems in discrete 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. Discrete 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 discrete time.
2. Observability in discrete 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

**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:

\[
\frac{4}{15} C_1 + \frac{4}{15} C_2 + \frac{4}{15} C_3 + \frac{3}{15} C_4 \\
\text{or} \\
\frac{12}{15} C_5 + \frac{3}{15} C_4
\]

where:
- \( C_1 \) = mark of the first partial test.
- \( C_2 \) = mark of the second partial test.
- \( C_3 \) = mark of the third partial test.
- Average \( C_4 \) = mark of the laboratory practices.
- \( C_5 \) = mark of the final test.

**Bibliography**

**Basic:**
The mechanical systems are the material base of the automatism, therefore, an engineer in Automatic and Industrial Electronics, will have to understand his movement, this cause and transmission generate that it. The objective of this subject is the one to transmit to the student these capacities.
Introduction to the mechanical systems

**Description:**

**Objectives**
The objective of the subject is to introduce to the student to the symbolism of the mechanical systems and to obtain the knowledge to be able to determine the number of drives that will make the wished movement possible of the system.

**Contents**

1.1 Kinematic Pairs. Classification.
1.2 Kinematics, opened and closed Chains
1.3 Planes and space mechanisms. Concept of reference.
1.4 Mobility and degrees of freedom of the mechanisms.
1.5 Kinematic scheme and equivalence kinematics.

**Activities, knowledge, abilities, aptitudes**
- The student will have to be able of:
  - To acquire the concepts of machine, mechanism, chain kinematics, element and kinematic pair.
  - To identify and to classify the pairs of a mechanism.
  - To calculate and to analyze the degrees of freedom and mobility of a mechanism.
  - To understand the meaning of reference system.
  - To become qualified for the outlining kinematics of mechanisms.
  - To dominate to the equivalence concept kinematics

**Planning**
This module is the introduction to the kinematics of mechanisms, and as so he is indispensable to understand the rest of the subject.

The movement in the mechanical systems

**Description:**

**Objectives**
The objective is to understand and to calculate the general movement of the mechanisms, from a kinematic point of view.

**Contents**

2.1 Calculation of speeds in mechanisms.
2.2 Calculation of accelerations in mechanisms.

**Activities, knowledge, abilities, aptitudes**
The student will have to be able of:
- Calculate the angular and linear speeds of mechanisms, both as flat space.
- Calculate the angular and linear acceleration mechanisms, both as flat space.
- Resolve problems in relative motion mechanisms

**Planning**
Aside from the own interest of this module to know the movement the mechanical systems, we will use its results to make later static and dynamic the calculations.
### Causes of the movement in the mechanical systems

**Description:**

Objectives

The objective is to understand and to calculate the efforts that cause the movement in the mechanical systems.

Contents

- 3.1 Permanent and transitory movement.
- 3.2 Diagram of the free body.
- 3.3 Resolution of statics problems.
- 3.4 Resolution of problems of dynamics by means of vectorial theorems (Newton).
- 3.5 Resolution of problems of dynamics by means of fictitious forces of inertia (of Alembert).
- 3.6 Resolution of problems of dynamics by means of virtual works.

Activities, knowledge, abilities, aptitudes

The student will have to be able of:

- Identifying the causes of the movement.
- Represent and interpret the state of vectorially solicitations outside of a mechanical system.
- Resolve the calculation of efforts to cause the movement mechanical systems.

### Transmissions

**Description:**

Objectives

The objective of this subject is the one to know different families from habitually used mechanisms in the transmission of the movement in the mechanical systems.

Contents

- 4.1 Strap and chains.
- 4.2 Trains of gears.
- 4.3 Screws of transmission.

Activities, knowledge, abilities, aptitudes

The student will have to be able of:

- To know the characteristics and fields application of the transmission systems object of the subject.
- To calculate them and to determine the proportions them kinetically.
### Selection of drives

**Description:**

**Objectives**

The objective is the one to know different types from used drives in the mechanical systems automated and the criteria of selection.

**Contents**

5.1 Receivers. Mechanical characteristic.
5.2 Linear drives. Pneumatic and hydraulic cylinders.
5.3 Drives of rotation. Electrical motors.
5.4 Fast drives.

**Activities, knowledge, abilities, aptitudes**

The student will have to be able of:
- To know the parameters that defines the requirements of entrance to the mechanical system to be able to obtain the wished functionality.
- To select the most suitable drives to secure the entrance requirements.
- To analyze the behaviour of answer of the set and to compare it with the initial specifications.

### Commercialized components of the mechanical systems

**Description:**

**Objectives**

The objective is the one to present the different families from commercialized elements employees in the mechanical systems and their implementation.

**Contents**

6.1 Guides for the tumbling: pads and bearings.
6.2 Guides for the linear movement.
6.3 The screw mechanism.
6.4 Trees and axes.
6.5 Connections.
6.6 Brakes.
6.7 Clutches.
6.8 Levies.

**Activities, knowledge, abilities, aptitudes**

The student will have to be able of:
- To know these elements, their applications and the main parameters define those them.
- To implement these elements in the mechanical systems.
### Mechanical vibrations

**Description:**

*Objectives*

The objective is to observe the importance of the mechanical vibrations in the industrial world, its measurement, control and application.

*Contents*

The basic apparatuses of measurement of vibrations are described and the associate one to its calculation is formulated mathematical. With this, the student will realize different acquisitions he will analyze and them.

*Activities, knowledge, abilities, aptitudes*

The student will have to be able of:

- To know the problematic one appeared before phenomena of vibrations nonwished.
- To know the different measurement systems from mechanical vibrations.
- To understand and to evaluate the phenomenon of the mechanical resonance and the determination of frequencies and own ways of vibration.

*Commentaries*

The student will elaborate a report in each one of the sessions of practices that part of the continued evaluation will form.

---

### Obtaining of the characteristic line of a rotation drive

**Description:**

*Objectives*

The objective is to fix the most elementary concepts of the dynamics of the mechanical systems and their practical application.

*Contents*

The reading of encoder, located in the axis of an electrical motor, during the transitory one of starting is obtained. The experiment with two configurations of inertia steering wheel is realized and the calculations of the speed characteristics, acceleration, pair and engine power are analyzed, as well as, the situation of deceleration and grazes of the system.

*Activities, knowledge, abilities, aptitudes*

The student will have to be able of:

- To calculate the pair of a motor of experimental form.
- To understand and to evaluate the corresponding theoretical formulation.
- To reason the differences of the results obtained in different speeds and with different steering wheels.

*Commentaries*

The student will elaborate a report in each one of the sessions of practices that part of the continued evaluation will form.
Qualification system

The qualification of the subject considers all the work carried out throughout the course. The final qualification (QF) of the subject is obtained from the following expression:

\[ QF = 0.2 \times \text{Qualification Practical} + 0.3 \times \text{Partial Examination} + 0.5 \times \text{Final Examination}. \]

Where the evaluative acts and their corresponding weight are:

- 1st evaluative act (weight 0.2):
  
  Practical (realized in the laboratory of mechanics in groups of two students with the support of the teacher. Later a report is given that is used for the qualification.)

- 2nd evaluative act (weight 0.3):
  
  Partial examination (it includes the 2 first subjects)

- 3rd evaluative act (weight 0.5):
  
  Final examination. (it includes all the matter)

The students who do not surpass the subject with the continued evaluation will have a recovery examination, which includes all the agenda.

Regulations for carrying out activities

Without documentation

Without calculator
Bibliography

Basic:

Moliner P.R.. Vibracions. CPDA,

Complementary:

Moliner P.R.. Cinemàtica de Màquines. CPDA,
Moliner P.R.. Dinàmica de Màquines. CPDA,
16204 - ININ-U1O10 - Industrial Instrumentation and Computers

Learning objectives of the subject

The general objective of the module is to study the instrumentation systems based on computers from an industrial point of view of acquisition, transmission, registry, processing and data analysis.
## Content

<table>
<thead>
<tr>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement System specifications and structures. Basic theory of errors</td>
</tr>
<tr>
<td>Analysis and reduction of noise. Interferences in electronics for instrumentation</td>
</tr>
<tr>
<td>Electronic techniques of design of equipment and systems</td>
</tr>
<tr>
<td>Virtual instrumentation and measurement automation</td>
</tr>
<tr>
<td>Wired Systems of industrial communication</td>
</tr>
<tr>
<td>Design and verification of remote acquisition systems</td>
</tr>
<tr>
<td>Introduction to language programming for Instrumentation</td>
</tr>
<tr>
<td>Statistical analysis. Error analysis and their reduction with LabVIEW</td>
</tr>
<tr>
<td>Data acquisition Systems. DAQ plug-in boards</td>
</tr>
<tr>
<td>Communication buses for instrumentation and control.</td>
</tr>
<tr>
<td>Internet/ Intranet as a new element of the measurement chain</td>
</tr>
</tbody>
</table>
The subject consists of a theoretical part and a practical part in the laboratory. The weight of the final mark of the theoretical part is 70% and 30% is awarded to the part of laboratory. The theoretical part consists of an eliminatory partial examination and a final examination. The mark for the laboratory part of the course is based on the practicals undertaken.

Bibliography

Basic:
Ramon Pallas. *Teoria Basica d'Errors*.

Complementary:
Joaquin del Rio. *Col.lecció de Problemes de l'Assignatura*.
P.J Riu, J.Rosell, J.Ramos. *Sistemas de Instrumentación*. Ed. UPC.
16205 - MOSS-U2T07 - Modelling and Simulation of Dynamical Systems

Learning objectives of the subject

This subject deals with the modelling and simulation of systems of discrete events and logistic processes. Stochastic concepts play an important role, and the theory of Petri networks is used. The two parts are developed simultaneously. In this course the student will learn some basic modelling and simulation techniques for logistic and production systems, as well as their limitations, and this will also be able to further study the subject.
### Introduction to the systems of discreet events

**Description:**

Objectives

The objective of this first module is to define what introducing means, what a system of discreet events is, as it is can model and simulate this type of system and because the modelled one and the simulation of this type of systems are both useful and necessary. The simulation of systems of discreet events is a tool of recognized added value in the design, evaluation and optimization of flexible systems of manufacture, storage and transport systems of computers and communications, systems logistic, etc. We will see introductory examples of systems of discreet events.

**Contents**

1. Introduction to the digital simulation of systems of discreet events
   1.1 Type of systems
   1.2 Type of models
   1.3 Models of simulation of systems of discreet events
     1.3.1 Stages in a simulation model
     1.3.2 Type of simulation models
   1.4 Alternatives of simulation of systems of discreet events
   1.5 Advantages and disadvantages of the simulation
   1.6 Examples of simulation of systems of discreet events

**Comments**

Documentation Digital Campus: notes, listing of problems

### Modelling with Petri Networks

**Description:**

Objectives


**Contents**

2. Modelling with Stony networks
   2.1 Formalization of conceptual models
   2.2 Theory of tails
   2.3 Networks of Stony (XdP)
     2.3.1 Definitions
     2.3.2 Bottom-Up programming
   2.4 Coloured networks of Stony (XdPC)
     2.4.1 Definitions
     2.4.2 Advantages of the formalism of the XdPC
   2.5 Exercises

**Comments**

Documentation Digital Campus: notes, listing of problems
**Random defects modelling**

**Description:**

**Objectives**

Basic concepts of probabilities and statistics (median, variance, confidence intervals, probability distributions).
Selection of the distributions of entrance (BestFit), diagrams and tests. Randomness to the manufacture systems.
Failures.

**Contents**

3.1 Definitions
3.2 Description of a system with statistics characteristics
3.3 Probability distributions
3.3.1 Definitions
3.3.1.1 Function density of probability
3.3.1.2 Accumulative Distribution function
3.3.2 Histograms and bar charts
3.4 Generation of random data using a probability distribution
3.4.1 Generators of linear congruencies
3.4.2 Method of the inverse transformed one
3.5 Acquisition and data analysis
3.5.1 Independence and homogeneity of the data
3.5.2 Adjustment to a family of distributions
3.5.3 Evaluation of the quality of the adjustment (kindness of the adjustment)
3.6 Selection of the distribution in the absence of data
3.7 Simulation of failures and unemployment of machines
3.8 Analysis of the entrances SANDS using it

**Comments**

Documentation Digital Campus: notes, listing of problems.
There will be an examination on completion of module 10 which will be based on modules 8, 9 and 10 (modules 1-3 of theory of part II)
Simulation of systems of discreet events

Description:
Objectives

Contents
4. Simulation of systems of discreet events
4.1 Elements of a simulation model
4.1.1 Temporary organizations, organizations and resources
4.1.2 Attributes
4.1.3 Activities
4.1.4 Events
4.1.5 Glues
4.2 Elements and strategies of simulation
4.2.1 Logical structure of a simulation model
4.2.2 Elements of a simulator
4.2.3 Programming of events
4.2.4 Interaction of processes
4.2.5 Exploration of activities
4.2.6 Simulation using a programming language
4.3 Simulation manual and measures of behaviour
4.3.1 Table of programming of events
4.3.2 Table of interaction of processes
4.3.3 Retardation average in the tails
4.3.4 So large average of the tails
4.3.5 Degree of use of the resources
4.3.6 Other statistical measures of interest

Comments
Documentation Digital Campus: notes, listing of problems
### Analysis of results

**Description:**

Objectives
- Transitory and permanent regime to statistics systems.
- Comparison of operation alternatives.

Contents
5. Analysis of results
5.1 Simulations with condition of conclusion
5.2 Simulations in stationary regime
5.3 Determination of confidence intervals
5.4 Comparison between two systems
5.5 Comparison enters more than two systems
5.6 Analysis of result using SANDS

### Laboratory of simulation of systems of discreet events by means of SAND

**Description:**

Objectives
The laboratory practicals will take place in the computer science classroom, using simulation software based on discreet events (SAND). Attendance is obligatory. At the end of each session, a report must be submitted. The mark for the practical sessions will be based on these reports.

Comments
The basic reference for this module is the script of the practices, available in the Digital Campus, as well as the software SAND. The evaluation for this module will be based on the work submitted at the end of each of the practical sessions.

### Mini project of simulation of a system of discreet events

**Description:**

Objectives
During the course an assignment or individual mini project must be completed. This assignment/ project must include the practical part of the knowledge acquired and must be related to the contents of the subject. The project consists of a simulation study in which SAND will create the simulation environment. The student's version of this software will be made available on the digital campus. A user's guide for the software will also be made available. The project will be presented orally in the last week of the semester.

Comments

Documentation Digital Campus
The global mark of the subject is:

\[ NF = 0.6 \times NT + 0.05 \times NL + 0.35 \times MP \]

where \( NF \) is the global mark of the subject, \( NT \) is the theory mark, \( NL \) is the laboratories mark and \( MP \) is the mark of the project.

The theory mark (\( NT \)) is the average of the two written tests:

\[ NT = 0.5 \times EP1 + 0.5 \times EP2 \]

**Bibliography**

**Basic:**


16206 - MOAE-U2T09 - Electric Machines and Drives

Coordinating unit: 340 - EPSEVG - Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú
Teaching unit: 709 - EE - Department of Electrical Engineering
Academic year: 2012
Degree: (ENG) ENGINYERIA EN AUTOMATICA I ELECTRONICA INDUSTRIAL (Syllabus 2003). (Teaching unit Compulsory)
Credits: 6 Teaching languages: Catalan, Spanish, English

Teaching staff
Others: Pere Andrada Gascon

Learning objectives of the subject

The primary target of the subject is to study the motors and more habitual electric drives from a point of view based on the principles of the electromechanical conversion of the energy and the electronics of power and control.
# Basic principles of the electromechanical conversion of the energy

**Description:**

**Objectives**
The objective of the subject is to present the laws of electromagnetism, the principles of the electromechanical conversion of the energy, as well as the basic structures of the electrical machines.

