In addition to the general offer of courses taught in English, some Centers also offer for incoming students English Friendly Courses (EFC): subjects taught in Spanish, in which the syllabus summary, lecturer tutoring, examinations and/or papers are available in English.

<table>
<thead>
<tr>
<th>FACULTY OF ENGINEERING - VITORIA-GASTEIZ (163)</th>
<th>SEMESTER</th>
<th>CREDITS</th>
<th>SCHEDULE</th>
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<td>25974 Fundamentos Físicos de la Ingeniería</td>
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<td>26018 Arquitectura de Computadores</td>
<td>Sep. 2019- Jan. 2020</td>
<td>6</td>
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<tr>
<td>26021 Lenguajes, Computación y Sistemas Inteligentes</td>
<td>Sep. 2019- Jan. 2020</td>
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<td>26036 Desarrollo de Sistemas Gráficos</td>
<td>Sep. 2019- Jan. 2020</td>
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<td>26005 Sistemas Empotrados</td>
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<tr>
<td>26045 Elasticidad y Resistencia de Materiales</td>
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<td>25999 Informática Industrial</td>
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<td>26023 Investigación operativa</td>
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<td>Control por Computador</td>
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<td>Introducción a la Mecánica</td>
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<td>Jan. 2020- May 2020</td>
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</table>

1 SCHEDULE: Morning (M)/ Afternoon (A): begins at 13.30. By clicking the subject’s name, its Syllabus will appear.
Outcomes / Objectives
Description: Fundamentals of mechanics, thermodynamics, fields, electromagnetism and waves.
Learning outcomes to be achieved:
1.- Establish dimensional relations between different physical magnitudes and correctly use the International Unit System within the scope of the subject.
2.- Use the fundamental laws of physics to explain natural phenomena and the basic operation of machines and devices within the scope of the subject.
3.- Apply the fundamental laws of physics to the solution of practical problems and interpret the results within the scope of the subject.
4.- Adapt the fundamental laws of physics and their scope of validity to different technological applications within the scope of the subject.
5.- Design physical models and define their restrictions for the experimental testing of phenomena or procedures within the scope of the subject.
6.- Estimate the uncertainty in any measurement and in the results of physical calculations, and to treat experimental data to obtain quantitative cause and effect relationships within the scope of the subject.

Syllabus
5.- General dynamics of particles: Equations of motion. Linear momentum, angular momentum, work and energy. Conservation theorems and principles: Conservative forces. Central forces.
6.- Oscillatory motion: Simple harmonic motion, damped and forced oscillations


17.- Stationary electric currents: Current intensity and density. Electromotive force. Ohm’s, Joule’s and Kirchhoff’s Laws. RC circuits.


19.- Magnetostatic interaction in matter: Diamagnetic, paramagnetic and ferromagnetic materials.


**Methodology**

**Teaching Method**

<table>
<thead>
<tr>
<th>Face-to-Face Teaching Hours</th>
<th>Lectures</th>
<th>Seminars</th>
<th>Classroom practice</th>
<th>Lab. practice</th>
<th>Computer sessions</th>
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<th>Lectures</th>
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</table>

**Clarification regarding the methodology**

Classroom instruction will develop the subject matter content and include practical exercises.

Some classroom practice sessions (GA) will include laboratory methods, consisting of the study of the measurement theory and an introduction to the handling of experimental data.

Students are expected to study the subject matter content developed in class and solve the proposed exercises. Continuous use of tutorials is recommended. Student hours of non face-to-face activities are indicative only.
Assessment System

General criteria
1. Written essay exam
2. Practical activities (exercises, cases or problems)

Clarification regarding assessment
Continuous and individual. The final overall grade for the subject will be between 0 and 10; the pass mark is 5 points or more. The final grade is calculated as follows:
1. The five best marks achieved in the six control tests account for 25%.
2. A test on experimental laboratory methods accounts for 10%.
3. A final test on the entire content matter of the subject accounts for 65%.
A voluntary partial test will be held at the end of the first semester, which will yield a partial grade by adding the overall mark achieved in the first three control tests with a weighting of 25% plus the mark achieved in this partial test with a weighting of 75%. If the partial grade is equal to or higher than 5, students will have the option of either sitting the final exam based on the entire content of the subject matter or based only on the part taught in the second semester; if the partial grade is less than 5, students must sit the final exam based on the entire content of the subject matter, and in calculating the final overall grade for the subject the partial grade achieved will not be taken into account, however the marks achieved in the first three control tests will count towards the final grade.
In order to ensure that the laboratory practice exercise and control tests are worth 35% of the final grade, students must comply with the following two requirements: (1) They must have performed all the control tests and the laboratory exercise (except for justified reasons). (2) They must have achieved a minimum mark of 3 out of 10 in the final exam. Where both requirements are not fulfilled, the final overall grade for the subject will be based on the mark achieved in the final exam only.
In the re-sit exam session students may only sit for the final exam, and the marks achieved in the control tests and laboratory exercise will be maintained, as well as the two previously established requirements.
More details and assessment criteria will be provided at the beginning of the academic year, and these will remain posted on the notice boards and on the Virtual Campus (Moodle) throughout the year.

Bibliography

Basic Bibliography

In-depth Bibliography
- Giancoli D.C. (2009), Física para Ciencias e Ingeniería con Física Moderna. Pearson Educación.
- Feynman, Leighton y Sands. Física (The Feynman Lectures on Physics). Addison-Wesley Iberoamericana
- Other publications which will be proposed for each part of the subject matter during the course.

Websites
- http://www.sc.ehu.es/sbweb/fisica/default.htm
- http://www.fisicahoy.com/
Centre | University College of Engineering of Vitoria-Gasteiz
--- | ---
Name of subject | 25975 – Chemical Foundations of Engineering
Qualification | Degree in Industrial Electronical and Automation Engineering
Brief description of the subject content | General chemistry. Inorganic chemistry. Organic chemistry.
Type | Compulsory
Credits | 9 ECTS
Year | 1
Term(s) | 1st and 2nd
Department | Chemical and Environmental Engineering
Language | Spanish and Basque

### Outcomes / Objectives
- General chemistry.
- Inorganic chemistry.
- Organic chemistry.

### Syllabus
8. Structural classification of organic compounds. Functional groups in organic chemistry and properties of compounds.

### Methodology

#### Teaching Method

<table>
<thead>
<tr>
<th>Face-to-Face Teaching Hours</th>
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<tbody>
<tr>
<td>Lectures</td>
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### Student Hours of Non Face-To-Face Activities
Lectures | Seminars | Classroom practice | Lab. practice | Computer sessions | Clinical practice | Workshops | Industrial workshops | Field practice
---|---|---|---|---|---|---|---|---
67.5 | 0.0 | 45.0 | 33.5 |

**Assessment System**

**General criteria**
- Written essay exam
- Practical activities (exercises, cases or problems)
- Individual projects.
- Team projects.

**Clarification regarding assessment**
- Exams 70%
- Portfolio 10%
- Deliverables (problems, projects, etc.) 15%
- Bibliographic Assignment 5%

**Bibliography**

**Basic Bibliography**
- ATKINS-JONES. Principios de química. Los caminos del descubrimiento Editorial Panamericana
- REBOIRAS, M.D. Química: la ciencia básica Editorial Thomas
- PRIMO YÚFERA E. Química Orgánica básica y aplicada. Ed. Reverté
- QUINOÁ E. Y R. RIGUERA. Cuestiones y ejercicios de Química Orgánica. Ed. McGraw-Hill

**In-depth Bibliography**
- VOLLHARDT P. Química Orgánica. Ed. Omega

**Websites**
- http://highered.mcgraw-hill.com/sites/970106111x/
<table>
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<td>Language</td>
<td>Spanish and Basque</td>
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</table>

**Outcomes / Objectives**

Statics, kinematics and dynamics of material systems and key applications in engineering. Principles of the resistance of materials.

**Syllabus**

VECTORS. Taking for granted previous knowledge of the concept of vector, we will focus on the study of vector systems. GEOMETRY AND MASS DISTRIBUTION. Spatial distribution of mass through the concepts of centre of mass and first- and second-order moments. Generalisation of the concept of tensor. STATICS. Concept of equilibrium in mechanical systems. Active forces and binding forces, smooth and rough bounds. KINEMATICS. Concept of position, velocity and acceleration. Relative motion. Kinematics of rigid bodies. Kinematics of rigid body systems. DYNAMICS. Laws of dynamics. Theorems of dynamics, for the point and for material systems. INTRODUCTION TO THE STUDY OF THE RESISTANCE OF MATERIALS. EXPERIMENTAL STUDY OF THE PROPERTIES OF MATERIALS. TRACTION AND COMPRESSION. STRESS AND STRAIN STATES. CUTTING AND ITS APPLICATIONS. GENERAL FLEXURAL THEORY.
**Methodology**

**Teaching Method**

### Face-to-Face Teaching Hours

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Seminars</th>
<th>Classroom practice</th>
<th>Lab. practice</th>
<th>Computer sessions</th>
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### Student Hours of Non Face-To-Face Activities

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**Assessment System**

**General criteria**

**Clarification regarding assessment**

**Bibliography**

**Basic Bibliography**

Teacher’s notes - BEER, F.P.; RUSSELL, E. Mecánica vectorial para Ingenieros. (Volumes I and II) Publisher: MacGraw-Hill.