**Contents**

1.1 Magnetic circuits.
1.2 Magnetic materials.
1.3 Law of Faraday.
1.4 Transforming.
1.5 Basic structures of rotating electrical machines.
1.6 Conversion of the energy.
1.7 Losses heating

**Activities, knowledge, abilities, aptitudes**
- To know how to analyze magnetic circuits.
- To know the materials magnetic that is used at the moment.
- To know how to use the basic laws of the electromechanical conversion.
- To identify the different structures that conform the electrical machines.
- To know what variable has a direct influence in the losses and the yield of the electromechanical systems

**Commentaries**
- [MOH00] N. Mohan. Electric Drives, MNPERE, 2000
## Electronic converters of power for electric drives

**Description:**

- **Objectives**
  The objective of the subject is to present the static switches and the topologies of used static converters more in the feeding of the electric drives.

- **Contents**
  2.1 Static switches.
  2.2 Electronic converters of power.
  2.3 Applications.

- **Activities, knowledge, abilities, aptitudes**
  - To know static the switches more used at the moment.
  - To identify the different topologies from static converters and their use in the feeding of electric drives.
  - To know what is the main applications of the static converters.

**Commentaries**
- [MOH00] N.Mohan. Electric Drives, MNPERE, 2000
Drive of DC

Description:
Objectives
The objective of the subject is the study of the motor of DC, the variables that have incidence in their control and like carrying out the electronic regulation of speed.

Contents
3.1 Structure.
3.2 Principles of operation and operation.
3.3 Equivalent circuit in permanent regime and transient state.
3.4 Reversibility, braking and variation of speed.
3.5 Electronic regulation of engine speed of DC.
3.6 The motor of DC without brushes

Activities, knowledge, abilities, aptitudes
- To study the constructive forms of the present drives.
- To understand the principle of operation of the motor of DC.
- To identify the control variables in the speed buffering of the motor.
- To study the topologies of the used electronic static converters in the drives of DC.
- To analyze the behaviour of the joint converter-machine in the electronic speed buffering of the drives of DC.

Planning
- [MOH00] N. Mohan. Electric Drives, MNPERE, 2000
Drives of AC voltage with asynchronous motors

Description:
Objectives
The objective of the subject is the study of the asynchronous motor, the variables that have incidence in their control and like carrying out the electronic regulation of speed.

Contents
4.1 Structure and classification.
4.2 Principles of operation and operation.
4.3 Equivalent circuit.
4.4 Reversibility, braking and variation of speed.
4.5 Electronic regulation of the induction motor.

Activities, knowledge, abilities, aptitudes
- Studying the ways constructive drives today.
- Understand the working principle of induction motor.
- Identify the control variables in regulating engine speed.
- Studying the topologies of static electronic converters used in asynchronous drives.
- To analyze the behaviour of all-converter machine in regulating speed electronic drives asynchronous.

Commentaries
- [MOH00] N.Mohan. Electric Drives, MNPERE, 2000
Drive of AC voltage with synchronous motors

Description:
Objectives
The objective of the subject is the study of the synchronous motor, the variables that have incidence in their control and like carrying out the electronic regulation of speed.

Contents
5.1 Structure and classification.
5.2 Principles of operation and operation.
5.3 Equivalent circuit.
5.4 Variation of speed.
5.5 Electronic regulation of synchronous motors with magnets.

Activities, knowledge, abilities, aptitudes
- To study the constructive forms of the present drives.
- To understand the principle of operation of the synchronous motor.
- To identify the control variables in the speed buffering of the motor.
- To study the topologies of the used electronic static converters in the synchronous drives.
- To analyze the behaviour of the joint converter-machine in the electronic speed buffering of the synchronous drives.

Commentaries
- [MOH00] N.Mohan. Electric Drives, MNPERE, 2000
Other types of electric drive

**Description:**

Objectives
The objective of the subject is the study of more specific electric drives, used in certain industrial applications.

Contents
6.1 Single-phase motors of induction.
6.2 Motors step by step.
6.3 Motor engines of reluctance

Activities, knowledge, abilities, aptitudes
- Studying the ways and constructive applications of single-phase induction motor.
- To analyze the functioning of the stepper motor.
- Studying the behaviour of the stepper motor together with the associated electronics to control it.
- Studying the behaviour of the engine together with the reluctance associated electronics for control

Commentaries
- [MOH00] N. Mohan. Electric Drives, MNPERE, 2000

Practical of Laboratory

**Description:**

Objectives
- Experimentally to verify the theoretical models of the electrical machines.
- Experimentally to verify the foundations of speed buffering of the electrical motors.
- To familiarize with the manipulation of the equipment of more habitual speed buffering of industrial use.
- To foment the work in equipment.
- To improve the capacity of written expression.

Contents
S1. Transforming. Operation in emptiness and load.
S2. Constructive forms of electrical motors. Different structures of stator and rotor. Generation of the revolving magnetic field
S6. Motor step by step. Principle of operation, type and possibilities of operation according to the used electronics.

Activities, knowledge, abilities, aptitudes
- To carry out the connection and put into operation of several electric drives.
- To obtain operating characteristics of the electrical motors and theoretically to resist the results obtained in the tests.
- To carry out the electronic speed buffering of electrical motors being used industrial equipment.
Works of evaluation

Description:
Objectives
To realize a series of works that affect different aspects of the machines and the electric drives and that require in addition a bibliographical effort search.

Contents
The subjects of the works that set out are:
- Transforming Design with standard nuclei.
- Design of the regulators of current and speed of a variation of speed
- Technical and economic Considerations of the electric drives of variable speed in the industry.

Activities, knowledge, abilities, aptitudes
- It develops abilities search bibliographical.
- One becomes familiar with the Literature of technical type.
- One faces practical problems that they require to use knowledge given in this subject and other subjects of the degree.

Module 9

Description:
Commentaries
J. Fraile Mora and J. Fraile Ardanuy. Problems of Electrical Machines
A. E. Fitzgerald, CH Kingsley, S. D. Umans. Electrical machines, 2004
**Qualification system**

A partial test (of 2 hours of duration) with a content will become that will include modules 1.2 and 3.
An ordinary final test (of 2 hours of duration) with a content will become that will include modules 1.2, modules 1, 2, 3, 4, 5 and 6
A test of validation of practices (of 1 hour of duration) with a content will become that will include module 7
A final test (of 2 hours of duration) with content will become extraordinary that will include modules 1, 2, 3, 4, 5 and 6

The final note, NF, will be obtained from the following expression:

\[ NF = 0.25 \, C1 + 0.45 \, C2 + 0.15 \, P + 0.15 \, TA \]

With:
- \( C1 \), mark of the partial test.
- \( C2 \), mark of the ordinary final test.
- \( P \), mark of practical of laboratory (0.6 MP+ 0.4 BP, Average MP of mark of each practical, BP mark of validation of practical
- \( TA \), mark of work of evaluation (Average of marks of each work)

**Extraordinary test:**
The final mark, NF, will be highest of:

\[ NF = \max (N1, N2) \]

With:
- \( N1 = 0.25 \, C1 + EX \, 0.45 + 0.15 \, P + 0.15 \, TA \)
- \( N2 = EX \, 0.7 + 0.15 \, P + 0.15 \, TA \)

Ex, mark tries extraordinary.

**NOTE:** The students who repeat the subject can choose not to make the practices of laboratory (module 7), but makes lack that make the validation of practices, the note of practices, in this case, will be the note obtained in the test of validation

**Bibliography**

**Basic:**
- Marcel Torrent. *Pràctiques de Motors i Accionaments Elèctrics*. Casmpus Digital EPSEVG.

**Complementary:**
- Marcel Torrent. *Pràctiques de Motors i Accionaments Elèctrics*. Campus Digital EPSEVG,
- Marcel Torrent. *Pràctiques de Motors i Accionaments Elèctrics*. Campus Digital EPSEVG,
- Pere Andrada. *Exercicis de Motors i Accionaments Elèctrics*. Campus Digital EPSEVG,
- Pere Andrada. *Programa de Motors i Accionaments Elèctrics*. Campus digital EPSEVG,
- Pere Andrada. *Transparències de Motors i Accionaments Elèctrics*. Campus Digital,
Learning objectives of the subject

It is tried that the student knows the importance that the industrial maintenance in the production systems represents, as well as the different techniques from support which they can be used to be able to detect failures, besides the reliability study the components, equipment and systems that form a productive system.
## Basic principles of the industrial maintenance

### Description:

Objectives
To present the purpose the maintenance, the types of maintenance according to the characteristics of the industrial system and the tools for its control.

Contents
1.1 Introduction to the maintenance.  
1.2 Type of maintenance.  
1.3 Study of the lack.  
1.4 Analysis of maintenance costs.  
1.5 Data to gather.

Activities, knowledge, abilities, aptitudes
- To identify the purpose of the maintenance.  
- To be able to apply in each case the type of suitable maintenance more.  
- To apply the tools of control of correct form.

Planning
This module is the basic one and has a direct relation with the other modules.

Commentaries
This module is summarized in chapter 1 of the book of the bibliography. Fernandez Cabins and other Techniques for the maintenance and diagnosis of rotating electrical machines.
## Reliability

**Description:**

Objectives
To apply the calculation of reliability in concepts of industrial maintenance.

Contents
2.1 Concepts of reliability.
2.2 Reliability with constant failure rate. Exponential model.
2.3 Reliability with nonconstant failure rate. Weibull model.
2.4 Reliability of systems.

Activities, knowledge, abilities, aptitudes
- To apply the concepts of reliability within the maintenance.
- To work with a program of calculation of reliability, (Minitab).
- To observe the power of this element of calculation.
- To identify the results with the industrial reality.

Planning
Although this module is independent, can help us to make decisions respect to which we will speak in other modules.

Commentaries
Chapter 12 of book R. Companys, A. Corominas Organization of the production and design of productive systems. The book Eulàlia Grifull Industrial Reliability. Of this book the reliability practices will be based that will become like work in house.
Techniques of measurement

Description:
Objectives
To know the different techniques to measure the most important parameters that they are used in the maintenance.

Contents
3.1 Electronic equipment.
3.2 Equipment for the analysis of the isolation.
3.2 Transducers.

Activities, knowledge, abilities, aptitudes
- To differentiate the different equipment that is in the market.
- To determine that equipment is adapted according to its benefits

Planning
It has direct relation with all the modules.

Commentaries
Capitol 3M. Fernandez Cabins and other Techniques for the maintenance and diagnosis of rotating electrical machines

Analysis of vibrations

Description:
Objectives
To introduce the techniques of the analysis of vibrations applied to the maintenance.

Contents
4.1 Analysis of vibrations.
4.2 Analysis of the characteristics.
4.3 Interpretation of the data.

Activities, knowledge, abilities, aptitudes
- To identify the main parameters of the analysis of the vibrations.
- To apply these parameters to the possible defects.
- To analyze the obtained results.

Planning
It has relation with module 1 and 2

Commentaries
Chapter 4 of the book: M. Fernandez Cabins and other Techniques for the maintenance and diagnosis of rotating electrical machines
Other techniques of maintenance

Description:
Objectives
To use the different techniques from maintenance that exist at the moment within the market, to be able to apply most suitable in each case.

Contents
5.1 Thermography.
5.2 Analysis of currents.
5.3 Acoustics.

Activities, knowledge, abilities, aptitudes
- To identify the existing techniques of maintenance in the market.
- To analyze its utility.
- To relate each of these techniques in real cases.

Planning
It has relation with the module 1 and module 6

Commentaries
Chapter 5 Ms. Fernandez Cabins and other Techniques for the maintenance and diagnosis of rotating electrical machines.
## Implantation of a maintenance system

### Description:

**Objectives**

To plan the implantation of a system of maintenance from an example being followed the correct steps, so that their implantation is effective.

### Contents

6.1 Description of the plant.
6.2 Steps to implement the system.
6.3 Selection of the techniques.
6.4 Organization of the implantation.
6.5 Valuation of the system.

### Activities, knowledge, abilities, aptitudes

- To plan the implantation of a system of maintenance in a concrete industry.
- To organize the different stages.
- To evaluate the system proposed with respect to the present system.

### Planning

It has relation with all the previous modules.

### Commentaries

Practicals of reliability

**Description:**
Objectives
To solve different exercises on reliability, that they will help to include/understand the theoretical explanations.

Contents
- P1 Representation of the failure rate.
- P2 Resolution of an exercise with the Excel program
- P3 Resolution of an exercise with the Minitab program
- P4 Censured Data. Excel.
- P5 Censured Data. Minitab

Activities, knowledge, abilities, aptitudes
- To differentiate the different mechanisms from calculation.
- To solve reliability exercises.
- To deduce the collected data.
- To relate them in cases of application to the maintenance.

Planning
Direct relation with module 2

Commentaries
Manual of reliability practices. Eulalia Grifull industrial Reliability
### Practicals of vibrations

**Description:**

**Objectives**

To actually apply to the theoretical concepts of the analysis of vibrations with a simulator of lack and its equipment of analysis of vibrations

**Contents**

7.1 Description of the equipment.
7.2 On-speed operation. Obtaining of the landlords.
7.3 Imbalance.
7.4 Misalignment
7.5 Lack in bearings and gears.

**Activities, knowledge, abilities, aptitudes**

- To manipulate a real equipment of analysis of vibrations.
- To obtain the results of the measures.
- To analyze the results verifying with the obtained landlord.
- To detect the lack to that the measurement corresponds.

**Planning**

It has relation with module 4

**Commentaries**

Manual of practices (digital Campus)
Chapter 4 of the book:
M. Fernandez Cabins and other Techniques for the maintenance and diagnosis of rotating electrical machines
Work on one of the proposed subjects

Description:
Objectives
To deepen in one of the subjects of the subject that set out to course principle. This work will be realized in equipment and will consist of an oral presentation on the part of the members of the equipment.

Contents
The works to choose by each group will be:
- Thermography.
- Analysis of vibrations.
- Acoustic.
- Analysis of currents.
- Maintenance TPM.

Activities, knowledge, abilities, aptitudes
- To deepen in a subject.
- To apply the work in equipment.
- To realize an oral presentation.

Planning
It has relation with the previous modules, and mainly with the module corresponding to the selected subject.

Commentaries
One is to look for specific bibliography of the selected subject.

Qualification system

0.30 NF = C1 + 0.5 C2 + 0.1 0.1 P + T
C1 = Note of the partial test.
C2 = Note of the final test.
Practical P = Note.
T = Work in group.
Bibliography

Basic:


Complementary:


16208 - SITR-U2T07 - Real-Time Systems

**Coordinating unit:** 340 - EPSEVG - Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú

**Teaching unit:** 707 - ESAII - Department of Automatic Control

**Academic year:** 2012

**Degree:** (ENG) ENGINYERIA EN AUTOMATICA I ELECTRONICA INDUSTRIAL (Syllabus 2003). (Teaching unit Compulsory)

**Credits:** 6  
**Teaching languages:** Catalan

### Teaching staff

**Coordinator:** Francesc Xavier Parra Llanas

### Learning objectives of the subject
16208 - SITR-U2T07 - Real-Time Systems

**Content**

<table>
<thead>
<tr>
<th>Theory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
</tr>
<tr>
<td><strong>Objectives</strong></td>
</tr>
<tr>
<td>The objective of the subject is to obtain that the student understands the problematic individual of the real-time systems, and the characteristics differentiate that them from other computer science systems. The most important methods that they are used to develop real-time systems with a high degree of reliability, especially those that talk about in accordance with the time, the planning of the use of the resources, the prevention and the tolerance to failures, and the organization of software and her application will be learned. The control applications of processes will be contemplated of special form. Several techniques will consider to develop these applications and the mechanisms necessary will settle down to evaluate their benefits. Will be some tools (programming languages and operating systems) adapted for the accomplishment of real-time systems and the theoretical concepts will study necessary to approach the accomplishment of computer science systems with a determinist temporary behavior.</td>
</tr>
<tr>
<td><strong>Contents</strong></td>
</tr>
<tr>
<td>1. Introduction to the computer science systems of real time.</td>
</tr>
<tr>
<td>1.1 Definition of real-time system.</td>
</tr>
<tr>
<td>1.2 Examples of real-time systems.</td>
</tr>
<tr>
<td>1.3 Characteristics of the real-time systems.</td>
</tr>
<tr>
<td>1.4 Type of real-time systems</td>
</tr>
<tr>
<td>1.5 Programming of the real-time systems: Smalltalks.</td>
</tr>
<tr>
<td>2. Multiprogrammed operating systems</td>
</tr>
<tr>
<td>2.1 Introduction.</td>
</tr>
<tr>
<td>2.2 RTOS. Idea of deadline.</td>
</tr>
<tr>
<td>2.3 Memory.</td>
</tr>
<tr>
<td>2.4 Input/output.</td>
</tr>
<tr>
<td>2.5 Processes, concurrency and communication.</td>
</tr>
<tr>
<td>2.6 Languages and real-time operating systems.</td>
</tr>
<tr>
<td>3. Cyclical systems.</td>
</tr>
<tr>
<td>3.1 Concepts and methodology</td>
</tr>
<tr>
<td>3.2 Cyclical planning</td>
</tr>
<tr>
<td>3.3 Segmentation of tasks</td>
</tr>
<tr>
<td>3.4 Construction of the cyclical plan of execution</td>
</tr>
<tr>
<td>3.5 Programming of the cyclical executive</td>
</tr>
<tr>
<td>4. Management of the time</td>
</tr>
<tr>
<td>4.1 Reference systems of time</td>
</tr>
<tr>
<td>4.2 Temporary clocks, retardations and limits</td>
</tr>
<tr>
<td>4.3 Temporary requirements</td>
</tr>
<tr>
<td>4.4 Tolerance to failures</td>
</tr>
<tr>
<td>5. Planning of tasks</td>
</tr>
<tr>
<td>5.1 Concepts and methodology</td>
</tr>
<tr>
<td>5.2 Planning with fixed priorities</td>
</tr>
<tr>
<td>5.3 Interaction between tasks</td>
</tr>
<tr>
<td>5.4 Planning with dynamic priorities</td>
</tr>
<tr>
<td>5.5 Model of tasks generalized</td>
</tr>
<tr>
<td>6. Multiprogramming</td>
</tr>
<tr>
<td>6.1 Management of processes and memory</td>
</tr>
<tr>
<td>6.2 Synchronization and communication between processes</td>
</tr>
</tbody>
</table>


16208 - SITR-U2T07 - Real-Time Systems

**Qualification system**

The qualification of the subject considers all the work carried out throughout the course. The final qualification is obtained to apply the following formula:

\[ NF = 0.35 \times Q_1 + 0.35 \times Q_2 + 0.3 \times Q_3 \]

where:
- \( Q_1 \) = mark of the first partial test.
- \( Q_2 \) = mark of the second partial test.
- \( Q_3 \) = mark of the laboratory practicals.
- Final \( NF \) = mark of the subject.

**Bibliography**
16209 - SPIN-U3T07 - Integrated Production Systems

**Coordinating unit:** 340 - EPSEVG - Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú

**Teaching unit:** 707 - ESAII - Department of Automatic Control

**Academic year:** 2011

**Degree:** (ENG) ENGINIERIA EN AUTOMATICA I ELECTRONICA INDUSTRIAL (Syllabus 2003). (Teaching unit Compulsory)

**Credits:** 6

---

**Teaching staff**

**Coordinator:** Pere Ponsa Asensio

---

**Prior skills**

It is recommended to have previous knowledge in industrial automatization.

Subject SPIN has a place Web with educational contents of support. It connects URL: http://bibliotecna.upc.se/factoria/projectes/epsevg/spin/

---

**Requirements**

To have attended subjects ENCO and MOSS previously

---

**Learning objectives of the subject**

The subject tries:

- The formation of the student from the point of view of the multidisciplinary treatment of contents
- To make to the student like expert engineer in technological aspects of supervision and automatization apt
- Application of the learning based on problems/projects PBL to the area of the automatization
- To affect the aspect of systems integration from the hierarchic level of supervision to the level plant inferior

---

**Content**

...
Foundations

Description:
1. Foundations
1.1 Definition of automatic, automatization and production
1.2 Integrated systems of manufacture (CIM)
1.3 Management of the production
1.4 Presentation of the practical activities of the subject

Activities, knowledge, abilities, aptitudes
When doing this module the student must know:
- to identify the agents who take part in a productive system
- to value the multidisciplinary cooperative work in real industrial projects

Planning
The module is a basic introduction necessary to clearly focus the contents of the subject

Commentaries
The reading of magazines specialized of the sector is recommended like for example:
- Automatic and Instrumentation I recommends the reading of the chapter 2 General Concepts of Management of the Production of the reference

Human supervision inside the control room

Description:
2. Human supervision inside control room
2.1 Definitions of monitoring, supervision, SCADA
2.2 Industrial control room
2.3 Design of supervision interface
2.4 Formation of workers in control room
2.5 Industrial examples

Activities, knowledge, abilities, aptitudes
When the finishing this module the student must be able to recognize the problems that are in the industrial control rooms, to contribute specifications for the improvement of the security of the supervision systems and to learn to design new interfaces with methodologic criteria.

Planning
This module complements the explanations supplied in the previous modules and allows to contemplate the information flow enters plant and the systems in charge of the management of the production.

Commentaries
There are few books in this matter. One of most recommendable is some precise chapter of the book Practical SCADA industry of D. Bailey. Respect to the training of workers makes lack mention the case of the simulator of the CTA, directed by the Dr. Caesar of Prairie, where is an example of simulator for the training of workers of industrial control room.
Programming d'SCADA In TOUCH

Description:
3. Programming of SCADA In TOUCH
   3.1 Edition and animation of objects
   3.2 Monitoring of the modular system of production
   3.6 Design of interfaces with SCADA In TOUCH
   3.7 Monitoring of a chemonuclear reactor with In TOUCH
   3.8 Communications of software In TOUCH with other resources (PLC, MATLAB, servant OPC)
   3.9 Remote control with In TOUCH

Activities, knowledge, abilities, aptitudes
When the finishing this module the student must be able to identify the workstations that are integrated in the modular system of production and to value the necessity to design interfaces of monitoring and supervision to size.

Commentaries
To emphasize the memories of PFC realized previously by other students like for example:
- Beginning of PLC CJ1M and integration in network of PLC's by means of DEVICENET. Xavier Parladé
- Beginning of PLCs SIEMENS S7-300 with communication PROFIBUS Courteous DP.Alejandro

Guide GEMMA

Description:
4. She guides GEMMA
   4.1 Methodology
   4.2 Graphical representation
   4.3 Study of situations
   4.4 Valuation of the use of the guide

Activities, knowledge, abilities, aptitudes:
When the finishing this module the student has to assimilate a new method that allows the improvement him of the productive systems applying guide GEMMA of rigorous form

Planning
This module is related to module 5 where the concepts are applied to study of cases

Commentaries
It is important to emphasize a series of places Web that opportunely will be indicated by the professor.
5. Applied guide GEMMA inside PLC and PC

5.1 Ways of march and shutdown
5.2 Verification with order/disorder
5.3 Design of control panel
5.4 Process of treatment of the thread in coil (PIRELLI CABLE)

Activities, knowledge, abilities, aptitudes
When finalizing this module the student must:
- to solve automatization problems everything applying guide GEMMA

Planning
To see Module 4 Commentaries See Module 4.

6. Systems of flexible manufacture (SFF)

6.1 Definition
6.2 Methods of work: Flow Shop, Job Shop and SFF
6.3 Integration of cells and stations in systems SFF
6.4 Automated transport and warehouses
6.5 Modular system of production
6.6 Examples

Activities, knowledge, abilities, aptitudes
When the finishing this module the student must be able to have a professional perspective on the industrial systems of manufacture. It must learn to value the importance of the multidisciplinary work for the accomplishment of automated systems complex.

Planning
The module is on the one hand an academic and formal introduction, but it also contemplates examples of industrial systems that enrich the academic vision. This module is related to module 7 where to design techniques of and system analysis of manufacture are applied.

Commentaries
The re-reading of the book is recommended
- Modeled and simulation of Toni Guasch, M.A. Piera, Editions UPC in the passages that modeled reference does to with Networks of Stony and simulation with SAND
The bibliographical search is also recommended from scholargoogle in the area of
- Discrete-even simulation
DESIGN AND ANALYSIS OF SFF

Description:
7. Design and analysis of SFF
7.1 Design of modular system of production
7.2 Design of automatization laboratory
7.3 Management of the production of Machine-Tool
7.4 Robotized station: modeled with Network of Stony, simulation with SAND
7.5 Study of station formed by machines in sequence

Activities, knowledge, abilities, aptitudes
When the finishing this module the student must demonstrate its competition in the ability to design manufacture systems and to use tools of modeled and simulation to analyze the behavior of productive systems and to contribute lines of improvement.

Planning
To see the planning of Module 6

Commentaries
To see commentaries of Module 6.

CONCLUSIONS

Description:
8. Conclusions
8.1 Companies of the industrial sector
8.2 Projects

Activities, knowledge, abilities, aptitudes
- The student must be able to recognize those companies related to the modules commented throughout the subject

Planning
This module is the conclusion of which it has been explained to the subject

Qualification system

The qualification of the subject considers all the work carried out throughout the course. The final qualification is obtained to apply the following formula:
NF = 0.25 M3s + 0.30 M5 + 0.45 SUBJECTS
where:
M3=mark of the work carried out with Module 3;
M5=mark of the work carried out with Module 5;
TEMAS=mark of the Examination with all the Modules of the program, even of the practical part of the subject;
Final NF=mark of the subject. The practical modules contemplate the individual work or in group, the answer to questionnaires, the solution of practical exerciseses, and the additional documentation as a dossier preparation. $$MQF$$
## Bibliography

### Basic:


Pere Ponsa, Ramon Vilanova. *Automatización de procesos mediante la guía GEMMA*. Edicions UPC Aula Politecnica / Computación y Control, nº 102, 2005.

### Complementary:


The objective of this subject is:
To give the student the opportunity to widen his knowledge of the control techniques that allow high level robot programming, providing him with greater autonomy. These techniques make a more flexible working environment possible and also offer a wide range of applications. Although the subject focuses on industrial-sized manipulating robots, it also looks at the emerging market of mobile robots.

### Content

**Foundations**

**Description:**
Contents
- Man-machine communication. Control systems. Historical evolution of the control and programming of robots.
- Present panorama.

**Kinematic control**

**Description:**
Contents
## Dynamic control

**Description:**
Contents

## Force Control

**Description:**
Contents
Configuration space. Frame of accommodation of the task. Control of force. Hybrid control position-force

## Robots Programming

**Description:**
Contents

## Telerobotics and movable robots

**Description:**
Contents

## Direct-inverse kinematic problem

## Generation of trajectories

## Simulation of dynamic problems

## Programming with Simulators
Partial examination (30%) in the middle of the course, final examination (30%) at the end of the course, practicals and practical examination (40%) (at the end of the course)

**Bibliography**

**Basic:**


**Complementary:**

The main goal of this subject is to develop a general understanding of the different types of existing sensors. An additional objective is to use sensors to measure the parameters of the real world, directly or indirectly. Also, we will analyze conditioning and processing methods to obtain signal with the required exactitude, present/display and to integrate the information.
The subject consists of a theoretical part and a practical part in the laboratory. The weight of the final mark of the theoretical part is 70% and 30% is awarded for the laboratory sessions. There are 2 examinations on theory, an eliminatory partial examination and a final examination. The laboratory sessions are evaluated by awarding marks for the practicals.

<table>
<thead>
<tr>
<th>Qualification system</th>
</tr>
</thead>
</table>

The subject consists of a theoretical part and a practical part in the laboratory. The weight of the final mark of the theoretical part is 70% and 30% is awarded for the laboratory sessions. There are 2 examinations on theory, an eliminatory partial examination and a final examination. The laboratory sessions are evaluated by awarding marks for the practicals.

<table>
<thead>
<tr>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic sensors. Types of sensors. Physical principles. Sensor Classification</td>
</tr>
<tr>
<td>Sensors Conditioning and Interface. Types of signals. Analogical conditioning techniques. Transmission signal and noise in sensors and circuits conditioning</td>
</tr>
<tr>
<td>Digital processing Techniques of signals. Discreet systems and signals</td>
</tr>
<tr>
<td>Data processing using TCP/IP and UDP/IP</td>
</tr>
<tr>
<td>Introduction to image acquisition and processing with LabVIEW.</td>
</tr>
<tr>
<td>Image processing applications.</td>
</tr>
</tbody>
</table>
16211 - SIPE-U3T10 - Perception Systems Sensor Network Designs

Bibliography

Basic:


R. Pallas, R. Bragos, O. Casas. *Sensores e Interfaces. Problemas Resueltos.* Ed. UPC,

Ramon Pallas. *Teoria Basica d'Errors.*

Complementary:


B. Patton. *Sensors, transducers & Labview.* Prentice Hall,


P. J. Riu, J. Rosell, J. Ramos. *Sistemas de Instrumentación.* Ed. UPC,
The objectives of this subject are:
- To introduce optimization techniques, in particular, the determinist methods of linear programming,
- To study the Calculus of Variations,
- To present optimal controls for systems governed by ordinary differential equations.
**Introduction to Linear Programming**

**Description:**
The objective is to explain what a linear programming problem is and to introduce its general formulation. A further objective is how to develop the graphical resolution of bi-dimensional problems which allow introducing basic concepts of linear programming. Moreover, some basic concepts of linear algebra will be noted.

**Contents:**
1.1 Introduction: motivations and examples.
1.2 Linear programming: basic concepts.
1.3 Formulation of linear programming models.
1.4 Graphical resolution of linear programming problems.
1.5 Reviewing linear algebra: the Gauss-Jordan method.

**Activities, Knowledge, Abilities, Aptitudes:**
The student should:
- understand what a linear programming problem is.
- recognize problems that can be formulated with/by linear programming.
- formulate a linear programming problem.
- model and solve bi-dimensional linear programming problems graphically.
- know types of solutions: single, multiple, degenerated, unbounded.
- refresh basic concepts of linear algebra.