HIGDON; STILES. Ingeniería Mecánica. (Volumes I and II) Publisher: Prentice-Hall Inc.

MERIAM, J.L. Mecánica (Volumes I and II) Publisher: Reverté.

Joseba García Melero. Resistencia de Materiales. Publisher: UPV-EHU

**In-depth Bibliography**

BILBAO, A; AMEZUA, E. Mecánica Aplicada: Estática y cinemática. Publisher: Síntesis.

BILBAO, A; AMEZUA, E; ALTUZARRA, O. Mecánica Aplicada: Dinámica. Publisher: Síntesis.

BASTERO, J.M.; CASELLAS, J. Curso de Mecánica, Publisher: EUNSA

Manuel Vazquez. Resistencia de Materiales. Publisher: Universidad Politécnica de Madrid


Timoshenko. Resistencia de Materiales (2 volumes). Publisher: Espasa-Calpe

**Websites**

- [http://www.vc.ehu.es/ingme](http://www.vc.ehu.es/ingme)
- [http://moodle.ehu.es](http://moodle.ehu.es)
26031- BASIC PROGRAMMING/ PROGRAMACIÓN BÁSICA

The subject of Basic Programming introduces students to the field of software development. This subject is the first step in the training of students in the development of programs in the degree course.

The competences to be acquired in the subject are:
- Ability to analyse and explain the behaviour of programs that contain: instructions, I/O operations, iteration, sub-programs.
- Ability to divide a problem into logical parts that can be solved (programmed) independently.
- Ability to design simple algorithms to solve problems, implement them, test them and fine-tune them. Ability to write code in accordance with rules of good practice.
- Knowledge, design and efficient use of the most suitable types and structures of data for problem-solving.
- Knowledge of basic algorithmic procedures in IT technologies for design solutions to problems, analysing the suitability and complexity of the algorithms proposed.

During lectures, explanations of concepts will be combined with the performance of exercises. In the laboratory, a series of (previously-distributed) exercises will be worked on. The sessions require prior preparation and the presentation of a report using the problem-solving methodology given. A project will also be created, in which the student will put the concepts worked on in the subject into practice.

Assessment in the ORDINARY call will be done under continuous assessment or final assessment. By defect, all students will do continuous assessment unless they withdraw from it.

* FINAL ASSESSMENT
The student may withdraw from continuous assessment to do final assessment (final exam). This withdrawal will be presented in writing to the professor responsible for the subject in the periods established in Article 8 of the Rules on Assessment of Students. Exceptional cases will not be accepted, nor can students withdraw from continuous assessment after the stated dates.

* CONTINUOUS ASSESSMENT
The final grade of the subject is calculated on the basis of the exam marks, laboratory work and individual practical work.

GRADING IN MINUTES:

Students who have not withdrawn from continuous assessment will be considered as presented for the ORDINARY call.

To pass the subject, the student must take all the exams and obtain a minimum final grade of 5 out of 10. The student must also score at least 3.5 out of 10 in the grade corresponding to the exams in which the practical and laboratory work is included. Otherwise, the grade obtained will be the average marks of the exams.

* WITHDRAWAL FROM THE EXAM
A student who, having opted for final assessment, does not present him/herself for the ORDINARY call will be graded as "NOT PRESENTED". A student who takes continuous assessment may withdraw from the call as stipulated in Article 12 of the Rules on Student Assessment.

* CASES OF COPVING
Article 11 of the current rules on student assessment will be applied.

Assessment in the EXTRAORDINARY call will consist of three parts:
In the extraordinary call, the students may recover the parts corresponding to practical work and laboratory work by answering some specific questionnaires. If they have passes all these parts, they may maintain the grade obtained in the ordinary call.

Students who have withdrawn from continuous assessment will have a single final exam in which the aspects worked on in class, the laboratories and practical sessions will be assessed.

To withdraw from this exam, it is sufficient not to appear on the day.
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**Outcomes / Objectives**

The subject comprises the following: segmented processors, the basic building blocks of today’s processors; the functional units that provide support for multimedia applications; minimum essential notions for software and hardware support for implicit and explicit parallelism; cache memory as an integral part of a computer’s memory hierarchy. Students analyse the efficiency with which compilers generate code, and write small parallel programs.

**Syllabus**

Cache memory. Analyses the most important parameters of cache memory. Studies on real programs the importance of taking cache memory into account when programming. Analyses some compiler optimisations.

Linear Segmented Processor. Students build a linear segmented processor. Some compiler optimisations that improve processor performance.

SIMD instructions. Analyses low level SIMD instructions: operations with small vectors supported by the functional units of conventional processors. Practical examples of programs for PC type processors.

Introduction to Parallelism. Different types of parallelism, as well as their hardware and software support. Analyses programs with parallelism extracted by the compiler and directly specified by the programmer.
Methodology

Teaching Method

Face-to-Face Teaching Hours

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Seminars</th>
<th>Classroom practice</th>
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Student Hours of Non Face-To-Face Activities

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Assessment System

General criteria

Oral exam.
Practical activities (exercises, case studies or problems).
Group assignments.
Presentation of assignments, reading...

Clarification regarding assessment

ORAL EXAM: 20
PRACTICAL ACTIVITIES (EXERCISES, CASE STUDIES OR PROBLEMS): 30
GROUP ASSIGNMENTS: 30
PRESENTATION OF ASSIGNMENTS: 20

Bibliography

Basic Bibliography

ARQUITECTURA DE COMPUTADORES. UN ENFOQUE CUANTITATIVO.

COMPUTER ARCHITECTURE. A QUANTITATIVE APPROACH.

ORGANIZACION DE COMPUTADORES.

ORGANIZACION Y ARQUITECTURA DE COMPUTADORES.

In-depth Bibliography

Websites

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<table>
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**Outcomes / Objectives**

Automata, grammars, formal languages, computability, complexity, programming paradigms, intelligent systems.

**Syllabus**

Methodology

Teaching Method

<table>
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<tr>
<th>Face-to-Face Teaching Hours</th>
<th>Lectures</th>
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Assessment System

General criteria

Clarification regarding assessment

Bibliography

Basic Bibliography


In-depth Bibliography

S.H. RODGER, T.W. FINLEY; "JFLAP: An Interactive Formal Languages and Automata Package". Jones and Bartlett, 2006

Websites

- Java Computability Tool kit (JCT): http://humboldt.sunyit.edu/jct/
- Visual and interactive tools (JFLAP): http://www.jflap.org/
- Java implementation of AI algorithms: http://code.google.com/p/aima-java/
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**Outcomes / Objectives**

Overview of the different areas covered by Computer Security and of the security issues derived from the use of computer equipment and applications.

Processes of conception, planning and implementation of reasonable security policies and measures in professional environments, making an approach to the knowledge of ISMSs.

Integration of computer security technical knowledge in the ethical, legal and organisational areas.

**Syllabus**

Information Systems Security Risk Analysis and Management.

Back up information and back-up copies

Information resource access control: identification and authentication. The digital signature.

Malicious software: security risks and measures

The human factor

Information encoding: usage contexts and basic techniques

Software protection

Planning, organising and administering computer security, audits: techniques and standards

Legal, ethical and organisational aspects: LOPD (Data Protection Act), LSSI (Information Society Services Act) and the Electronic Signature Act.

**Methodology**

**Teaching Method**

**Face-to-Face Teaching Hours**

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Seminars</th>
<th>Classroom practice</th>
<th>Lab. practice</th>
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Assessment System

**General criteria**
- Written essay exam
- Multiple-choice test
- Oral exam
- Practical tasks (exercises, case studies or problems)
- Individual assignments
- Group assignments
- Presentation of assignments, readings...

**Compulsory materials**
Class notes, teaching support materials in the classroom and laboratories. LOPD (Data Protection Act), LSSI (Information Society Services Act) and Digital Signature Act.

**Bibliography**

**Basic Bibliography**
- Álvaro Gómez Vieites, "Enciclopedia de la Seguridad Informática", Ra-Ma 2011 (2ª edición actualizada)
- Jesús Costas Santos, "Seguridad y Alta Disponibilidad", Ra-Ma 2011.

**In-depth Bibliography**

**Journals**
- Auditoría + Seguridad informática
- IEEE Security & Privacy

**Websites**
- www.agpd.es
- www.criptored.upm.es
- www.intypedia.com
- www.rediris.es/cert
- www.inteco.es/Seguridad
**Centre**
University College of Engineering of Vitoria-Gasteiz

**Name of subject**
26036 - Graphics Systems Development

**Qualification**
Degree in Computer Management and Information Systems Engineering

**Type**
Elective

**Credits**
4.5 ECTS

**Year**
4

**Term(s)**
1st

**Department**
Computer Languages and Systems

**Language**
Spanish

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**Outcomes / Objectives**

Study of the development of applications with 2D and/or 3D graphical interfaces, from the hardware and the use of already developed graphics engines to commonly used programming interfaces.

**Syllabus**

1. Introduction to graphics systems. Definitions. Abstraction layers. Hardware, API, graphics engines, application. Basic concepts in graphics applications.
4. Graphics engines. Introduction to graphics engines. OGRE.
5. Architecture of a graphics application.

**Methodology**

**Teaching Method**

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Assessment System

**General criteria**
→ Individual assignments.

**Bibliography**

**Basic Bibliography**
- "OpenGL(R) Programming Guide: The Official Guide to Learning OpenGL(R)", Versión 2.1 OpenGL ARB, Dave Shreiner, Mason Woo, Jackie Neider, Tom Davis

**In-depth Bibliography**
- "GPU Gems 3" Hubert Nguyen
- "Advanced Graphics Programming Using OpenGL" Tom McReynolds, David Blythe

**Websites**
- http://www.developer.nvidia.com
- http://www.gamedev.net/
- http://www.gamasutra.com/
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<th>Centre</th>
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</table>

**Outcomes / Objectives**

Criteria for selecting and using electronic devices. Manufacturing and design techniques

**Syllabus**

1. Passive electronic components. Description and characteristics of linear fixed and variable resistors, non-linear resistors (thermoresistors, LDR, VDR...), fixed and variable condensers.
2. Optoelectronics.
4. Sensors. Description, characteristics and operation of common industrial sensors (temperature, pressure, level, flow, rate, position, displacement...)

**Methodology**

**Teaching Method**

**Face-to-Face Teaching Hours**

<table>
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<th>Lectures</th>
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Assessment System

→ Written essay exam
→ Practical tasks (exercises, case studies or problems)
→ Group assignments

Bibliography

Basic Bibliography

1. Teacher notes.

In-depth Bibliography

1. Características de fabricante de componentes pasivos.
2. Características de fabricante de sensores.
5. EMI control in the design of printed circuit boards and backplanes. Donald R. J. White. Don White Consultants, Inc. 1982

Magazines

1. Elektor
3. Revista española de electrónica. REDE. Barcelona

Websites

➢ Moodle course page
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**Outcomes / Objectives**

Be able to:

- Apply, in the context of an organisation, the management principles for quality, preservation of the environment and occupational safety.
- Know and correctly apply the vocabulary used in the quality, environment and occupational safety models.
- Work in a team to undertake cooperative tasks with other team members in the context of the subject.

**Syllabus**

1) CHAPTER I: Introduction. (4h)

1.1) The new business framework

1.2) Social responsibility of business organisations

1.3) Business management systems.

1.4) Accreditation, approval and certification

2) CHAPTER 2: Total Quality Management. (6h)

2.1) Concept and objectives of quality.

2.2) Different approaches to quality.

2.1.1) The Noriaki Kano or Bidimensional quality model

2.2.1) The three approaches to quality

2.3) Key factors applied to a product’s quality

1.3) Quality tools.

1.3.1) The Deming cycle.

1.3.2) Continuous Improvement.

1.3.3) The Cause-Effect Diagram.

1.3.4) Brainstorming

1.3.5) The Pareto Chart.

3) CHAPTER III: Environmental Management. (8h)

3.1) Sustainable development.

3.1.1) Social responsibility and the new business paradigm.

3.2) Identification and assessment of environmental aspects.

3.2.1) Applicable concepts and definitions.

3.2.2) General methodologies for environmental risk assessment.

3.3) Environmental indicators.

3.3.1) Definitions.

3.3.2) Indicators of environmental quality and pollution.

3.3.3) Indicators of natural resource consumption.

3.4) Life cycle analysis.

3.4.1) Definition and objectives.

3.4.2) Life cycle analysis methodology.
4) CHAPTER IV. Occupational Risk Prevention. (6h)
4.1) Introduction to occupational safety: basic concepts.
4.1.1) Overview of occupational safety
4.2) Prevention principles.
4.2.1) Injuries and losses.
4.2.2) Causes of accidents.
4.3) Identification and assessment occupational risks.
4.3.1) General prevention principles.
4.3.2) Risk detection.
4.3.3) Magnitude of risk.
4.3.4) Assessment criteria.

5) Chapter V. Management Systems. (20)
5.1) Definition and objectives.
5.2) ISO 9001:2008 international standard.
5.3) ISO 14001:2004 standard
5.4) UNE 81900:1996 EX standard. Occupational Risk Prevention
5.5) System integration.

Methodology

Teaching Method

Face-to-Face Teaching Hours

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Student Hours of Non Face-To-Face Activities

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Assessment System

General criteria

→ Multiple choice test
→ Practical tasks (exercises, case studies or problems)
→ Presentation of assignments, reading.

Clarification regarding assessment

ASSESSMENT CRITERIA

Multiple choice theory test. (Minimum marks required to pass the test: 3.5 points) 50%
Practical exam. Problem solving. (Minimum marks required to pass the exam: 3.5 points) 20%
Team assignment. 30%

TEAM WORK ACTIVITIES

Short discussion tasks. 5%
Search for bibliographic information (seminar) 20%
Written document (seminar) 20%
Oral presentation and discussion of results (seminar) 45%
Dynamic assessment of group assignment (student assessment) 5%
Individual assessment of the content of the tasks/products 5%
Bibliography

Basic Bibliography

- Alfonso Fernández Hatr. Sistemas Integrados de Gestión. Editado por Instituto de Desarrollo Económico del Principado de Asturias.

In-depth Bibliography


Websites

- Asociación Española de Normalización y Certificación. http://www.aenor.es
- IHOBE (Sociedad Pública de Gestión Ambiental). http://www.ihobe.es
Centre | University College of Engineering of Vitoria-Gasteiz  
---|---
Name of subject | 26046 – Kinematics and Dynamics of Machines  
Qualification | Degree in Mechanical Engineering  
Type | Compulsory  
Credits | 6 ECTS  
Year | 3  
Term(s) | 1st  
Department | Mechanical Engineering  
Language | Spanish and Basque

### Outcomes / Objectives

Understand the structure of mechanisms: elements and kinematic pairs of mechanisms, number of degrees of freedom of mechanism, concept of kinematic chain.

Learn the fundamental theorems of planar motion, complementing what has been learnt in the course of Applied Mechanics, as a theoretical basis for the dimensional analysis and synthesis of mechanisms.

Acquire capabilities to perform the kinematic analysis of planar mechanisms. Study of rotativity, singular position analysis and obtaining quality parameters of mechanisms.

Carry out the direct and inverse dynamic analysis of planar mechanisms (rigid body hypothesis) based on the principles studied in Applied Mechanics and through specific procedures for desmodromic mechanisms.

Carry out the deformable body dynamic analysis of single- and multiple-degree-of-freedom systems.

Acquire capabilities to analyse planar cams. Notions of the different types of cams and their applications.

Study the kinematics and dynamics of gears, in particular cylindrical gears. Notions of the capabilities of gear systems.

### Syllabus

- **Unit 1:** Basic concepts of mechanisms and machines.
- **Unit 2:** Geometry of the planar motion.
- **Unit 3:** Kinematic analysis of planar mechanisms.
- **Unit 4:** Kinematics of cams.
- **Unit 5:** Kinematics of gears.
- **Unit 6:** Inverse dynamics problem.
- **Unit 7:** Direct dynamics problem.
- **Unit 8:** Theory of vibrations.