**Comments:**
The module is based on the explanations in Winston W.L., (chapter 3)
Many exercises, examples and applications can be found in Bradley, S.P. (chapter 1).
The Simplex Algorithm

**Description:**
Objectives:
In this section, we learn a method to solve general linear programming problems: the simplex algorithm. We study the inner workings of the simplex algorithm and in this way recognize the different kinds of solutions: single solution, multiple solutions, degenerated, unbounded, etc. We have chosen WINQSB as the computer science package to solve numerical examples.

Contents:
2.2 The simplex algorithm: enter and leaving basic variables. Multiple optimal solutions. Unbounded problems. Degenerated problems and the convergence of the algorithm.
2.3 The M method. The two-phased method.
2.4 Variables without sign constraints.

Activities, Knowledge, Abilities, Aptitudes:
The student should:
- formalize a PL problem in standard form,
- solve PL problems using the simplex method,
- interpret and analyze the solutions,
- solve problems using WinQSB program.

Comments:
The module is based on the explanations in Winston, W.L. (chapter 4). Many exercises, examples and applications can be found in Bradley, S.P (chapter 4).
# Duality and Sensitivity Analysis

## Description:

Objectives:
Sensitivity analysis tries to examine the effects on the optimal solutions due to changes in the parameters of the model. Shadow prices and reduced costs are introduced. The dual problem is stated, interpreted, and analyzed.

Contents:
- 3.1 Sensitivity analysis: an example.
- 3.2 Shadow prices, reduced costs.
- 3.3 Sensitivity analysis of the coefficients of the objective function.
- 3.4 Sensitivity analysis of the second members of the constraints.
- 3.5 Alternative optimal solutions and shadow prices.
- 3.6 Definition of the dual problem.
- 3.7 Relation between the dual problem and the primal problem.
- 3.8 Economic interpretation of duality.

Activities, Knowledge, Abilities, Aptitudes:
The student should:
- know the meaning of a sensitivity analysis.
- recognize the two types of sensitivity: changes in the coefficients of the objective function and changes in the second members of the constraints.
- compute the ranks of sensitivity in both cases.
- understand and use the shadow price and reduced costs.
- make sensitivity analysis using WinQSB program.
- build the dual problem associated to a primal problem.

Comments:
The module is based on the explanations in Taha, H.A (chapter 4) and Bradley, S.P. (chapters 3 and 4)
Transportation, Assignment, and Trans-shipment Problems

**Description:**
In this section we analyze three specific types of linear programming problems: the transportation problem, the assignment problem, and the trans-shipment problem. For all of them we explain their proper algorithms and how to use the WinQSB program.

**Contents:**
4.1 The transportation problem: Definitions and formulation. Balanced transportation problems.
4.2 How to search for an initial basic feasible solution: the northwest corner method, the minimum cost method and the Vogel’s method.
4.3 The transportation simplex algorithm.
4.4 Assignment problems. Cost matrices.
4.5 The Hungarian method.
4.6 Trans-shipment problems. Trans-shipment points.

**Activities, Knowledge, Abilities, Aptitudes:**
The student should:
- define, recognize and formulate a transportation problem.
- understand the importance of the balanced condition in a transportation problem.
- know how to use the WinQSB package to solve transportation problems. In particular, to find an initial basic feasible solution by using the north-west corner method, the minimum cost or the Vogel’s method.
- recognize and solve an assignment problem.
- recognize, formulate and solve a transshipment problem.

**Comments:**
This subject is based on Winston W.L. (chapter 7). More examples and exercises can be found Taha H.A. (chapter 5)
### Network Models

**Description:**

Objectives:

In this section we introduce the notation and terminology associated with network models. We formulate shortest-path problems and we use the Dijkstra’s algorithm to solve these kinds of problems. We also formulate maximum flow problems and use the Ford-Fulkerson’s method to solve them.

Contents:

5.1 Definitions: Network, node, arc, chain, path.
5.2 Shortest path problem. Dijkstra’s algorithm.
5.3 Shortest Path Problem formulate as a Trans-shipment Problem.
5.4 Maximum flow problem. Ford-Fulkerson’s method.

Activities, Knowledge, Abilities, Aptitudes:

- understand the application of network models in industrial engineering problems.
- understand the notation and terminology associated with network models.
- recognize, formulate and solved shortest path problems.
- recognize, formulate and solved maximum flow problems.

Comments:

This subject is based on Winston W.L. (chapter 8). More examples and exercises can be found in Taha H.A. (chapter 6).

### Introduction to the Optimal Control

**Description:**

Objectives:

The aim of this section is to present, with the aid of several examples and exercises, the main concepts, the similarities and differences between the models we develop later. In this section we also review the main historical milestones of the optimal control and the calculus of variations.

Activities, Knowledge, Abilities, Aptitudes:

- know the differences and the similarities between the calculus of variations and the classical optimization.
- know some examples of systems with control variables.
- know what a problem of optimal control is.
- know the concepts of admissible control and admissible trajectory.

Comments:

This subject is based on Zinober, A.S.I. (chapter 1). More examples can be found in Pinch, Enid.R. (Chapter 1) Optimal Control and the Calculus of Variations, Oxford University Press, New York.
## Calculus of variations

### Description:
Objectives:
We present the basic problem of calculus of variations. We establish the necessary conditions of first and second order and sufficient conditions for an optimum. The fundamental result is the Euler equation. We present the historical problem which gave rise to calculus of variations (Brachistochrone curve). Next, we introduce basic concepts and formulate the calculus of variations problem with one variable and fixed end-point. Later, we give the necessary conditions: Euler and Legendre. Afterwards, we study how the optimal necessary conditions change when we consider different end-point conditions. We also study sufficient conditions for global optimum. Finally, we make generalizations with several variables and/or more than one function and/or functional depending on higher-order derivates.

Contents:
2. Basic theory. Admissible functions.
3. Necessary conditions: Euler Lagrange's equation, Legendre's condition.
4. Special forms of the transversality condition.
5. Sufficient conditions.
6. Functional of several variables.
7. Functional depending on higher-order derivates.

Activities, Knowledge, Abilities, Aptitudes:
The student should:
- recognize a calculus of variations problem.
- know what the admissible function is.
- use the Euler Lagrange's equation.
- know the different forms of the transversality condition.
- solve functional of several variables.
- solve functional depending on higher-order derivates.

Comments:
This subject is based on Zinober, A.S.I. (chapter 2). More examples can be found in Pinch, Enid.R. (Chapter 2) Optimal Control and the Calculus of Variations, Oxford University Press, New York.
Variational problems with constraints

**Description:**

Objectives:
The objective of the subject is to solve variational problems with constraints using the Lagrangian method.

Contents:

3.1 A review on extremes of functions of several real variables with constraints.
3.2 Calculus of variations with constraints. The Lagrange method.
3.3 Special cases and examples.

Activities, Knowledge, Abilities, Aptitudes:
The student should:
- use the Lagrange method to determine the possible optimal solutions.
- solve calculus of variations with constraints given by differential or integrals equations.

Comments:
This subject is based on Zinober, A.S.I. (chapter 4). More examples and exercises can be found in Pinch, Enid.R. (Chapters 1 and 3) Optimal Control and the Calculus of Variations, Oxford University Press, New York.
Optimal control

Description:
Objectives:
We present the basic problem of optimal control. We establish the necessary condition and also we study some sufficient conditions. The fundamental result is the Pontryagin maximum principle. We introduce basic concepts and formulate the optimal control problem with one variable and fixed end-point. Afterwards, we study how the necessary optimal conditions change when we consider different end-point conditions. We also study sufficient conditions for global optimum. Finally, we make generalizations with several variables and we also study the special case given by the bang-bang control.

Contents:
4.1 Approaching the optimal control problem. Different functionals: Bolza, Mayer and Lagrange.
4.2 Necessary conditions: The Pontryagin maximum principle.
4.3 Sufficient conditions: Mangasarian conditions.
4.4 Transversality condition associated to different end-point conditions.
4.5 The bang-bang control.

Activities, Knowledge, Abilities, Aptitudes:
The student should:
- know what a problem of optimal control is.
- know what a Hamiltonian is.
- apply the Pontryagin maximum principle to solve optimal control problems.
- know the transversality condition for different end-point conditions.
- solve bang-bang optimal control problems.

Comments:
This subject is based on Zinober, A.S.I. (chapters 6-8). More examples and exercises can be found in Pinch, Enid.R. (Chapters 4-5) Optimal Control and the Calculus of Variations, Oxford University Press, New York

Optimal control II

Description:
Objectives
The aim of this theme is to establish the sufficient conditions to see if a check, which is one extreme, there is a maximum or a minimum.

Contents
1. Ownership of the Hamiltonian: conservation of energy along the optimal solutions.
2. Terms of second order to establish whether the optimal solution is a maximum or a minimum.

Activities, knowledge, abilities, skills
The student must be able to:
- know and apply the conditions of second-order (second partial derivatives) to determine the nature of optimal control.

Comments
The topic can be found in Chapter 7% [Z] in Chapter 4% [P]
# Applications

**Description:**

Objectives
The objective of this theme is three applications of items 5 and 6 (the problem LQP, if eligible discontinuous controls and control of minimum energy).

Contents
1. Presentation of the lineal quadratic problem (LQP). Introduction of special case in which time is infinite.
2. Principle of maximum / minimum allowable discontinuous controls, with a jump of discontinuities.
   2.1 Problem with drivers dimensional optimal time. Getting the 'bang-bang'-control that is discontinuous. Introduction of unique case. Examples.
   2.2 Statement of the principle of maximum / minimum controls for discontinuous. 3. Control of minimum energy

Activities, knowledge, abilities, skills
The student must be able to:
- Know the three proposed uses.
- Knowing the existence of optimal controllers and discontinuous saberlos find.

Comments
The theme is elaborated in Chapter 5 [P] and Chapter 8 [Z]

---

# WinQSB Practices

**Description:**

Objectives:
The aim of this section is to present the package WinQSB suitable to solving LP numerical problems. Moreover, we will also use it to solve several special cases such as: transportation, assignment, trans-shipment and network problems.

Contents:
1: Introduction to WinQSB and the simplex algorithm.
2: Sensitivity analysis and duality.
3: transportation, assignment and trans-shipment problems.
4: Networks.

Activities, Knowledge, Abilities, Aptitudes:
The student should:
- use WinQSB to solve LP problems.

Comments
This subject is based on Chang, Y.L. (chapters 1, 2 and 5).
16212 - OPCO-U3T43 - Optimal Control and Optimization

Qualification system

<table>
<thead>
<tr>
<th>Name</th>
<th>Content</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>First assessment</td>
<td>Sections 1-5</td>
<td>2 hours</td>
</tr>
<tr>
<td>Second assessment</td>
<td>Sections 6-9</td>
<td>2 hours</td>
</tr>
<tr>
<td>Final exam</td>
<td>Sections 1-9</td>
<td>3 hours</td>
</tr>
</tbody>
</table>

FINAL MARK
The final mark for this subject is MAX \{0.5 \times C1 + 0.4 \times C2 + 0.1 \times E, PF\} where:
- \(C1\) = first assessment mark.
- \(C2\) = second assessment mark.
- \(E\) = Homework.
- \(PF\) = Final exam mark.

Bibliography

**Basic:**

- *Optimal Control.*

**Complementary:**

16213 - CPAN-U4O36 - English for Professional Communication

Coordinating unit: 340 - EPSEVG - Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú
Teaching unit: 736 - PE - Department of Engineering Design
Academic year: 2012
Degree: COMPUTER SOFTWARE ENGINEERING (Syllabus 1992). (Teaching unit Optative)
(ENG) ENGINYERIA EN AUTOMATICA I ELECTRONICA INDUSTRIAL (Syllabus 2003). (Teaching unit Compulsory)
(ENG) ENG.TÈCN.IND., ESP. EN MECÀNICA, PLA 95 (Syllabus 1995). (Teaching unit Optative)
Credits: 6

Learning objectives of the subject
### Theory

**Description:**
- **Objetives**
  This course aims to introduce the student in the world of oral and written communication in the proper scope of engineering professionals in the Electrical, Electronic and Industrial. Thus, the objectives of the course are to improve the language proficiency in English student and provide the resources needed for an effective oral and written communication in the professional environment. Specifically, will address the following areas: Techniques and strategies for professional communication both orally and in writing. Practice in understanding and speaking and writing in English, through the documents themselves of the engineer. Learning the conventions and rhetoric to business records own engineer. Practice in the oral presentation of information and documentation professional engineer. Introduction of student writing in collaborative projects.
  
  **NIVELL PUTS OF THE SUBJECT ACCORDING TO THE COMMON EUROPEAN FRAME OF REFERENCE FOR THE LANGUAGES:**
  
  C1 (experienced user domain functional cash)

**Contents**

#### UNIT 1: EFFECTIVE TECHNICAL COMMUNICATION IN ENGLISH.
1.1 Technical communication: definition and characteristics
1.2 Principles of technical communication
1.3 An introduction to the most common technical documents.

#### UNIT 2: COMMUNICATION IN THE WORKPLACE: THE PLANNING STAGE.
2.1 Main stages in the communication process: planning, outlining, drafting, revising
2.2 Elements to consider when planning a document: audience, purpose, tone, and style
2.3 The planning stage

Practicals 1 and 2: Designing a document: the plan sheet

#### UNIT 3: WRITTEN COMMUNICATION.
3.1 Writing: from the outline to the draft
3.2 Elements of text organization: the paragraph and the sentence
3.3 Revising the text: language and style

Practicals 3 and 4: Writing a text.

#### UNIT 4: ORAL COMMUNICATION.
4.1 Speech features of English: a few guidelines
4.2 Oral communication in the workplace: strategies and techniques
4.3 Practice in common communicative situations
4.4 Designing technical presentations

Practicals 5 and 6: Simulations

**COLLABORATIVE PROJECT: WRITING A DOCUMENT AND PRESENTING IT ORALLY**
Laboratory

Description:
Objectives
During these sessions students will put into practice the skills and strategies learnt through the different modules. Thus, the main objective of practical sessions is to enable students to develop different technical communication tasks, both in speech and writing, paying special attention to the principles and approaches reviewed in class. At the end of the practical sessions, students should:

- Have acquired certain techniques and strategies for effective professional communication, both in speech and writing.
- Have done extensive practice in understanding and producing technical texts (both in speech and writing) related to their field of engineering.
- Have learnt about the conventions and the rhetoric of the most common professional documents in their field.
- Have done extensive practice in presenting and discussing technical information orally.
- Be familiar with the collaborative dimension of writing in the technical professions.

Contents
Practical sessions 1 and 2: Students will devise a plan sheet, a document that should enable them to define and approach the technical communication task, whether it is a written document or an oral presentation. To develop the plan sheet, students will take into account the principles of technical communication reviewed in the first module.

Practical sessions 3 and 4: After doing module 3 (written communication), students will work on a technical document related to their field of study. These activities will require them to go through the different stages of the writing process (outlining, drafting, revising), paying attention to elements of language and style as well as to the rhetoric of the specific technical documents of the field.

Practical sessions 5 and 6: After working on module 4 (oral communication) students will take part in different simulations. They will have the opportunity to practise and develop a variety of skills and strategies for successful participation in communicative situations of their own field (meetings, presentations, technical descriptions, demos, etc.).