### Methodology

#### Teaching Method

**Face-to-Face Teaching Hours**

<table>
<thead>
<tr>
<th>Lectures</th>
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**Student Hours of Non Face-To-Face Activities**

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Assessment System

General criteria
- Written essay exam
- Practical tasks (exercises, case studies or problems)
- Individual assignments
- Group assignments

Bibliography

Basic Bibliography
- Guía del estudiante para el curso 2012-2013
- Colección de enunciados de examen de Cinemática y Dinámica de Máquinas 2005 – 2012
- Lecturer’s software:
  - MECAN4 (Hernández, A.; Casado, H.; Castillo, J; Urruchi, J.V.; Abascal, L.; Pinto, Ch.)
  - BIEMAN (Hernández, A.; Alonso, A.; Macho, E.; Petuya, V.)
  - Pinto, Ch.; Agirrebeitia, J; Petuya, V.; Hernández, A. MANUAL DE USUARIO DE MECAN4 Y BIEMAN.

In-depth Bibliography

Websites
- http://www.biblioteka.ehu.es Página web de la biblioteca de la UPV/EHU.
- www.thinkmotion.eu Página web del proyecto thinkMOTION para la creación de una base datos europea online sobre contenidos de Teoría de Máquinas.
- www.dmg-lib.org Librería online sobre modelos mecánicos, bibliografía e investigadores alemanes.
- www.technologystudent.com Ejercicios sobre análisis y diseño de sistemas mecánicos.
- www.howstuffworks.com Vídeos y animaciones sobre el funcionamiento de diferentes sistemas mecánicos.
- www.tribology-abc.com Herramientas para el cálculo online de diferentes elementos de máquinas.
### Centre
University College of Engineering of Vitoria-Gasteiz

### Name of subject
26045 – Elasticity and Resistance of Materials

### Qualification
Degree in Mechanical Engineering

### Type
Compulsory

### Credits
6 ECTS

### Year
3

### Term(s)
1st

### Department
Mechanical Engineering

### Language
Spanish and Basque

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### Outcomes / Objectives
Analysis of stress and strain states in resistant mechanical elements. Fundamentals of mechanical design and of the materials engineering application.

### Syllabus

### Methodology

#### Teaching Method

Face-to-Face Teaching Hours

<table>
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<th>Lectures</th>
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### Bibliography

#### Basic Bibliography
- Joseba García Melero. Resistencia de Materiales. Editorial: UPV-EHU

#### In-depth Bibliography
- Manuel Vazquez. Resistencia de Materiales. Editorial: Universidad Politécnica de Madrid
- Timoshenko. Resistencia de Materiales (2 tomos). Editorial: Espasa-Calpe

#### Websites
- [http://moodle.ehu.es](http://moodle.ehu.es)
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**Outcomes / Objectives**

Applications of industrial informatics and industrial communications

**Syllabus**

1. Introduction. Specific problems of control applications. The role of the computer in the control of different types of industrial systems.
2. Comparison centralised vs. distributed control.
3. Operating systems. Expansion of the knowledge of operational systems acquired in basic subjects. The role of the kernel. Kernel planning policy. Real-time operating systems.
4. Advanced C programming. Expansion of the programming concepts acquired in basic subjects: files, memory management, system calls, etc.
5. Concurrent programming techniques. Introduction to concurrent programming. Main concepts.
8. Description of the TCP/IP family of protocols.
Methodology

Teaching Method

Face-to-Face Teaching Hours

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<th>Lectures</th>
<th>Seminars</th>
<th>Classroom practice</th>
<th>Lab. practice</th>
<th>Computer sessions</th>
<th>Clinical practice</th>
<th>Workshops</th>
<th>Industrial workshops</th>
<th>Field practice</th>
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Student Hours of Non Face-To-Face Activities

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<tr>
<th>Lectures</th>
<th>Seminars</th>
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<th>Lab. practice</th>
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</tbody>
</table>

Assessment System

→ Written essay exam
→ Practical tasks (exercises, case studies or problems)
→ Group assignments
→ Presentation of assignments, reading...

Bibliography

Basic Bibliography

- STALLINGS, W. 2005. Sistemas Operativos. 5ª Ed. (Prentice-Hall)
- KERNIGHAN, BRIAN; RITCHIE, DENNIS. 1991. El Lenguaje de Programación C. (Prentice Hall)
- MARQUEZ F. M. 2004, Unix Programación avanzada, 3ª Ed, (Ra-Ma)
- CASTRO, M. y otros. 2007 Comunicaciones Industriales: Principios Básicos. Ed. UNED

In-depth Bibliography

- BURNS, A. y WELLINGS, A. 2003 Sistemas de tiempo real y Lenguajes de Programación, Ed. Addison-Wesley Iberoamericana, 3ª Ed.
- ASHENDEN, PETER J. 2008. The designer’s guide to VHDL.
- CASTRO, M. y otros 2007 Comunicaciones Industriales: Sistemas Distribuidos y Aplicaciones. Ed. UNED,

Magazines

- Revista Iberoamericana de Automática e Informática Industrial (http://riai.isa.upv.es/)
- IEEE Transactions on Industrial Informatics Computers in Industry Control Engineering

Websites

- www.ehu.es
- http://es.wikipedia.org/wiki/Modelo_OSI (Communications)
Outcomes / Objectives

OUTCOMES

C1. Ability to write and develop projects aimed at the construction, conservation, installation, assembly or operation of industrial facilities, equipment and plants in the area of the environment applying knowledge of Industrial Engineering.

C2. Ability to direct activities in the area of environmental technology focused on the industry framework.

C3. Knowledge of environmental issues, in particular in relation to pollution and pollution prevention in the three large areas of air, water and waste, providing students with sufficient knowledge to perform environmental audits in industry.

C4. Develop problem solving and decision making skills, as well as critical thinking skills and the ability to transmit knowledge, in the field of industrial technology.

C5. Knowledge required to perform calculations, carry out studies and write reports in the environmental sector.

C7. Ability to analyse and assess the environmental impact of technical solutions.

C10. Ability to work in a multidisciplinary environment.

C11. Be able to use relevant bibliographic sources correctly to obtain, understand and interpret scientific-technical information regarding environmental technology.

C12. Adopt a responsible, orderly attitude at work, and be willing to learn.

BRIEF DESCRIPTION OF THE CONTENT

1. Introduction to Environmental Technology.


OBJECTIVES

To achieve a minimum level of training in environmental issues, in particular in relation to pollution and pollution prevention in the three large areas of air, water and waste, providing students with sufficient knowledge to perform environmental audits in industry.
Syllabus

1. INTRODUCTION
   1.1. Sustainability
   1.2. Ecological concepts and natural resources
   1.3. Definitions of human impact and pollution.
   1.4. Introduction to environmental audit and industry

2. ATMOSPHERIC POLLUTANTS I: BASIC CONCEPTS, TYPES AND SOURCES
   2.1. Classification of atmospheric pollutants
   2.2. Sources of atmospheric pollution
   2.3. Atmospheric pollutants

3. ATMOSPHERIC POLLUTANTS II: EFFECTS AND MEASUREMENT
   3.1. Effects of atmospheric pollution
   3.2. Measurement of atmospheric pollution

4. DISPERSION OF POLLUTANTS IN THE ATMOSPHERE
   4.1. Dynamics of the atmosphere
   4.2. Factors affecting the dispersion of pollutants

5. GASEOUS EFFLUENT TREATMENT PROCESSES I: REMOVAL OF PARTICLES BY MECHANICAL METHODS
   5.1. Separation by gravity: sedimentation chambers
   5.2. Separation by centrifugal force: cyclones
   5.3. Separation by filtration

6. GASEOUS EFFLUENT TREATMENT PROCESSES II: REMOVAL OF PARTICLES BY WASHING MACHINES AND ELECTROSTATIC PRECIPITATORS
   6.1. Wet separators
   6.2. Electrostatic precipitators
   6.3. Comparison of PARTICLE REMOVAL equipment

7. GASEOUS EFFLUENT TREATMENT PROCESSES III: REMOVAL OF GASEOUS POLLUTANTS BY TRANSFER
   7.1. Absorption
   7.2. Adsorption
   7.3. Condensation

8. GASEOUS EFFLUENT TREATMENT PROCESSES IV: REMOVAL OF GASEOUS POLLUTANTS BY TRANSFORMATION
   8.1. Chemical transformation
   8.2. Biological transformation. Biofilters
   8.3. Control technique selection criteria

9. POLLUTION CONTROL SYSTEMS FOR SOME SPECIFIC POLLUTANTS
   9.1. Sulphur oxides
   9.2. Nitrogen oxides
   9.3. Volatile organic compounds

10. WATER POLLUTION
    10.1. Quality criteria and measurement of water pollution
    10.2. Water pollutants and their effects
    10.3. Discharge regulations

11. LIQUID EFFLUENT TREATMENT PROCESSES I: PHYSICAL TREATMENTS
    11.1. Grilles
    11.2. Screens
    11.3. Sedimentation
    11.4. Filtration
    11.5. Flotation