Planning
Activity
Description
Time
Practical session 1
Preparing for technical communication: the plan sheet (1)
2 hours
Practical session 2
Preparing for technical communication: the plan sheet (2)
2 hours
Practical session 3
Writing a technical document
2 hours
Practical session 4
Writing a technical document
2 hours
Practical session 5
Oral communication practice: Simulations
2 hours
Practical session 6
Oral communication practice: Simulations
Course evaluation is as follows:
- 1st written test = 30 % of the final mark.
- 2nd written test = 30 % of the final mark.
- Collaborative Project = 30 % of the final mark.
- Attendance and active participation in the classroom: 10 % of the final mark.
Final mark: 30 % + 30 % + 30 % + 10 %

The final mark results from adding the four different percentages: 1st written test + 2nd written test + Collaborative Project + Attendance and active participation.
16214 - PROJ-U4T07 - Automatic Control Project

**Coordinating unit:** 340 - EPSEVG - Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú

**Teaching unit:** 707 - ESAII - Department of Automatic Control
710 - EEL - Department of Electronic Engineering

**Academic year:** 2011

**Degree:** (ENG) ENGINYERIA EN AUTOMATICA I ELECTRONICA INDUSTRIAL (Syllabus 2003). (Teaching unit Compulsory)

**Credits:** 6

---

**Teaching staff**

**Coordinator:** Enric Xavier Martin Rull

---

**Learning objectives of the subject**

This subject has like objective that the students are able to raise, to realize and to direct industrial projects in the area of the automatic, from the application of scientific and technical knowledge, of aptitudes and procedures, once have been identified and valued his conditional. The subject is divided in three parts: in first the bases for the exposition, analyzes, evaluation and direction of a project will be explained; in second, raised real industrial projects like cases will be analyzed; and to third, the students will develop a mini-project of the automatic specialty.
Elements of a project of engineering in automatic

**Description:**
Objectives
The student learns the exposition, analysis, evaluation and direction of an engineering project.

Contents
1. The project concept.
2. Methodology and type of projects.
3. Reach and phases of a project.
4. Service life.
5. Previous studies: viability of a project.
6. Budget and programming of a project.
7. Graph of Gantt and method PERT.
8. Organization and direction of a project.
9. Type of execution of a project.
10. Pursuit and control of a project.
12. Legal aspects.
14. Projects R+D

Studies of cases of projects in the area of the automatic

**Description:**
Objectives
To study specific projects in automatization, its approaches and adopted solutions

Contents
Study of several projects in the area of the automatic and its stages:
1. Exposition of the project
2. Obtaining and analysis of the data
3. Study of viability
4. Preliminary budget and time of accomplishment
5. Selection of the best alternative
6. Detailed analysis of the selected project
7. Programming of the project
8. Organization and direction of the project
9. Plan of pursuit and control of the project
10. Plan of quality
11. Documentation
Development of mini-project in the area of the automatic

**Description:**

Objectives

To develop a mini-project in the area of the automatic.

Contents

1. Definition and distribution of mini-projects
2. Study of the mini-project
3. Development of the mini-project
4. Writing of the mini-project
5. Public defense of the mini-project.

Qualification system

Analysis and development of miniprojects (weeks 3.4 and 5, 20% mark)
Presentation First draft of the work to do (week 9, 25% mark)
Defense of the realized Project (weeks 13 and 14, 30% mark)
Memory of the realized Project (weeks 13 and 14, 25% mark)

Bibliography

**Basic:**


The subject introduces the main applications of power electronic systems, from DC/DC regulation, low-harmonic rectification to the generation of signals of AC power for several industrial applications.
Applications of Power Electronics

**Description:**
Objectives
The aim of the course is to familiarize the student with the main applications and the future trends of power electronic circuits and their typical loads. Also, the student will be able to select the most suitable configuration for a determined application, as much with respect to the power circuit topology as the control configuration.

Contents
1. DC/DC regulators for modern microprocessors.
2. DC/DC regulators for aerospace applications.
4. Active power filters.
5. Inverters for AC control.
6. Inverters for induction cooking.
7. High-frequency inverters for lighting systems.
8. Photovoltaic systems with grid interconnection.
9. Aeolian systems with grid interconnection.

Laboratory

**Description:**
Objectives
To apply simulation tools for the study, analysis, design and evaluation of electronic power systems.

Contents
1. Power supply for the Intel Pentium IV microprocessor.
2. Nonlinear loads with low harmonic content.
3. Supplying a lighting system.
4. Photovoltaic system with grid interconnection.

Project

**Description:**
Objectives
To apply the theoretical knowledge and the simulation tools to the design of an electronic power system. To evaluate the benefits of the studied system.

Contents
The detailed study of an actual application of power electronics, selected among a set of proposals. The work will be carried out in groups. Each group can be made up of two or three students. The standard phases of a project will be followed: collection of information, selection of the power circuit topology, design and simulation of the electronic system (power circuit and control configuration, experimental verification, conclusions).
Qualification system

Mark = 0.6* (Mark for Project) +0.4* (Mark for Laboratory work)
Mark for Laboratory work = 0.25*P1+0.25*P2+0.25*P3+0.25*P4.

Bibliography

Basic:

Complementary:

Coordinating unit: 340 - EPSEVG - Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú
Teaching unit: 739 - TSC - Department of Signal Theory and Communications
Academic year: 2011
Degree: (ENG) ENGINYERIA EN AUTOMATICA I ELECTRONICA INDUSTRIAL (Syllabus 2003). (Teaching unit Optative)
Credits: 6
Teaching languages: Catalan, Spanish, English

Learning objectives of the subject

Content

Studies

Description:
The first objective of this subject is to equip the student with the basic knowledge that allow him to face situations of malfuncionamiento of the equipment, systems of communication, etc. in industrial surroundings strongly contaminated electromagnetically. As designer occurs the formation him necessary to go ahead to these problems and to make robust and safe designs. The second objective would go directed to know the legislation as far as fulfillment the European directives of Electromagnetic Compatibility of products and the possibilities of integrating this quality control in the production chain. The pursuit could be nonACTUAL WITH adaptable POSITIONS OF A GUARDIAN to the schedules of the students, of course, of the laboratory sessions that are not obligatory.

Contents
Tema 1. Introduction to the Subject
Tema 2. Interferences by Common Impedance. Compatible design of Printed circuits or wirings.
Tema 3. Interferences Lead in the Network of Low Tension.
Tema 4. Interferences in lines of communication.
Tema 5. Filters by Lead interferences.
Laboratory

**Description:**

**Objectives**
To give necessary the practical cover to the theory subjects. To introduce concepts that are more listeners when they are seen actually.

**Contents**
- Practical 1. Introduction to the Electromagnetic Interferences
- Practical 3. Connections and Interference. Cable screening.
- Practical 5. Design, Simulation, Construction and Measurement of Filtro of BT.

Qualification system

Note of laboratory (30%)
Exercises or small works of each subject (70%)

Bibliography
To train students in the calculation and design machine tools applied last generation, both the three-dimensional modeling, as the calculation using the finite element method and kinetic.

Learning objectives of the subject

To train students in the calculation and design machine tools applied last generation, both the three-dimensional modeling, as the calculation using the finite element method and kinetic.

Content

**Tension and deformation. Axial load**

**Torsion and Flection**

**Combined loads**

**Kinematics**
The qualification of the subject is obtained from the following formula:

\[ 0.25 \text{C}_1 + 0.15 \text{C}_2 + 0.60 \text{C}_3 \]

Where:
- \( \text{C}_1 \) = mark of the first partial test. Theory and problems (item 1 and 2)
- \( \text{C}_2 \) = mark of the second partial test. Information of practical of the students.
- \( \text{C}_3 \) = mark of the final test. Theory, problems and practical.

**Bibliography**
The course aims to publicize the state of the European energy planning, the institutions involved, the fundamental principles of the most important renewable energy, deepening implementations with photovoltaic solar energy and wind power to achieve these two projects related to renewable sources.
### Theory

**Description:**
The course aims to publicize the state of the European energy planning, the institutions involved, the fundamental principles of the most important renewable energy, deepening implementations with photovoltaic solar energy and wind power to achieve these two projects related to renewable sources.

**Contents**
- Item 1. - Introduction: power panorama.
- Item 2. - Power Resources.
- Item 3. - Photovoltaic solar Energy.
- Item 4. - Aeolian Energy.
- Item 5. - Other renewable energies: to pave thermal, biomass, geothermal, mini hydraulics, and tidal.

### Laboratory

**Description:**
- To approach the student to the calculation, practical assembly and evaluation of results in the projects of photovoltaic solar energy and Aeolian energy.

**Contents**
- Practical 1:
  1. Simulation technology of silicon, making characteristics plate photovoltaic
  2. Assembly of a photovoltaic Solar System.
- Practical 2:
  1. Planning to implant a system or Aeolian park.
  2. Simulation and design of an Aeolian system.

### Qualification system

The qualification is obtained choosing the maximum of \(0.5 \times C_5 + 0.25 \times C_3 + 0.25 \times C_4\) and \(0.25 \times C_1 + 0.25 \times C_2 + 0.25 \times C_3 + 0.25 \times C_4\)

where:
- \(C_1\) = Mark of the first partial test.
- \(C_2\) = Mark of the second partial test.
- Average \(C_3\) = Mark of the practical work.
- \(C_4\) = Mark of project.
- \(C_5\) = Mark of the final test.
16227 - ENRE-U2P10 - Green Energy Technologies

Bibliography

Basic:


Learning objectives of the subject

The objective is to enable the student to integrate the acquired knowledge of the diverse skilled branches of engineering to the Degree: mechanics, electronics, computer science and control. During the course a mechatronics project will be designed, constructed, evaluated and documented.
<table>
<thead>
<tr>
<th>Content</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Presentation** | **Contents**  
  - Demonstration of mechatronics devices  
  - Basic specifications of the mechatronics project that we will realize during the course.  
  - To determine the proportions main elements structures mechanics.  
  - Kinematic and dynamic basic calculations. |
| **Steps toward a mechanical design** | **Contents**  
  - Exposition of a part of the design that we will realize.  
  - Work of the students in group: to outline the raised design and to limit considering it the specifications, the process of manufacture and the later assembly. |
| **Definitive design** |                                                                                   |
| **Modelling of the selected design** |                                                                                   |
| **CAD/ CAM**     | **Contents**  
  - Demonstration of UNIGRAPHICS module CAM.  
  - Turning of some from the pieces to the manufacture factory.  
  - Assembly of the mechanical set |
Electronic elements. General concepts

Description:
Contents
- Electronic elements. General concepts
- Liabilities: condensing resistance and coils.
- Basic semiconductors: diodes, transistors and op amps.
- Special devices: semiconductors of power and other integrated circuits.
- Characteristics of the more excellent electrical signals.
- Discussion of the characteristics of the most excellent Datasheet: small signal versus. Great signal, concept of bandwidth, etc.
- Processes of manufacture of electronic circuits.
- Processes and techniques used in the manufacture of printed circuits.
- Advice for the weld and assembly of electronic prototypes.
- Recent SMD and other technologies.

Activities, knowledge, abilities, aptitudes
At the end of this meeting, the student will have learned the practical usefulness of the main elements that may have electronic circuits to cope with its design and manufacturing processes of the same

Computer science tools of electronic design

Description:
Contents
- Process of electronic design: graphical design (SCH), simulation (Spice) and drawn up of tracks (PCB)
- Software of electronic design.

Activities, knowledge, abilities, aptitudes
When finalizing this session the student will have become familiar with the software of electronic design that will use for the implementation of the electronic devices that will be used in the mechanical structure.
Electronicses that interact with the surroundings

**Description:**
Contents
- The sensors and actuators in the mechanical systems. Classification of sensors and actuators.
- General and specific characteristics for the selection of the sensor/suitable actuator.
- Preparation of sensors and actuators
- Other special devices: Video cameras, CD's among others.
- Election of sensors and actuators.

Activities, knowledge, abilities, aptitudes
This session is destined to the electronic elements that have more relation with the world of mechanical engineering and which; somehow, they are used to interact with this type of systems, or taking information or acting in its physical surroundings. When finalizing this session the students must be able to interpret the most important characteristics of the sensors/actuators that must bring to him to make the possible most optimal selection of these. At the same time one provides the basic knowledge to them to be able to make his preparation.

Aspects on special microcontrollers and other devices

**Description:**
Contents
- Practical examples of integration of electronic circuits in mechanical systems. Mechanical systems.
- Robotics
- Hydraulics
Etc.

Activities, knowledge, abilities, aptitudes
In this session the student will acquire the general knowledge necessary to be able to implement structures physically based on microprocessor that, a priori, has collected the data of the sensor and must provide the signal corresponding to the actuator.
On the other hand, and by means of examples, he tries himself to make the student reflect on aspects of electronic design that condition to three engineering in the development of projects in mechatronics: mechanics and control

Implementation of the electronic system

**Description:**
Activities, knowledge, abilities, aptitudes
This session is destined to debate the proposals presented to choose that one that is more optimal and to let the whole system ready to implement the algorithm that controls the kinematic behaviour of the same
### Modelling and syntony of controller

**Description:**

**Contents**

Of the theoretical model to the real model. To identify and to obtain the parameters and ranks of values necessary to be able to control the system.

Specifications. To return to review the initial specifications of the system and their agreement or discrepancy with the characteristics and nonlinearities of the model.

Syntony of controller. From the model of the system the type of suitable control will be selected but.

**Activities, knowledge, abilities, aptitudes**

In this session the students will get the parameters characterizing the system as well as the ranks of operating sensors and actuators on the study of the mechanical and electronics. From this model will be designed driver of the variables of interest and control structure.

### Control and errors

**Description:**

**Contents**

Digital control. Study of the stages of the control and creation of the algorithm differences that the designed control will implement to be able to be executed to the microprocessor.

Errors and purification. Syntony and minimization of the errors and disturbances nonconsidered initially that cause that the system moves away of the initial specifications.

**Activities, knowledge, abilities, aptitudes**

In this session the students will have to obtain the discretizadas equations of the continuous algorithms. The equations will suitably implement to the microcontroller structuring the stages of control within the period of sampling.

### Control at low level

**Description:**

**Contents**

Control in low level. Development of algorithms of control of variables in low level: position, speed, pair.

**Activities, knowledge, abilities, aptitudes**

In this session the students will be design and develop the algorithms that are allowed them to realize movements with trajectories predefinides.
Integration

Description:
Objectives
Beginning of a mechatronic system.

Qualification system

Evaluation of the Project (45%)
Individual presentation (25%)
Evaluation Laboratory (30%)

Bibliography

Basic:


Complementary:

# Learning objectives of the subject

**Coordinating unit:** 340 - EPSEVG - Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú  
**Teaching unit:** 709 - EE - Department of Electrical Engineering  
**Academic year:** 2012  
**Degree:** (ENG) ENGINYERIA EN AUTOMATICA I ELECTRONICA INDUSTRIAL (Syllabus 2003). (Teaching unit Optative)  
**Credits:** 6
Content

Theory

Description:
Objectives
To deepen in the modelling and the electronic control of the electric drives. One will dedicate to special attention to the simulation using commercial programs like PSPICE and SIMULINK and to the practices of laboratory in which it will be introduced to the students in the techniques of fast prototype.

Contents
1. - Introduction to the modelling of the electric drives.
2. - Model with fasores space of the electrical machines of AC voltage.
3. - Vectorial Control of the electric drives with asynchronous motors.
4. - Vectorial Control of the electric drives with synchronous motors
5. - Engine control of reluctance

Laboratory

Description:
Objectives
The practices will be subdivided in:
Practices of simulation.
They must by objective simulate the behavior of the electric drives from the models presented/displayed in the theory classes, using commercial programs PSPICE and SIMULINK.
Practices of Laboratory.
They must by objective experimentally verify the developed theoretical models in theory class, become familiar with the industrial equipment of regulation and control of electrical machines and introduce in the techniques of fast prototype.