12. LIQUID EFFLUENT TREATMENT PROCESSES II: CHEMICAL AND PHYSICAL-CHEMICAL TREATMENTS
    12.1. Neutralisation
    12.2. Coagulation/flocculation
    12.3. Chemical precipitation
    12.4. Adsorption
    12.5. Ionic exchange
    12.6. Membrane processes
    12.7. Stripping
    12.8. Oxidation processes

13. LIQUID EFFLUENT TREATMENT PROCESSES III: AEROBIC BIOLOGICAL TREATMENTS
    13.1. Aerobic metabolism
    13.2. Aerobic treatment systems with suspended biomass
    13.3. Aerobic treatment systems with fixed biomass
14. LIQUID EFFLUENT TREATMENT PROCESSES IV: ANAEROBIC BIOLOGICAL TREATMENTS AND REMOVAL OF NUTRIENTS
  14.1. Anaerobic metabolism and process parameters
  14.2. Anaerobic treatment systems with suspended biomass
  14.3. Anaerobic treatment systems with fixed biomass
  14.4. Comparison of biological treatment systems
  14.5. Biological nutrient removal

15. SLUDGE TREATMENT AND MANAGEMENT PROCESSES
  15.1. Characterisation of water treatment plant sludge
  15.2. Treatment processes
  15.3. Sludge evacuation

16. GENERAL DIAGRAM OF AN URBAN WASTEWATER TREATMENT PLANT
  16.1. Pre-treatment
  16.2. Primary treatment
  16.3. Secondary treatment
  16.4. Sludge line

17. URBAN SOLID WASTE I: CHARACTERISTICS, MANAGEMENT AND RECYCLING
  17.1. Definition, origin and production of urban solid waste
  17.2. Properties of urban solid waste
  17.3. Principles of waste management
  17.4. Storage, collection and transport of urban solid waste
  17.5. Recovery and recycling of urban solid waste

18. URBAN SOLID WASTE II: TREATMENTS AND DISPOSAL
  18.1. Biological treatments
  18.2. Heat treatments
  18.3. Controlled disposal

19. INDUSTRIAL AND HAZARDOUS WASTE
  19.1. Definition and generation of hazardous waste
  19.2. Labelling and transport of hazardous waste
  19.3. Recovery and recycling
  19.4. Treatments
  19.5. Stabilisation and solidification
  19.6. Secure landfill

20. OTHER WASTE
  20.1. Agricultural and forestry waste
  20.2. Livestock farming waste
  20.3. Construction and demolition waste
  20.4. Mines and quarries
  20.5. Fly ash from thermal power stations
  20.6. Disused tyres
  20.7. Disused vehicles
  20.8. Hospital waste
  20.9. Radioactive waste

Methodology

Teaching Method

<table>
<thead>
<tr>
<th>Face-to-Face Teaching Hours</th>
<th>Lectures</th>
<th>Seminars</th>
<th>Classroom practice</th>
<th>Lab. practice</th>
<th>Computer sessions</th>
<th>Clinical practice</th>
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</table>
Assessment System

General criteria
→ Written essay exam
→ Practical tasks (exercises, case studies or problems)
→ Group assignments
→ Presentation of assignments, reading...

Clarification regarding assessment
The subject can be passed by either sitting an essay exam in the official examination sessions, or partially as follows:
• Essay theory exam with a value of up to 6.0 points
• Academically supervised assignment with a value of up to 2.5 points
• Practical exercises or problems with a value of up to 0.5 points
• Visits to companies in relation to the subject matter of the course, or alternatively, oral presentation of the submitted report, with a value of up to 1.0 point

Bibliography

Basic Bibliography
- Baird, C. “Química ambiental” (2001) Barcelona
- Ramalho, R.S. “Tratamiento de aguas residuales” (1996) Barcelona

In-depth Bibliography

Magazines
- Ingeniería del Agua, Tecnología del Agua, Química Industrial, Biomass and Bioenergy, Environmental Engineering Science.
SUBJECT
26023 - Operations Research
ECTS Credits: 6

DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT

"Operational Research" is an area of study that is originated during the second world war, basically, it consists of applying the scientific method (making use of mathematic models, statistics and algorithms) in order to model and solve complex problems.

Most of the situations try to find an optimal use of the resources, which are subjected to a series of limiting conditions. The applications are wide and include the manufacturing improvement, business management and programming.

In its current state "Operational Research" covers a wide range of topics such as linear and nonlinear programming, simulation, graph theory and so on. The aim of this academic subject is having a first approach to the problems, tools and strategies considered here, as well as acquire basic/medium competences for employing these techniques in productive contexts.

The subject is part of the module devoted to "basic training", in particular, inside the unit of "mathematics", and gives answer to the competence CM01 ("being able to solve mathematic problems in Engineering. Capability to use efficiently Algebra, Calculus, Numeric Methods, Statistics and Optimization"). It complements the rest of subjects on mathematics that are seen during the studies.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

During the course, some deterministic methods concerning "Operational Research" aimed at solving lineal models will be revised.

As for the competences that students will acquire, the following ones can be stressed:

C1.- Application of the scientific method in problems related with the control of organizations or systems so as to improve the solutions.

C2.- Understanding of real problems and ability to model them mathematically under different circumstances.

C3.- Employ specific mathematic tools.

C4.- Analyzing how changes in inputs might affect to the outputs of a model (sensibility).

THEORETICAL/PRACTICAL CONTENT

Chapter 1: Introduction.
Definition of the subject, stages of implantation and critical assessment of the method.

Chapter 2: Linear programming, basics.
Definition of a lineal program and graphic solution.

Chapter 3: Simplex method.
Description, uses, variations and computational issues.

Chapter 4: Duality.
Dual formulation and properties.

Chapter 5: Analysis of sensibility.
Study of the changes in the solutions due to changes in the initial conditions.

Chapter 6: Integer linear programming.
Problem solving when the variables have to take only integer values. Specific algorithms.

Chapter 7: Model of transportation.
Application to the transportation problem.

METHODS

During part of the sessions, the lecturer will explain the concepts related with each chapter and propose points of discussion with students, therefore, participative sessions will be greatly encouraged. Complementarily, some sessions will be dedicated to practical exercises. The students will also work in groups developing a personal case study that will be part of the evaluation.

All teaching material will be available in the virtual classroom and students will have at their disposal a wide range of virtual tools for studying and communicating with their colleagues and with the lecturer.
# Types of Teaching

<table>
<thead>
<tr>
<th>Type of Teaching</th>
<th>M</th>
<th>S</th>
<th>GA</th>
<th>GL</th>
<th>GO</th>
<th>GCL</th>
<th>TA</th>
<th>TI</th>
<th>GCA</th>
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<tbody>
<tr>
<td>Classroom hours</td>
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<tr>
<td>Hours of study outside the classroom</td>
<td>67.5</td>
<td>22.5</td>
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Legend:
- M: Lecture
- S: Seminar
- GA: Pract.Class.Work
- GL: Pract.Lab work
- GO: Pract.computer wo
- GCL: Clinical Practice
- TA: Workshop
- TI: Ind. workshop
- GCA: Field workshop

# Assessment Systems

- Final assessment system

# Tools Used & Grading Percentages

- Extended written exam 60%
- Team work (problem solving, project design) 20%
- Actividades en el aula virtual 20%

# Ordinary Exam Call: Guidelines & Declining to Sit

Final exam: 60% (a minimum result of 4.5/10 is asked).
Continuous evaluation by means of exercises gathered along the semester (20%).
Work in group (20%).

Students who do not want to follow the aforementioned evaluation system will have the possibility to be evaluated only with a final exam.

Students will abide with all pertinent rules about the evaluation, in particular they will keep in mind the following norms:

- Students's regulation: https://www.ehu.eus/documents/3026289/3106907/Reglamento_Alumnado_UPV_EHU.pdf
- Regulation for students' evaluation: https://www.ehu.eus/es/web/estudiosdegrado-gradukoikasketak/ebaluaziorako-arautegia
- Code of ethics: https://www.ehu.eus/documents/2100129/0/6.-+b%29+Protocolo+plagio+cas+-..pdf/11f13960-d46a-cf5a-ac13-ebfb5ad10acd

During the final exam study notes can be used provided students meet the following criteria:

a) the material for consultation is for each specific student and cannot be shared.
b) only documents in print will be allowed, no electronic devices (such as laptop, tablets or mobile phones).
c) notes will never get mixed with the exam. During the exercise, notes will be placed at the side, students will be allowed to check them at any moment but will have to let them back to the very place after consulting.
d) students cannot add to the exam any piece of material previously elaborated.

Students will carry their calculators for the exam, as well as some basic materials for drawing (e.g. a ruler) in order to improve the drawing up of charts.

# Extraordinary Exam Call: Guidelines & Declining to Sit

By means of a written exam (100% of the mark). Previous work done along the semester will not be considered in the extraordinary call.

# Compulsory Materials

Materials in the virtual classroom.

# Bibliography

Basic bibliography

- "Operations research : an introduction"
  Taha, Hamdy A.
  Ed. Prentice-Hall

- "Linear programming : foundations and extensions"
  Robert J Vanderbei
  Ed. Springer

In-depth bibliography
"Elementary linear programming with applications"
Bernard Kolman, Robert E Beck, Robert Edward Beck
San Diego Academic Press

Journals
https://link-springer-com.ehu.idm.oclc.org/journal/41274
https://www-sciencedirect-com.ehu.idm.oclc.org/journal/european-journal-of-operational-research

Useful websites
https://www.ehu.eus/es/web/dma

REMARKS
Description and Contextualization of the Subject

The subject is an introduction to the elasticity and resistance of materials and their application in the field of automotive design.

The elasticity and resistance of materials is the science that studies the behavior of the deformable solid. It can be contextualized within the subjects of the Mechanics. When it comes to studying solids, two types are distinguished: rigid solid and deformable solid. In this subject, it will be considered that the solids are deformable.

The theory of elasticity studies the elastic bodies, mathematically formulating the relation that exists between the external actions and the answer of the body. The resistance of materials, studies the most common elements of the structures. These elements have a simple geometry, and allow the use of simplifying hypotheses that accelerate the calculation. The results are not as accurate as the elasticity theory, but the error can be considered negligible.

Competences / Learning outcomes of the subject

Knowledge and use of the principles of resistance of materials for the calculation and design of automotive structures.

Theoretical-practical contents

1.- Introduction to the resistance of materials.
2.- Traction and compression.
3.- State of tension and deformation in traction and compression.
4.- Cutting.
5.- Bending.
6.- Simple bending.
7.- Möhr theorems
8.- Bending oblique or deflected.
9.- Composite bending.
10.- Hyper-static flexion.
11.- Continuous beams.
12.- Torsion.
13.- Torsion and bending.
14.- Expression of the internal potential energy for different voltage states.
Methodology

In the theoretical classes, the theory will be explained and related examples will be solved.

In the classroom practices, theoretical concepts can be explained and exercises can be developed.

In class, the teacher will propose some work, which can be problems, practices or exercises to work the theory. During the semester, a partial examination will be carried out, which if passed will release matter in the face of the final examination. This exam, together with the possible problems collected in class, will represent 20% of the final mark.

A work will be proposed for students whose weight in the final grade will be 50%.

The final exam will have a weight of 30% in the final mark. In this exam, a minimum of 5 must be obtained to pass the subject.

Evaluation systems

Tools and percentages of qualification:
- EXERCISES AND EXAMINATION DURING THE 20% COURSE
- WORK (PBL) 50%
- FINAL EXAM 30%

Ordinary Call: Guidance and Waiver

The written tests to be developed are detailed below:
There will be a partial exam in the middle of the semester. The approved one releases the matter. The final exams will be attended with the pending subject.

The final mark of the exams will be the average of the two parts.

Who does not attend the final exam, will obtain a non-submitted qualification.

The work has a value of 50% of the final grade, will be taken into account for the evaluation of the work:
- The document: Quality of the same, skills developed at work (minutes, tutorials, contact hours).
- The presentation: Peer evaluation teacher evaluation, attendance and participation.

Extraordinary Call: Guidance and Waive

As in the ordinary

Materials of compulsory use

Theory and problems explained in class.
Bibliography

BASIC BIBLIOGRAPHY

Joseba García Melero. Resistencia de Materiales. Editorial: UPV-EHU
Luis Ortiz Berrocal. Resistencia de Materiales. Editorial Mc Graw Hill

The subject "Manufacturing Processes in Automotive Technology" tries to introduce the student to the knowledge of the most relevant metal-mechanical manufacturing processes in the automotive sector and to familiarize him with the most significant elements and characteristics of each of them.

The main objectives are:

1.- To provide an overview and basic information related to the Metal-Mechanical Manufacturing Industry.

2.- To introduce the characteristics and capacities of the main processes of manufacture M-M (welding, molding, plastic forming and starting of material).

3.- To set the foundations and criteria to get to know how to choose the suitable manufacturing process for a specific type of piece.

4.- To know the basic procedures for the measurement and verification of parts.

**Competences / Learning outcomes of the subject**

Starting from the product design and the knowledge of the materials, the subject Processes of Manufacturing in Automotive Technology establishes the foundations of the knowledge and the application of the processes of conformation metal - mechanics in a logical sequence according to his location in the productive context. Hence the multidisciplinary nature of the subject, and the large number of interrelations with other fields or areas of knowledge.

This discipline is responsible for the identification and characterization of the various factors involved in the processes of mechanical transformation that a material experiences (mainly metals and their alloys), from being processed raw to being transformed into a finished product such as the parameterization of these factors and the establishment of limits for their control.

It is about developing the basic knowledge and skills for the selection, design and control of the processes of metal-mechanical manufacturing, from the production of unit parts to the production of large series, paying special attention to the criteria of flexibility and costs of the production and relationships with other fields of engineering knowledge.
Theoretical-practical contents

METROTECNIA

UNION OF METAL ELEMENTS. WELDING

MOLDING CONFORMATION

METAL PLASTIC CONFORMING

MACHINING

Methodology
The MA classes will serve to expose the theoretical foundations of the manufacturing processes and of those matters that are intimately linked to their development and control, trying to describe the multiple relationships existing with other disciplines and with the application of the knowledge that will be acquired in other Engineering specialties. Likewise, the conceptual bases for the realization of the practices of workshop and laboratory and for the resolution of practical exercises of medium complexity are established.

In the practices of workshop and laboratory will put into practice some of the knowledge acquired in the master classes, by means of the use of the software, instrumental and machinery available in each case.

The workshop and laboratory practices will be carried out in groups consisting of a maximum of 25 students, which will be organized in turn into teams of two, maximum three students (depending on the practice), who will develop the practice integrating skills and knowledge. In those cases where due to space, security or capacity of the available
equipment, the number of participants would have to be limited, the practice group will be subdivided into two subgroups of twelve or thirteen members each.

**Evaluation systems**

Tools and percentages of qualification:
- EXERCISES AND EXAMINATION DURING THE 20% COURSE
- WORK (PBL) 40%
- FINAL EXAM 40%

**Ordinary Call: Guidance and Waiver**

The evaluation of the ordinary call will be made according to the following criteria:

1) Evaluation of the workshop or laboratory practices: up to a maximum of 20% of the joint qualification.

2) Assessment of the mastery and / or knowledge of the contents of the master classes and the corresponding application exercises: up to a maximum of 40% of the joint qualification.

3) Assessment of learning based on PBL projects: up to a maximum of 20% of the joint qualification.

4) The previous evaluations will be complementary and their respective qualifications will add up to a maximum of 100% of the final joint qualification, having to approve both independently to pass the subject as a whole. The first practical class of the semester will be introductory and in it students will be informed about the details of the process of both assessments and about the minimums to be reached in each case.

5) The unjustified absence of two or more sessions of practices will mean the automatic loss of 20% of the maximum qualification attainable in the whole of the evaluation as a workshop or laboratory practice.

It will be possible to obtain 100% of the mark, by means of the theoretical - practical examination written in the case in which the student opts by the "System of Final Evaluation" for which he will have to communicate it in writing to the professor of the master classes of his group within nine weeks from the beginning of the course.

In the other cases the weighted sum of the qualifications obtained in the evaluation of the master contents and exercises of application and the evaluation of the practices of workshop and laboratory will be applied, having to fulfill, in any case, the condition expressed in the points 3 and 4.

**Extraordinary Call: Guidance and Waiver**

In the extraordinary call, there will be a single test or final exam (written test) in which all the contents developed during the course will be considered.
If the student does not attend the examination of the ORDINARY call or the EXTRAORDINARY call, he / she will obtain a “Not presented” regardless of his participation in the workshop or laboratory practices.

Materials of compulsory use

Documentation and information provided by the subject's faculty.

Bibliography

BASIC BIBLIOGRAPHY

The bibliography is specific to each topic, although there are two books that collect most of the topics consistently.