Contents
Practices of simulation:
1. - Introduction to the simulation of electric drives with PSPICE
2. - Introduction to the Simulation of electric drives with SIMULINK
3. - Simulation with PSPICE of a drive of c.c with trozeador
4. - Simulation with SIMULINK of a drive of c.c with trozeador
5. - Simulation of a motor of c.c without brushes (Brushless D.C.motor)
6. - Simulation of an three-phase investor SV-PWM
7. - Simulation of a drive with motor of induction and vectorial control

Practices of laboratory
1. - Vectorial Control of an three-phase asynchronous motor
2. - Vectorial Control of a synchronous motor with permanent magnets
3. - Introduction to the Hardware associated to the digital control of drives
4. - Control of a autoconmutado motor of reluctance
The subject will be evaluated by means of the following expression:

FINAL MARK = 0,2 C1 + 0,25 C2 + 0,2 P.S. + 0,2 PL + 0,15 T

With
C1 mark proves partisan
C2 mark proves end
P.S. mark practical simulation
Practical PL mark laboratory
T mark work in group

Bibliography
The objective of this subject is to introduce to the student in the knowledge of the digital processors of signal (DSP) like tool for the digital signal processing and the implementation of algorithms of control in real time and high speed. The approach of the subject will concentrate in the description of the internal architecture of the DSP and its programming and in the implementation of digital filters (FIR or IIR), and algorithms of control PI and PID.

Learning objectives of the subject

The objective of this subject is to introduce to the student in the knowledge of the digital processors of signal (DSP) like tool for the digital signal processing and the implementation of algorithms of control in real time and high speed. The approach of the subject will concentrate in the description of the internal architecture of the DSP and its programming and in the implementation of digital filters (FIR or IIR), and algorithms of control PI and PID.
16233 - SDAV-U3P10 - Advanced Digital Systems

Content

Theory

Description:
Objectives
The objective of this subject is to introduce to the student in the knowledge of the digital processors of signal (DSP) like tool for the digital signal processing and the implementation of algorithms of control in real time and high speed. The approach of the subject will concentrate in the description of the internal architecture of the DSP and its programming and in the implementation of digital filters (FIR or IIR), and algorithms of control PI and PID.

Contents
1). Introduction to the DSP (internal Architecture, Peripheral, DSP of control, eats fixes and floating.
2). Programming in C and game of instructions (Subroutines, instructions in assembler, I connect, etc.).
3). Programming of filters IIR. (Obtaining from the bilinear transformed one and the MATLAB), Filtering of signal with the DSP, etc.
4). Programming of control algorithms type PI or PID. Discretización of the control, implementation, etc.
5). Programming of filters FIR. (Obtaining of coefficients with MATLAB, etc.)

Laboratory

Description:
Objectives
To cause that the student knows and makes use of the tool software Code Composer Studio that manufacturing the Instruments Roofing tiles she gives to work and to simulate with his DSP of family TMS320.

Contents
S1. Introductory session to the Code Composer Studio. Description from the surroundings to software. Location of registries. Generation, compilation and Link of programs. Accomplishment of small programs in assembly language and his equivalent in language C.
S2. Starter Kit eZdsp DSK TMS320LF2407. Connection and use of eZdsp with the surroundings to the Code Composer. Edition, compilation and Link of programs. Internal resources. Structure of memory of eZdsp and programming in C. Configuration of interruptions and use of a D/interno of the DSP.
S3. Filters FIR. Design with Matlab of a symmetrical filter FIR. Implementation in algorithm. Programming and passage to the formed Q15. Establishment of the theoretical results with the practitioners of eZdsp.
Qualification system

The qualification will be done considering those students who have not followed the course with the sufficient dedication, offering to them a final test. In particular, the qualification is obtained choosing the maximum of

\[ \text{Mark} = 0,2 \text{ Prac} + 0,2 \text{ C1} + 0,25 \text{ C2} + 0,35 \text{ C3} \]

where:
C1=mark of the first partial test.
C2=mark of the second partial test.
C3=mark of the final test.
Average Prac=mark of the practices.
The normal evaluation will consist of a series of works that will be in charge in class.

Bibliography

Basic:


Complementary:


16234 - SDIC-U2P10 - Measurement and Control Digital Systems

Coordinating unit: 340 - EPSEVG - Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2012
Degree: (ENG) ENGINYERIA EN AUTOMATICA I ELECTRONICA INDUSTRIAL (Syllabus 2003). (Teaching unit Optative)
Credits: 6

Teaching staff
Coordinator: Rafael Ramon Ramos Lara

Learning objectives of the subject
Introduction to the advanced programmable systems

**Description:**

Objectives

In this subject to the different technologies from practical accomplishment of digital systems and the criteria are described that allow to select the most suitable technology for a certain application. A review becomes of the characteristics and architecture of the digital programmable devices and the general parameters are indicated that they allow to select the most suitable device. Finally a brief description is made of the programmable analogical devices.

Contents

1.1. Introduction to the PLD's
1.1.1. Alternatives of design of digital systems. Design with PLD's.
1.1.2. Basic structures
1.2. PLD's of high capacity
1.2.1. Architecture of the CPLD's
1.2.2. Architecture of the FPGA's (family XC4000 of Xilinx)
1.3. Programmable devices of Xilinx
1.3.1. Family Spartan II
1.3.2. Family Virtex II
1.3.3. Family XC9500
1.4. Programmable Analogical devices (FPAD)
1.4.1. TRAC of FAS
1.4.2. ispPAC of Lattice

Activities, knowledge, abilities, aptitudes

When finalizing this subject the student must be able of:

- To identify the possible practical accomplishments of a digital system.
- To determine the more suitable technological solution for the accomplishment of a digital application.
- To identify what is the architecture and the capacity of a more suitable PLD to carry out a design.

Commentaries

Rafael Lara Branches, Subject 1 of SDIC
### Architecture of the systems based on programmable digital devices

**Description:**

**Objectives**

This subject tries on the different associated aspects from the design of the hardware of a digital system. The subject is divided in two parts: in one first part the components more habitual are described than they accompany the digital devices in general applications, distinguishing next for applications of instrumentation and control; in the second part the considerations practical are explained to consider in the accomplishment of the application with reference to noise attenuation, electromagnetic interferences and design of PCB.

**Contents**

- 2.1. Basic blocks of an advanced digital system for industrial applications
  - 2.1.1. analogical Entrance-exits. Signal conditioners
  - 2.2.1. Propagation of signals
  - 2.2.2. Techniques of PCB design
  - 2.1.2. digital Entrance-exits
  - 2.1.3. System of configuration and test
  - 2.1.4. System of feeding
- 2.2. Electrical considerations

**Activities, knowledge, abilities, aptitudes**

When finalizing this subject the student must be able of:

- To determine more suitable the electronic components for an application based on PLD.
- To know the mechanisms programming and verification of the hardware of the digital application.
- To design the PCB of the digital application considering considerations of electromagnetic compatibility.

**Commentaries**

Rafael Lara Branches, Subject 2 of SDIC
**Design of arithmetic subsystems**

**Description:**

**Objectives**

In this subject the characteristics, analyzes and design of the elements are introduced that compose the arithmetic subsystem. To the more habitual elements of arithmetic-logical processing and the different architectures of implementation are described from the same providing the basic criteria that allow to select to the element and architecture more adapted to the function to realize and the logical device that this function will implement.

One also explains the implementation of complex, arbitrary functions and series of powers.

**Contents**

3.1. Formats of numerical representation
3.2. Architectures series, parallel and pipelined
3.3. Sumadores/restadores
   3.3.1. Sumadores/restadores Series-Series
   3.3.2. Parallel Sumadores/restadores
3.4. Multipliers
   3.4.1. Array multipliers (Parallel)
   3.4.1.1. Multipliers Array Unsigned
   3.4.1.2. Multipliers Array a.c.
   3.4.2. Series-Parallel multipliers
   3.4.2.1. Multipliers Series-Parallel Unsigned with algorithm CSAS
   3.4.2.2. Multipliers Series-Parallel Unsigned with algorithm FSP
   3.4.2.3. Series-Parallel multipliers c.a.2 with algorithm CSAS
   3.4.2.4. Series-Parallel multipliers c.a.2 with algorithm FSP
   3.4.2.5. Multipliers Series-Parallel MSB-primero
3.4.3. Multipliers Sequential Series
3.4.4. Series-Series multipliers
3.4.5. Pipelined multipliers
3.4.6. LBooth algorithm
3.4.7. Multipliers of reduced hardware
3.5. Splitters
   3.5.1. Parallel-Parallel splitter
   3.5.2. Sequential splitter

**Activities, knowledge, abilities, aptitudes**

When finalizing this subject the student must be able of:

- To know the habitual formats representation of numerical display with the binary system of numeration.
- To select the numerical but suitable format in relation to the characteristics of the information to process.
- To know the different architectures and strategies from accomplishment of basic arithmetic-logical elements, as well as their characteristics in relation to occupation and time of process.
- To design and to combine different arithmetic elements realized with different architectures to carry out a specific function adjusting to a level of occupation and time of concrete process.

**Commentaries**

Rafael Lara Branches, Subject 3 of SDIC
# Design of temporisation subsystems and communication

**Description:**

**Objectives**

In this subject the design and practical implementation of habitually used auxiliary circuits in digital modulator, control applications are explained as accountants and watchdogs can be the timers of width of pulses and system of communication parallel series.

**Contents**

4.1. Timers, accountants and watchdogs
4.2. Modulator of width of pulses (PWM) digital
   4.2.1. Modulator of simple incline
   4.2.2. Modulator of double incline
4.3. Systems of data transmission

**Activities, knowledge, abilities, aptitudes**

When finalizing this subject the student must be able of:

- To design a timer/accountant and to know its possible applications.
- To suitably determine the proportions to the timer/necessary accountant for a concrete application.
- To know the structure basic the modulators of width of digital pulses.
- To design circuit PWM based on the precision required by the application.
- To know the systems data transmission, their utility and organization habitual.
- To design communication ports parallel series.

**Commentaries**

Rafael Lara Branches, Subject 4 of SDIC_4
**Design of control subsystems**

**Description:**

Objectives
In this subject the function of the subsystems of control within a digital design is explained. The different techniques of implementation are indicated based on scales, doors logics and memories. The different types from codification of states (binary canonical, one-hot and Gray) comment, their basic characteristicsses and their practical accomplishment with PLDs. The more habitual problems of design related to the design and operation of the control subsystems are explained, as well as the solution to adopt in each case.

Contents
5.1. Sequential control units
5.2. Machine of states

Activities, knowledge, abilities, aptitudes
When finalizing this subject the student must be able of:
· To know the functionality the subsystem of control within a digital design.
· To determine the most suitable architecture of the control system on the basis of the characteristics of the control sequence to generate.
· To design the machine of states that controls the operation and sequencing of operations of the rest of components of the digital system.

Commentaries
Rafael Lara Branches, ¿Subject 5 of SDIC¿
Digital systems of control in discreet time

**Description:**

**Objectives**
This first subject of the second part of subject SDAV is dedicated to the accomplishment of applications in the scope of control linear and nonlinear. The implementation of diverse control loops is described based on the elements studied in previous subjects. In the first place the digital accomplishment of the Proportional-Integral-Derivational control is explained (PID). Next the design of digital filters for control applications in discreet time is explained, setting out the diverse architectures of accomplishment as well as its advantages and disadvantages. Finally they comment implementations of nonlinear digital controls, as they are the control in sliding way and the diffuse control in the scope of application of the power electronics.

**Continguts**
6.1. Digital control PID
6.2. Digital filters for filtrate and control
6.3. Architectures of accomplishment of digital Filters
   6.3.1. Direct programming
   6.3.2. Standard programming
   6.3.3. Programming parallel series/
   6.3.4. Programming in stairs
6.4. Control in sliding way
6.5. Diffuse control

**Activitats, coneixements, habilitats, aptituds**
When finalizing this subject the student must be able of:
· To design a digital control PID based on devices PLDs.
· To select the most suitable architecture of filter digitalis for control applications on the basis of the characteristics of function of control to implement, occupation and time of process.
· To determine the proportions the elements suitably arithmetic that takes part in the control system.
· To combine the processing elements and architectures to design a digital system for applications of linear control in discreet time.
· To know diverse solutions digital implementation of controls nonlinear complexes that work in real time.

**Comentaris**
Rafael Lara Branches, Subject 6 of SDIC
Digital systems of instrumentation and measurement

Description:
Objectives
This subject is dedicated to the global design of digital systems based on PLDs in the scope of application of the instrumentation and electronic measurement, in particular in the field of digital processing of the measurement signal. In each one of the sections one comments the design and digital accomplishment of circuits of processing of signal very used in instrumentation as it can be filters, circuits of linealización of the characteristic of sensors, the fast transformed one of Fourier, the converter of effective value and systems of measurement of power. The selected applications to illustrate this subject try to be a representative selection of the coarse set of electronic systems related to the instrumentation and measurement.

Contents
7.1. Programmable filters
7.2. Adaptive filters
7.3. Linealización of sensors
7.4. Transformed fast of Fourier (FFT)
7.5. Converter RMS
7.6. Measurer of power

Activities, knowledge, abilities, aptitudes
When finalizing this subject the student must be able of:
· To know practical examples digital implementation of circuits for applications of instrumentation.
· To identify the involved aritméticológicas basic functions in the design of an instrumentation system.
· To determine the proportions and to organize the elementary blocks and the sequence of operations to carry out the function required by the application.
· To realize the global design of the digital system for applications of instrumentation including the subsystem of acquisition of the measurement signal.

Commentaries
Rafael Lara Branches, Subject 7 of SDIC
# Practical 1 - Introduction to the development system DIGILAB 2/2E-DIO1

**Description:**

**Objectives**

This practice allows the student to become familiar with the surroundings of work Foundation ISE for the development of digital designs based on FPGA of Xilinx.