Mechanical Technology and Metrotechnics Coca Rebollero, Pedro and Rosique Jiménez, Juan
Editorial: Pyramid

Manufacture. Engineering and Technology Kalpakjian, Serope and Schmid, Steven R.
Publisher: Pearson Education

The claim of these texts is formative and not informative. Therefore, in the writing of each chapter, the process is analyzed, rather than described, for the reader, at each stage, to evaluate the influence of the parameters involved in it. Thus when the lamination is studied, for example, it goes deeper into the analysis of the thermal-mechanical process of the passage of the material between cylinders and deals very succinctly with the farragous (to be read) description of the lamination trains, since well looked at, cylinder more or less, does not change the essence of the process. The same can be said of casting technology, welding methods, etc.
The subject of "Programming Methodology", which is taught after "Basic Programming", complements the latter by adding theoretical elements for algorithm design, emphasising formal specification methods.

Ability to analyse, design, construct and maintain applications in a robust and secure manner.

Ability to specify, document, validate and verify programs.

Ability to reason and justify properties related to programs.

Ability to evaluate and compare specifications and documentation of programs from the quality point of view.

Knowledge of formal specification and program design methods.

Knowledge of basic notions of axiomatic semantics of programming languages.

Knowledge and application of basic algorithmic procedures of IT technologies for the design of solutions to problems, analysing the suitability and complexity of the algorithms proposed.

During the classes, group work will be done systematically, discussing and presenting the results of exercises with the aim of encouraging direct participation in the course and also students' motivation.

Assessment of the subject in the ordinary call is done through continuous assessment or final assessment. By defect, all students will do continuous assessment, unless they withdraw from it.

A student may decide to withdraw from continuous assessment to take a final exam. This withdrawal must be presented in writing to the professor responsible for the course in the period set out in Article 8 of the Rules for Student Assessment. Withdrawals from continuous assessment will not be accepted after the dates stated, except in very exceptional cases.

The exam will test the entire content of the subject. To pass the subject, it is necessary to obtain a minimum mark of 5 out of 10 in the exam.

By defect, continuous assessment is the standard method, unless the student has expressly withdrawn from it.

Continuous assessment is done through written tests, in which the students should demonstrate that they have acquired the knowledge and competences taught in the subject.

1) First-order logic (20% of the grade)
2) Sequences and conditionals
3) Iterations
4) Recursiveness and function calls

Requirements to pass the exam

Ordinary final exam:

The only students who can present themselves are those who have passed at least three written tests, although they may not have reached the level required to pass an ordinary call in continuous assessment.

The exam will be divided into four parts, corresponding to each test:

The student may take the parts he/she wishes
The grades from previous tests will be maintained if they are not taken in this exam.
The grade of previously taken tests will not be maintained (corresponding to the parts taken in this exam) for the purposes of the calculation of the final grade.

**Requirements to pass the ordinary call:**
Have taken all the written tests (in the ordinary final exam or before)
Minimum mark of 5 in the sum of all the written tests
Minimum mark of 25% in each written test

**Withdrawal from the exam:**
A student following continuous assessment may withdraw from the call as per that stated in Article 12 of the Rules for Student Assessment.

**Cases of copying:**
Article 11 of the Rules for Student Assessment will be applied.
To withdraw from the exam, it is sufficient not to appear on the day. In this case, the grade will be "Not Presented".
The grade obtained in the written tests under the ordinary call is not maintained.
Material of the subject (Notes and Laboratories)
eGela virtual platform of the UPV/EHU for the subject "Programming Methodology"
### Outcomes / Objectives

**Specific:**
- C1: Be able to distinguish the various stages of a software engineering process.
- C2: Be able to understand an object-oriented software system in the UML language.
- C3: Be able to design a software system applying multi-level architecture based on analysis.
- C4: Be able to implement a system based on the application design.

**Cross-curricular:**
- C9b: Be able to communicate and convey knowledge, abilities and skills of the computer engineering profession.

### Syllabus

**UT1: Introduction to software engineering**
- Motivation and software life cycle
- Objectives, properties and associated programming technologies.

**UT2: Specification of UML artefacts**
- Study of the different artefacts in UML

**UT3: Multi-level software architectures: Presentation, Business Logic and Data**
- Design of the different layers of a software system

**UT4: Object-oriented design and programming**
- Design of functionality

**UT5: Implementation of a specific product**
- Implementation of a software system using a set of current languages and tools
Methodology

Teaching Method

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<th>Face-to-Face Teaching Hours</th>
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As this is a predominantly practical subject, LECTURES (M) will be used for presenting the theoretical concepts which will be subsequently used in the practical lessons, and for solving any queries students may have. Similarly, the concepts acquired in class will be reinforced through exercises, completed either individually or in small groups. Students may self-assess and correct the exercises completed during the subject with the use of the Web-CAT tool, which will provide them with an automatic assessment of the syntax and functionality of their implementations.

In the COMPUTER PRACTICE (GO), students will carry out a project that should realistically encompass the contents of the subject and will be done over the whole term. The project will be undertaken in groups and students must follow the jigsaw strategy, in such a way that they must first perform an individual task to analyse the proposed project, brainstorm alternatives, divide the tasks among the group members, form expert groups to discuss the solutions adopted, and integrate the results into the final product, which will be subsequently defended in an oral presentation.

MORE INFORMATION: Moodle site of UPV/EHU for the subject Software Engineering.

Assessment System

General criteria
Written essay exam
Practical activities (exercises, case studies or problems)
Group assignments
Presentation of assignments, reading...

Clarification regarding assessment
Written exam(s) (60% of the final grade):
----
In the extraordinary examination session, students will sit a single exam encompassing both parts. To pass the subject, students require a minimum grade of 3.5 in the final grade of the exam.

Deliverables (40% of the final grade)

Computer project (90%): The laboratory project will be carried out in a group following the jigsaw methodology. Any member of the group may be asked to explain any part of the project during the oral presentation of the project, and the grade obtained by that member will be applied to all the members of the group.
Other deliverables (10%): Reports on other design and programming tasks, subject forum, blog...
GRADE ON GRADE REPORT: Students may only opt for a single exam accounting for 100% of final grade in exceptional cases which have been justified at the beginning of the academic year and described in article 43 of the current student assessment regulations. Any exceptional cases must be notified to the lecturer prior to commencement of the subject or when the exceptional circumstance occurs, if it occurs throughout the course of the subject. No exceptional cases will be accepted past this time. Justification must be duly documented. In all other cases, written exams will always account for 60% of the final grade. The grade obtained for the practice will be saved throughout the year, but not for future academic years. If a student sits at least 2 exams in the ORDINARY examination session, the grade obtained will be the sum of both exams, otherwise it will be regarded as "Not Sat". If a student does not sit the exam in the EXTRAORDINARY examination session (June), it will be regarded as "Not Sat". Provided that the student sits the exam, the grade obtained from the practice in that year will be added to the grade obtained in the written exam.

Bibliography

Basic Bibliography

In-depth Bibliography

Websites
- http://jff.acm.org/
- http://download.oracle.com/javase/tutorial/
- http://jga.sourceforge.net/
Outcomes / Objectives

1.-Understand the fundamentals of decision support.
2.-Apply the different decision making strategies under uncertainty.
3.-Discuss the nature of the different ways to approach the decision making problem in a variety of contexts and applications.

Syllabus

0.-Introduction to the decision making problem and general presentation of the techniques to use
1.-Bayesian networks
   1.1.-Naive Bayesian method
   1.2.-Notion of graph and its application to Bayesian networks
   1.3.-Inference with Bayesian networks
   1.4.-Need for machine learning for the construction of a Bayesian network
2.-Influence diagrams and decision trees
   2.1.-Definition and construction of influence diagrams and decision trees
   2.1.-Cost-utility analysis
   2.2.-Sensitivity analysis
3.-Machine learning
   3.1.-Supervised neural networks
   3.2.-Unsupervised neural networks
   3.3.-Optimisation algorithms and genetic algorithms
   3.4.-Classifiers and meta-classifiers: ID3, AdaBoost.

Methodology

Teaching Method

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<thead>
<tr>
<th>Face-to-Face Teaching Hours</th>
<th>Lectures</th>
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Assessment System

General criteria
→ Written essay exam
→ Practical tasks (exercises, case studies or problems)

Clarification regarding assessment
1.- Written exam on the first 2 units. 3.5 points over total points. Halfway through the course.
2.- Written exam on the last unit. 3.5 points over total points. At the end of the course.
3.- Laboratory practice. 3 points over total points. Throughout the course.

If in the first exam the student achieves half the points allocated to that exam, the score achieved will be kept and added to the other scores. Otherwise, the student must sit the second exam, which in that case will be over 7 points and the student will be assessed on all the units. Therefore, students who pass the first exam do not need to take an exam on those units again.

The final score will be the sum of the 3 assessment scores. The passing grade for the subject is a final score of 5, and the sum of the 2 exam scores must be at least 3.5.