**Contents**

- **P1.1. Plates of Digilab evaluation 2/2E and DIO1**
- **P1.2. Plate of converters ADC and DAC**
- **P1.3. Control of display of 4 digits of 7 segments**
  - **P1.3.1. Description of the application**
  - **P1.3.2. Converter of BCD-HEX to 7 segments with VHDL**
  - **P1.3.3. Design of the sequential system of control with StateCAD**
  - **P1.3.4. Design of the base of times with CORE Generator**
  - **P1.3.5. Accomplishment of the multiplexer with CORE Generator**
  - **P1.3.6. Design of high level with Schematic Editor (ECS)**
  - **P1.3.7. Compilation of the design and programming of the FPGA**
- **P1.4. Binary converter**
  - **P1.4.1. Description of the application**
  - **P1.4.2. Hierarchic design**
  - **P1.4.3. Design of the sequential system of control with VHDL**
  - **P1.4.4. Design of the shift register of 12 bits**
  - **P1.4.5. Definitive design of the binary-BCD converter**
  - **P1.4.6. Definitive design of the control of display of 4 digits of 7 segments**
- **P1.5. Theoretical questions**

**Activities, knowledge, abilities, aptitudes**

With this practice it is tried that the student:

- The surroundings Know development Digilab 2, DIO1 and the plate of converters ADC and DAC
- 5.1i Knows the surroundings of design Xilinx Foundation ISE
- He is able to realize schematic designs with Schematic Editor (ECS) of Foundation ISE
- It designs sequential systems with the publisher of states StateCAD de Foundation ISE and to verify its correct operation by means of simulation
- It realizes logical blocks with the tool CORE Generator - the strategy Knows hierarchic design
- It implements converters of codes binary-BCD and BCD-7 segments
- It uses and it combines different tools from digital design suitably

**Comentaris**

Rafael Lara Branches, Practices 1 of SDIC_U2

XAPP029: Serial Code Conversion and Binary between BCD
# Practical 2 - Digital voltmeter with ADC MAX1246

**Description:**

**Objectives**
In this practice the design of a chain of digital measurement is carried out to monitor a tension.

**Contents**

- P2.1. Description of ADC MAX1246
- P2.2. General characteristics of the application
- P2.3. Basic components
- P2.4. Design of the sequential system of control
- P2.5. Generation of the signal of clock of ADC MAX1246
- P2.6. Visualization of the result with LED's diodes
- P2.7. Visualization of the result with display of 4 digits of 7 segments
- P2.8. Theoretical work

**Activities, knowledge, abilities, aptitudes**

- It knows the operating characteristics of converter ADC MAX1246
- He is able to control digitally, via FPGA, the operation of ADC MAX1246.
- He is able to visualize results of the conversion analogical-digital is in display of 4 digits of 7 segments
- Series SPI for programming of peripheral knows the bases the communication protocol

**Commentaries**

Rafael Lara Branches, Practices 2 of SDIC MAX1246/MAX1247 dates Sheet
## Practical 3 - Measurement of Temperature with sensor AD22103

### Description:

#### Objectives

In this practice the design of a system of acquisition of digital temperature is realized based on the temperature sensor AD22103.

#### Contents

- P3.1. Description of the temperature sensor AD22103
- P3.2. General characteristics of the application
- P3.3. Modification of the design of the control system of ADC MAX1246
- P3.4. Design of the system digital conditioner of signal
- P3.5. Theoretical work

#### Activities, knowledge, abilities, aptitudes

With this practice it is tried that the student:
- It knows the operating characteristics of the temperature sensor AD22103
- He is able to determine the proportions suitably to the components and blocks necessary to process information of measurement sensors
- He is able to design the aritmético block necessary to extract the information of the physical variable offered by the sensor

#### Commentaries

Rafael Lara Branches, ¿Practice 3 of SDIC¿

AD22103: 3.3 V Supply, Voltage Output Temperature Sensor with Signal Conditioning
Practical 4 - Rectifier of complete wave

Description:
Objectives
The objective of this practical one is to design a digital system of processing of signal for applications of instrumentation and/or control.

Contents
P4.1. Description of converter DAC MAX5253
P4.2. General characteristics of the application
P4.3. Modification of the design of the control system of converter ADC MAX1246
P4.4. Design of the system of digital processing of signal
P4.5. Control of the conversion of DAC MAX5253
P4.6. Theoretical work

Activities, knowledge, abilities, aptitudes
With this practice it is tried that the student:
- It knows the operating characteristics of converter DAC MAX5253
- He is able to control the operation of converter DAC MAX5253
- He is able to determine the proportions suitably to the components and blocks necessary to conduct operations of signal accused.

Commentaries
Rafael Lara Branches, Practical 4 of SDIC¿ MAX5253 dates Sheet

Work of subject

Description:
Objectives
The objective of this work is to apply the knowledge acquired in this subject in the design of an application related to a control or instrumentation system.

Bibliography

Basic:

Learning objectives of the subject

Content

Theory

Description:

Objectives

The objective of the subject is to offer an introduction to the design of controllers employed in the industry of processes with the following characteristics:
- Modular and independent physical architecture
- Architectures of communications for distributed control

Contents

1. PRESENTATION. State of the art of DSC, Distributed Systems Control
2. PHYSICAL ARCHITECTURE. Physical description of the industrial controller of processes. Algorithms of control PID. Industrial application to the temperature control. Comparison of controller industrial verse PC
3. ARCHITECTURE OF COMMUNICATIONS. Definition of scenes. Efficiency.
4. MODELS. Fundamental paradigms. Structures and organization of the communication objects. Connection with the services of distribution
5. INDUSTRIAL APPLICATIONS. Present panorama. Variability of the market. Sector automobile, excellent machine-tool of computerized numerical control, scientific applications in the society.

Laboratory

Description:

Objectives

Practices to realize in the laboratory of L-109 communications

Contents

There are computer networks, as well as drivers of industrial processes (temperature control) communicate with each other
Evaluation continued in the form of 2 Examinations and the elaboration of information of laboratory practices $0.4 \times Q_1 + 0.4 \times Q_2 + 0.2 Q_3$. Where

$Q_1$ is the first examination,
$Q_2$ is the second examination, and
$Q_3$ is the practical activity of laboratory.
This course presents one hand, an initial vision of manufacturing technologies being used, from a mechanical point of view (casting, forging, rolling, cutting, machining, welding ...); and on the other hand, and other aspects technologies involved in manufacturing processes and in the process of current production, as the numerical control of machinery, metrology, quality control, or planning of the production system, among others. It is a vision fulfilled fleeing technology classical mechanics to adapt to the learning needs of today. It is important to the engineer in auto manufacturing is why virtually the field of application of greater automation today.

Introduction to the manufacture processes

**Description:**

Objectives

To introduce to the student in the concepts of process, process of manufacture, process of production, as well as to acquire a generalized vision of the different technologies from manufacture and the importance of the materials in the manufacture.

Processes of smelting

**Description:**

Objectives

To know the processes molding and the parameters more excellent that take part
### Conformation for plastic deformation

**Description:**
- Objectives
To know the different types in the heat of the moment from processes of deformation, deformation in cold and cuts, its characteristics and the cases in that they are applicable each of them.

### Weld

**Description:**
- Objectives
To know the processes welding and the parameters more excellent that take part.

### Metrology

**Description:**
- Objectives
Knowing the most relevant aspects of metrology and metrotecnia; become aware of the importance metrology and testing in the manufacturing process and quality control at all stages of the production process, to assess their need and difficulty, and know different solutions in the industry and the tools available.

### Processes of material starting

**Description:**
- Objectives
The student must know the different processes from mechanized, the basic machinery, the used tools, and the field of application.

### Numerical control

**Description:**
- Objectives
The student must know the concept numerical control, his advantages, the machinery, and basic concepts of programming.
The system of continued evaluation used consists of four evaluative acts:

- 1r evaluative act (weight 0.3): First Partial Examination (to 1rExPar). First Blocks
- 2n evaluative act (weight 0.4): Final examination. (Ex.Fin.) Rest of Blocks
- 3r evaluative act (weight 0.3): PrÃ ct. 8 Practices the final qualification (QF) without clearing will be:

\[ QF = (0.3 \times 1rEx.Par + 0.4 \times Ex.Fin + 0.3 \times PrA \times ct.) \]

**Bibliography**

**Basic:**


**Complementary:**

- 1996.
16238 - TIIP-U3P44 - Industrial Intranet/Internet Technologies

Coordinating unit: 340 - EPSEVG - Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú
Teaching unit: 744 - ENTEL - Department of Telematics Engineering
Academic year: 2011
Degree: (ENG) ENGINYERIA EN AUTOMATICA I ELECTRONICA INDUSTRIAL (Syllabus 2003). (Teaching unit Optative)
Credits: 6
Teaching languages: Catalan, Spanish, English

Teaching staff

Others: Daniel Guasch Murillo

Learning objectives of the subject

The objective of this subject is to present/display the possibilities that offer the communications networks Internet/Intranet in the optimization of the industrial production systems. They will be introduced, then, the fundamental protocols, applications and systems in this scene (TCP/IP, SNMP, etc). As well as the main mechanisms to assure the quality and the security in the processes.

Content
# Introduction

## Description:

**Objectives**

The central objective of the subject is to introduce to the student in the surroundings of study of the communications networks, being presented the fundamental characteristics of the industrial communications networks and the advantages of technologies Internet/Intranet in this scene.

## Contents

1.1 Introduction.

1.2 Architecture of a system of communications. Model OSI.

1.3 Industrial communications networks. Ethernet alternatives and bus of field.

## Activities, knowledge, abilities, aptitudes

The student will be able of:

- To include/understand architecture OSI as model of reference for the design and the network analysis of communications.
- To know the scene and the technologies the industrial communications networks.
- To know the advantages that technologies Internet/Intranet contribute to the industrial production.

## Commentaries

The contents can be developed using chapters 1 and 2 of *Communications and networks of computers*, as well as chapter 1 of *Networks of computers* and chapters 1.2 and 3 of *Industrial The Ethernet networking guide understanding the infrastructure connecting business enterprises, factory automation, and control systems*. 
Networks TCP/IP

**Description:**

Objectives
The central objective of the subject is the study of the networks based on protocols TCP/IP, bases of the majority of the present networks. The protocols of network level will be analyzed (IP, ICMP) and their characteristics (the address, the guidance, etc); the main transport protocols (TCP, UDP) and the classic applications that use these services.

Contents
2.1 Introduction.
2.2 Address IP. Subnets
2.3 Protocols of the network level: IP, ICMP
2.4 Guidance and interconnection. Routers.
2.5 Protocols of the transport level: TCP, UDP
2.6 Protocols of the application level: DNS, telnet, FTP, HTTP, smtp, POP3

Activities, knowledge, abilities, aptitudes
The student will be able of:
- To design networks and subnets IP.
- To identify the different elements from a network IP.
- To understand the characteristics of the service provided by protocol IP.
- To understand the advantages and disadvantages of the main alternatives of transport (TCP, UDP) based on the scene where it is had to execute a certain application of communications and the characteristics of this.
- To know main the applications associated networks TCP/IP.

Commentaries
For the study of this subject anyone of references TCP/IP can be used illustrated TCP/IP. Principles, protocols and architecture TCP/IP explained and TCP/IP. Architecture, protocols and implementation, besides Ipv6 and security of IP, where one widely documents to the family of protocols and applications TCP/IP.
## Monitoring and remote control

**Description:**

**Objectives**
The objective of the subject is to study the possibilities that offer the networks for the monitoring and the control of remote equipment of production. One will introduce to the student in the protocols and basic systems that allow to carry out these tasks using services TCP/IP.

**Contents**
- 3.1 Introduction.
- 3.2 Protocol HTTP.
- 3.3 Protocol SNMP.

**Activities, knowledge, abilities, aptitudes**
The student will be able of:
- To study the requirements of a system of communications for the monitoring and/or the control of remote equipment of production.
- To know protocol HTTP and the technologies Web available for the remote monitoring.
- To use protocol SNMP for the management and control of remote equipment of production.
- To design inlaid systems that allows the access to equipment of production by network.

**Commentaries**
In order to develop this subject chapter 11 can be used, 14 and 15 of *Industrial The Ethernet networking guide understanding the infrastructure connecting business enterprises, factory automation, and control systems*. And to complement it with the references *SNMP, SNMPv2, SNMPv3 2 and RMON 1 and* and chapter 20 of *TCP/IP. Architecture, protocols and implementation, besides Ipv6 and security of IP* and 26 of *TCP/IP. Principles, protocols and architecture* as far as SNMP.
## Security in networks TCP/IP

**Description:**

The objective of this subject is to raise the problematic one of the security in the communications networks and to know the main technologies that allow constructing safe networks. One will deepen subjects of authentication, devices (fire-guards), control of access, protocols (TLS/SSL) and based.

### Contents

5.1 Introduction. Requirements and threats to the security.
5.2 Protections of network. Firewalls.
5.3 Control of access.
5.4 Privacy with coding.
5.5. Protocols: TLS/SSL, IPSec

### Activities, knowledge, abilities, aptitudes

The student will be able of:
- To identify the possible problems of security in a network.
- To know specific solutions several types security problems in a network.
- To administer and to restrict the access to the services of the machines of a network by means of fire-guards.
- To know the state-of-the-art in the matter of coding.
- To know the protocols standard that provides an encrypted communications for networks TCP/IP.

### Commentaries

In order to develop this subject, it is possible to be used the chapter 18 of Communications and networks of computers and chapter 28 of TCP/IP. Principles, protocols and architecture like basic references. The reference Hazards report for local PC and networks provides ample information on fire-guards.
Practices of the subject

**Description:**

**Objectives**

To reinforce the theoretical knowledge of class and to see the practical application of the networks in the processes of industrial production.

**Contents**

Practice 1. Structured wiring. Description of the wiring and equipment that forms an Intranet.
Practice 2. Networks TCP/IP. To offer a complete vision of the protocol and basic applications.
Practice 3. Control with SNMP. To provide a standard mechanism of management of equipment.
Practice 4. Implementation of a network TCP/IP. To realize the putting in operation of a network TCP/IP.

**Activities, knowledge, abilities, aptitudes**

The student will have to be able of:
- To know the technologies low level and the elements of interconnection with which the physical support for an Intranet can be constructed.
- To know the characteristics the network technologies and transport in what an Intranet is based and to use the associate classic applications to these.
- To evaluate and to decide what transport protocols more are adapted for a given type of application.
- To manage equipment of remote form by means of the services provided by protocol SNMP.
- To integrate the knowledge of the entire subject in the implementation of a network TCP/IP on Ethernet.

**Commentaries**

In order to realize the practices the references "Industrial The Ethernet can be consulted networking guide understanding the infrastructure connecting business enterprises, factory automation, and control systems\[1\], SNMP, SNMPv2, SNMPv3 2 and RMON 1 and\[2\] and \[3\] TCP/IP. Architecture, protocols and implementation, besides ipv6 and security of IP\[4\]."

Works on networks TCP/IP

**Description:**

**Objectives**

The students will realize a set of directed works to treat parallel subjects to the explained ones to class. Concretely, the works will be realized on monitoring and remote control, quality on watch and security, in all the cases, within the framework of technologies Intranet/Internet for the production. The works will be proposed by the professor.

**Commentaries**

The election of the bibliography depends on thematic the specific one to try

Qualification system

The qualification of the subject considers all the work carried out throughout the course, and simultaneously it gives a final opportunity to those students who have not followed the course with the sufficient dedication: 25% (to 1er partial) + 25% (2A\[0\] partial) + 10% (note class) + 15% (individual work) + 25% (practical)
Bibliography

Basic:


Complementary:


16239 - XACI-U2P07 - Industrial Communication Systems

Coordinating unit: 340 - EPSEVG - Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú
Teaching unit: 707 - ESIAI - Department of Automatic Control
Academic year: 2011
Degree: (ENG) ENGINYERIA EN AUTOMATICA I ELECTRONICA INDUSTRIAL (Syllabus 2003). (Teaching unit Optative)
Credits: 6
Teaching languages: Catalan

Teaching staff
Coordinator: Pau Marti Colom
Others: PAU MARTI COLOM

Degree competences to which the subject contributes

General:
1. Ability to apply knowledge to practice
2. Troubleshooting
3. Teamwork

Learning objectives of the subject

Content

(ENG) Introducció a les xarxes de comunicacions industrials

(ENG) Controller Area Network (CAN)

(ENG) Profibus

(ENG) Ethernet (cable i sense cable) i TCP/ IP en entorns industrials
# Bibliography

## Basic:


## Complementary:


The subject deals with the data transmission, analyzing the associated theory of modular form in agreement with a standardized model of reference. The student will know the concepts he needs to build a data communication network between systems, and to describe what networks and protocols should be implemented to interconnect centralized and/or distributed systems. The model of basic reference on which the theoretical subjects are based is the model TCP/IP; basically, the protocols and applications of the Internet network. The theory that we will develop will especially make reference around the industrial communications networks.

Learning objectives of the subject

The subject deals with the data transmission, analyzing the associated theory of modular form in agreement with a standardized model of reference. The student will know the concepts he needs to build a data communication network between systems, and to describe what networks and protocols should be implemented to interconnect centralized and/or distributed systems. The model of basic reference on which the theoretical subjects are based is the model TCP/IP; basically, the protocols and applications of the Internet network. The theory that we will develop will especially make reference around the industrial communications networks.
## Subject 1. Introduction to the communications networks

### Description:

**Objectives**

The central objective of the subject is to introduce in the student the theoretical subjects that it is necessary to know in the surroundings of the industrial communications networks.

### Contents

- Introduction communications networks.
- Architecture of a system of communications. Model OSI and TCP/IP.

### Activities, knowledge, abilities, aptitudes

The student will have to be able of:

- To include/understand the need to analyze the interconnection among systems from a modular architecture of communications.
- Classification of communications networks.
- To distinguish and to know the main architecture standards: OSI and TCP/IP like reference models.
- To know the scene the industrial communications networks.
- Standard and international normalization.

### Planning

This initial module must serve to us to introduce in the data transmission, doing special attention to the meaning of the architecture of communications TCP/IP which is the core of the Internet. Practice 1 will help and complement the theory developed in this chapter.

### Commentaries

The general bibliography shows a series of titles very adapted for the pursuit of the theoretical and practical subjects of the subject. If it is necessary it will indicate complementary bibliography even though we do not create it necessary for an introductory course like this.
Subject 2. The physical level

Description:
Objectives
We understand by physical level the means that allow the transmission of DS and/or analogical by means of wire or wireless elements.

Contents
2.1 Ways of communication.
2.2 Type of signals.
2.3 Transmission of analogical signals: modulation.
2.4 Transmission of DS: codification.
2.5 Problematic on the transmissions they depend on physical means.
2.6 Average of transmission guided, bus as particular case of the industrial communications.
2.7 Average of transmission wireless, use in the industrial surroundings.
2.8 Topology.
2.9 Multiplexation.

Activities, knowledge, abilities, aptitudes
The student once obtained the level of this chapter will know the problematic one related to the interchange data through physical means and as she affects to the resolution of a communication between physical systems. In addition he will recognize the main advantages and disadvantages of the average physicists employed for the transmission and will be able to define what is the adapted ones to implant them in a certain installation. We will pay special attention to the average ones more used in associated industrial means and the problematic one.

Planning
The physical level occupies an important part of the course since its knowledge is key for the future engineer at the time of solving the automatization of an industrial process. Practices 2 and 3 will help and complement the theory developed in this chapter.

Commentaries
The general bibliography shows a series of titles very adapted for the pursuit of the theoretical and practical subjects of the subject. If it is necessary it will indicate complementary bibliography even though we do not create it necessary for an introductory course like this.
Subject 3. The connection level. Industrial local networks and protocols of access in means

Description:

Objectives
The connection level analyzes the interchange of messages between systems interconnected directly by physical means, especially the meaning of the error and flow control to obtain a free interchange of errors. The functions of a local area network are completely included/understood from the concepts and functions that the connection level describes. The student will know the protocols access means most important in the industrial surroundings, making special emphasis of the protocol industrial Ethernet and Token Diver. The content of this chapter is fundamental in this agenda the local networks, and especially the Ethernet, is to a large extent the base of the communications in the present plants of automatization and in the future. Besides wireless emergent technologies like and the optical ones.

Contents
3.1. Main meaning of the connection level, concepts.
3.2 Type of protocols of connection level.
3.3 Control of error and flow, mechanisms of sliding window.
3.4 Control of access to means, sub-level MAC. Evaluation of benefits
3.5 Classification of protocols MAC: random determinists and.
3.6 Protocol CSMA/CD. The network Ethernet, type and basic characteristics. Industrial Ethernet
3.7. The Token-Bus protocol (IEEE 802,4), characteristics.
3.8. Wireless and optical local networks in the industrial surroundings.
3.9. Level 802.2.

Activities, knowledge, abilities, aptitudes
- To describe the functionalities of the connection level.
- To understand the necessity to apply techniques of error and flow control in a connection of data transmission.
- To analyze the used methods more common.
- To deepen in the control of access to possible means, methods.
- To evaluate the characteristics of the different methods.
- To know the protocols used concerning connection in the industrial communications networks: Ethernet and Token Bus Ethernet.
- To analyze and to evaluate the transit of a network Ethernet.

Planning
The industrial buses and of other systems of communication in the factory apply the protocols that will be seen in this module. Especially important it is to know the Ethernet protocol since it is the used protocol but in these surroundings. Practices 2 and 3 will help and complement the theory developed in this chapter.

Commentaries
The general bibliography shows a series of titles very adapted for the pursuit of the theoretical and practical subjects of the subject. If it is necessary it will indicate complementary bibliography even though we do not create it necessary for an introductory course like this.
Subject 4. Networks of ample reach

Description:
Objectives
The objective of this subject is to present/display the networks of transport of information of ample problematic reach and the technological one to solve by these: address and control of congestion among others. In addition we will make a classification of the types to networks and like solving the interconnection between networks of different types.

Contents
4.1 Concept of communications network.
4.2 Type of networks taking care of different classifications.
4.3 Congestion and address, topology, signaling, flow control in networks. Differentiated quality on watch and services.
4.4 Networks of commutation.
4.4.1. Commutation of circuits.
4.4.2. Commutation of packages.

Activities, knowledge, abilities, aptitudes
- To know the behaviour thorough a communications network.
- To distinguish different types from networks and their applications at the time of interconnecting distributed equipment and systems.
- To understand how the networks and the problems work that present/display as far as signaling, to address, congestion control, etc.
- The meaning of a network of commutation and used type of commutation in the networks of ample reach.

Planning
Practice 4 will help and complement the theory developed in this chapter.

Commentaries
The general bibliography shows a series of titles very adapted for the pursuit of the theoretical and practical subjects of the subject. If it is necessary it will indicate complementary bibliography even though we do not create it necessary for an introductory course like this.
Subject 5. Protocol TCP/IP. Interconnection of networks

**Description:**

**Objectives**

More and more it is needed to interconnect, to manage and to control systems automated different by means of private and public networks from all type. This chapter will explain the concepts to us that lack makes dominate for being able to design and to implant solutions that allow the interconnection of distributed systems.

**Contents**

- 5.1 Architecture TCP/IP.
- 5.2 IPv4 protocol. Address and subnetting.
- 5.3 IPv6 protocol.
- 5.4 Transport protocols: TCP and UDP.
- 5.5 Applications.
- 5.6 Main interconnection, concepts and elements.
- 5.7 Equipment of interconnection of local networks, bridges (bridges), commutators (switch).

**Activities, knowledge, abilities, aptitudes**

- To know thorough the meaning the problematic one to solve by means of a communications network being used the model of architecture of communications.
- To define the necessary architecture for the interconnection of systems by means of networks of different types.
- To know the different necessary equipment by the implantation from a distributed system and the way to interconnect local and remote networks.
- To learn to form the equipment and to define subjects that improves the global benefits of the systems.

**Planning**

In this module we will see protocol TCP/IP in detail. In the module of practices it will be seen:

- Applications: FTP and telnet. Configuration of a servant of Internet.
- Evaluation of a network of a small office. (OPNET).

The practices; especially the 1, 3 and 4; they will help and complement the theory developed in this chapter.

**Commentaries**

The general bibliography shows a series of titles very adapted for the pursuit of the theoretical and practical subjects of the subject. If it is necessary it will indicate complementary bibliography even though we do not create it necessary for an introductory course like this.
## Practices

**Description:**

Objectives
To apply of form practical the acquired knowledge to solve in the laboratory a real problem by means of suitable tools and software

Contents

P1. Configuration of a servant of Internet. We will use the package of free distribution EASYPHP.
P2. Configuration and beginning of switch. OPNET
P3. Analysis transit of a network Ethernet. To analyze the transit being started off of architecture TCP/IP of a local network. We will use software LAN AGILENT and OPNET.
P4. Interconnection of networks and analisi of the benefits. To analyze and to evaluate the connection from a small office to a local and or remote servant. We will use software OPNET.

Activities, knowledge, abilities, aptitudes
The practices will be developed in the laboratory of the school and will make lack install and learn to make work suitable software. It will be necessary to know the more common operating systems usuary level: WINDOWS. YOU on this system we will install software: - FTP: CERBERUS. - WEB: EASYPHP

Planning
The practical ones are related to the theoretical subjects that they will go away development in the modules from the 1 to the 5.
P1. - Related to theoretical module 1.
P2. - Related to module theoretical 2 and 3.
P3. - Related to module theoretical 2, 3 and 5.
P4. - Related to module theoretical 4 and 5.

Commentaries
The general bibliography shows a series of titles very adapted for the pursuit of the theoretical and practical subjects of the subject, and also material specific developed for the accomplishment of the practices. If it is necessary it will indicate complementary bibliography although we do not create it necessary for an introductory course like this.
Work Exhibition in class

Description:
Objectives
In this work, the student tutored by the professor will develop a selected subject of communications networks on the basis of a series of subjects that will propose for the professor. The student will have to prepare a consisting of work:
- Content. Index and summary of the content of the chapters to develop
- Theoretical Memory from 10 to 15 pages.
- Oral Exhibition accompanied by ad-hoc transparencies.

Contents
The student will have to prepare a consisting of work:
- Content. Index and summary of the content of the chapters to develop
- Theoretical Memory from 10 to 15 pages.
- Oral Exhibition accompanied by ad-hoc transparencies.

Qualification system

The Final Qualification calculates by average of the any evaluating activity and test of Final Evaluation. The appraisable activities will be:
- Check tests and End realized to half and end of course. (33% by control and 67% by the final evaluation).
- Practical.
- Realized Activities in class: problems, exercises several, etc.
- Work of the student.

Lime. END = 40% Theory + 40% Practice + 10% Class + 10% individual Work.
16240 - XATE-U2P44 - Telematics Networks

Bibliography

Basic:


Complementary:

Learning objectives of the subject

To understand the basic aspects of human behaviour in organizations, from a managerial skills and human resource management perspective. A further objective is to understand and develop interpersonal competencies and abilities to function in an organization. The student has the technical knowledge and when s/he joins an organization, will eventually have to direct and motivate a team of workers and therefore understand what the main techniques of Management of Human Resources are. A final objective is to be able to use the techniques and instruments of non-presential education (such as participation in forums, consultations in the Digital Campus) and to develop abilities to work independently: looking for of relevant information, teamwork, efficient task planning.
16242 - HADI-U3P32 - Management Skills

Content
### Unit I. Team management and motivation

**Description:**

**Objectives**

- To understand the basic aspects of human behaviour in organizations, from a managerial skills and human resource management perspective.
- To understand and develop interpersonal competencies and abilities to function in an organization. The student has the technical knowledge and when s/he joins an organization, will eventually have to direct and motivate a team of workers and therefore understand what the main techniques of Management of Human Resources are.

**Contents**

1. **Motivation**

2. **Emotional Intelligence**
   - Concept of emotional Intelligence. Personal or individual competencies (Self-knowledge, self-control and Self-motivation) and interpersonal (social empathy and abilities).

3. **Communication**

4. **The teams**

5. **Leadership**

**Activities, knowledge, abilities, aptitudes**

These activities in the presential sessions are to allow the group to accumulate and share experience which will serve to improve understanding of personal and group relationships within an organization. They are based on several situations (dysfunctional conflicts, communications, etc) that serve as study material.

1. Initial presentation activity
2. Role play
3. Questionnaire of psycho-social factors

There is a training module available from library staff which focuses on looking for and selecting information for the accomplishment of an assignment and on presenting/displaying a report in writing and making an oral presentation. The students will have to contact the library to arrange the session (individual or in small groups) that will be held during the 4th and 5th week.
**Planning**
周期为10周。在讲授课程时，教师将提供课程大纲。这被理解为学生的指导。其目的是展示/展示课程，提出学习材料，并澄清疑问。每个主题将提供以下内容：
- 幻灯片格式的材料用于课堂演讲和其他补充材料（数字校园）
- 具体的参考文献，包含其查找信息，重点关注电子格式的材料

**Objective**
了解人力资源管理的主要技术。

**Contents**
6. 人力资源管理概念。人力资源管理在组织中的职能。任务的分散化。人力资源规划。
7. 人员选拔。员工培训。预防心理-社会风险。阶段。内部和外部选拔。选拔面谈。培训。培训阶段。促进健康问题。公司的社会环境和预防心理-社会风险（压力、霸凌和职业倦怠）。

**Planning**
周期，4周
The following work will be evaluated:
The assignments presented on cases or articles: the average mark of all the assignments presented. Group work: both the report handed in and the oral presentation will be evaluated. The members of the groups will receive the same mark. The understanding of the concepts: an individual written test. Participation: attendance and participation in both the class and the debates on the digital campus. The final mark will be the result of the following:
0.3 mark for cases + 0.3 mark for written test + 0.3 mark for group work + 0.1 mark for participation

**Study of practical suppositions of organizational behaviour**

**Description:**

**Objectives**

- To apply understanding to analyze and resolve situations in the context of interpersonal relations within organizations and the management of people in the company.
- To effectively use the techniques and instruments of non-presential education, and to develop abilities to work independently: looking for relevant information, teamwork, efficient task planning, ability to exchange points of view and to discuss, and capacity to learn from a debate

**Activities, knowledge, abilities, aptitudes**

- Understanding of the presented/displayed situation and capacity to synthesize the most relevant aspects.
- To apply the concepts studied to practical cases.
- Capture the complexity of real situations, different management techniques and points of view and the diverse dimensions of the organizational phenomena.
- To become familiar with resourcing information on management. Presentation of written documents

**Planning**
The individual work on cases or articles will be based on questions proposed by the teacher and will not exceed 3 pages in length. These assignments will be handed in on the date decided on at the beginning of term. The cases must be in electronic format (Word or pdf) and sent to the digital campus. The deadline for the assignments will appear in the calendar. The cases are evaluated as follows: A (10), B (7,5), C (5) and D (3,5). Late work will be penalized. The work will be returned to the student no later than one week after the deadline. The tutor will post individualised comments along with examples of some of the better assignments on the digital campus for reference.

**Teamwork**

**Description:**

**Objectives**

To apply knowledge acquired to analyze and resolve situations in the context of interpersonal relations in organizations and the management of people in the company. To effectively use the techniques and instruments of non-presential education, and to develop skills to work independently: looking for relevant information, teamwork, efficient planning of the tasks centred on a subject chosen from the proposals made by the teacher during the second week of the course. The work will take the form of a written document and an oral presentation in class at the end of the course. The delivery of the rough draft must be handed in during the 5th week, to allow enough time to prepare the definitive version.

**Qualification system**

The assignments presented on cases or articles: the average mark of all the assignments presented. Group work: both the report handed in and the oral presentation will be evaluated. The members of the groups will receive the same mark. The understanding of the concepts: an individual written test. Participation: attendance and participation in both the class and the debates on the digital campus. The final mark will be the result of the following:
0.3 mark for cases + 0.3 mark for written test + 0.3 mark for group work + 0.1 mark for participation
Bibliography

**Basic:**