Bibliography

Basic Bibliography
1.- S. Ríos, C. Bielza, A. Mateos. Fundamentos de los sistemas de ayuda a la decisión. Ra-Ma, 2002.
3.- Francisco Javier, Díez, Introducción a los modelos gráficos probabilistas, Departamento de Inteligencia Artificial, Uned, Octubre de 2007
4.- REDES NEURONALES Y SISTEMAS BORROSOS.
   MARTIN DEL BRIO, BONIFACIO / SANZ MOLINA, ALFREDO

In-depth Bibliography
- Sistemas Expertos y Modelos de Redes Probabilisticas, Enrique Castillo y otros, Universidad de Cantabria.

Journals
- Decision Support Systems
- IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE
- International Journal of Neural Systems
- IEEE Computational Intelligence Magazine
- JOURNAL OF MACHINE LEARNING RESEARCH

Websites
- http://dssresources.com
- http://www.hindawi.com/journals/cin/aims/
- http://siba-ese.unisalento.it/index.php/ejasa_dss
- http://www.hindawi.com/journals/aans/aims/
Outcomes / Objectives

This subject deals with the main aspects that support web information systems, tracing the history of the Web, its technological support, the architecture of its applications and basic client- and server-side technologies, as well as information exchange technology (XML). The advanced aspects are concerned with the knowledge of the fundamentals of Web services, the architecture of emerging information systems, and the increasingly more important aspect of security, including an introduction to the protocols that incorporate security elements.

Syllabus


Methodology

Teaching Method

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Assessment System

General criteria

Clarification regarding assessment

Compulsory materials

Class notes, teaching support materials in the classroom and laboratories.

Bibliography

Basic Bibliography


In-depth Bibliography


Journals

Websites

- http://www.w3.org/http://www.librosweb.es/
<table>
<thead>
<tr>
<th>Centre</th>
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<td>Name of subject</td>
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<td>Language</td>
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**Outcomes / Objectives**

Production techniques, equipment and processes. Flexible manufacturing systems.

**Syllabus**

Description of production processes. Machine tools, plastic forming, casting, welding and others

Design of production processes

Facility layout

Independent demand inventory management

Sales and operations planning

MPS (Master Production Scheduling). MRP (Material Requirements Planning)

Capacity planning

Production scheduling – Operations Scheduling – JIT (Just in Time)

TOC – Theory of constraints. Project management: PERT, CPM
**Methodology**

**Teaching Method**

**Face-to-Face Teaching Hours**

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<th>Lectures</th>
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**Assessment System**

**General criteria**

Production techniques, equipment and processes. Flexible manufacturing systems.

**Clarification regarding assessment**


**Bibliography**

**Basic Bibliography**

Notes on production scheduling and control.

**In-depth Bibliography**

**Websites**
Centre: University College of Engineering of Vitoria-Gasteiz

Name of subject: 25995 – Electronic Instrumentation

Qualification: Degree in Industrial Electronic Engineering and Automatics

Type: Compulsory

Credits: 6 ECTS

Year: 3

Term(s): 2nd

Department: Electronic Technology

Language: Spanish

Outcomes / Objectives

Measuring equipment and systems

Syllabus


Methodology

Teaching Method

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Assessment System

General criteria

Clarification regarding assessment
Bibliography

Basic Bibliography

- Teacher notes
- LabVIEW. Entorno gráfico de programación.
- Technical documentation of laboratory instruments and data acquisition card

In-depth Bibliography

- How to control electrical noise / by Michel Mardiguian.
- Sensores y acondicionadores de señal / Ramón Pallás Areny.
- EMI control in the design of printed circuit boards and backplanes / by Donald R. J. White.
- Interferencias electromagnéticas en sistemas electrónicos / Josep Balcells... [et al.]
- Noise reduction techniques in electronic systems / Henry W. Ott.
- EMI control methodology and procedures by Donald R. J. and Michel Mardiguian
- Grounding and shielding techniques in instrumentation / Ralph Morrison.

Magazines

- Instrumentation Newsletter. National Instruments
- IEEE instrumentation & measurement magazine

Websites

- Subject's FTP site. ftp://ftp.ehu.es/cidira/dptos/depjt/Instrumentacion/
- Course Moodle page (users must be registered)
- National Instruments website (Labview)
- http://www.ni.com/
- Agilent Technologies Spain website (Instruments)
- ICP DAS website (Manufacturer of data acquisition card)
- http://www.icpdas.com/
Centre | University College of Engineering of Vitoria-Gasteiz  
---|---  
Name of subject | 25996 – Digital Electronic Systems  
Qualification | Degree in Industrial Electronic Engineering and Automatics  
Type | Compulsory  
Credits | 6 ECTS  
Year | 3  
Term(s) | 2nd  
Department | Electronic Technology  
Language | Spanish  

Outcomes / Objectives

Study, design and applications of microprocessors

Syllabus

- 8051 architecture:
  Data and code memories
  Interrupts and integrated peripherals
  Assembly programming.
- Synchronous communications: I2C and SPI applied to LED drivers or ADCs
- I/O peripheral and external monitors.
Keyboard reading, LCDs, watchdogs and voltage supervisors.
- PLD. CPLD and FPGA architectures.
- Hardware programming languages: VHDL.
Modelling, simulation and synthesis.
Combinational and sequential systems implementation.
Design and implementation of logic problems using VHDL.

Methodology

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</table>
Assessment System

General criteria

Clarification regarding assessment

Compulsory materials

Microcontroller development cards and programmable logic device

Bibliography

Basic Bibliography

- Microcontroladores MCS-51. Angel Mª Aledo Amorós class notes
- Prácticas Básicas con microcontroladores. José Miguel Gil-García notes

In-depth Bibliography

- C and the 8051 Vol.I y II. Thomas W.Schultz
- The designer’s guide to VHDL Ashenden, Peter Morgan Kaufmann
- The students guide to VHDL

Websites

- URLs of interest are provided in each 02 chapter
- www.embedded.com www.8052.com
### Centre
University College of Engineering of Vitoria-Gasteiz

### Name of subject
26006 – Industrial Informatics Extension

### Qualification
Degree in Computer Management and Information Systems Engineering

### Type
Elective

### Credits
6 ECTS

### Year
4

### Term(s)
2nd

### Department
Systems and Automation Engineering

### Language
Spanish

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#### Outcomes / Objectives
Applications of industrial informatics and industrial communications.

#### Syllabus
Introduction. Specific problems of industrial applications. Operating systems specific for industrial applications. Fundamental characteristics of the operating systems used in industrial applications. Embedded system design and programming. Construction problems of embedded systems such as those found in industrial applications (robotics, etc.). Distributed applications. Basic concepts for the construction of distributed applications. Introduction to object-oriented programming. Man-machine interface. Importance of the man-machine interface in industrial control applications. Construction of graphical applications with visual programming environments.

#### Methodology

##### Teaching Method

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Assessment System

General criteria

Clarification regarding assessment

Bibliography

Basic Bibliography
- BARR AND MASSA Programming Embedded Systems: with C and GNU development Tools, O'Reilly
- BURNS, A. y WELLINGS, A. 2003
- Sistemas de tiempo real y Lenguajes de Programación, Ed. Addison-Wesley Iberoamericana, 3ª Ed.
- Sistemas Operativos. 5ª Ed. (Prentice-Hall)CASTRO, M. y otros 2007 Comunicaciones Industriales: Sistemas Distribuidos y Aplicaciones. Ed. UNED

In-depth Bibliography

Magazines
- Revista Iberoamericana de Automática e Informática Industrial (http://riai.isa.upv.es/)
- IEEE Transactions on Industrial Informatics Computers in Industry Control Engineering

Websites
- www.ehu.es
- http://www.mindview.net/Books/TIJ/
- http://www.mindview.net/Books/TICPP/ThinkingInCPP2e.html
- http://lejos-osk.sourceforge.net/
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**Outcomes / Objectives**

Hydraulic pump project, network operation and regulation. Project on different types of water turbines.

Hydroelectric power stations.

**Syllabus**

Hydraulic turbomachines: overview and fundamental principles. Hydraulic machines and the main parts of a turbomachine are studied and classified, including forms of representation and velocity triangles. Nomenclature for heights, flow rates, power, losses and efficiency is also included, for both pumps and turbines. The subject also studies the application of the fundamental theorem of turbomachinery or Euler's theorem to turbines and pumps, as well as the different applications of hydraulic turbomachinery. Similarities and dimensional analysis applied to turbomachinery. The similarities and analogies required between two turbomachines in order for a transfer of their respective behaviours to occur are analysed. The Buckingham theorem is used to determine the most important dimensionless parameters in turbomachinery, analysing the fundamental theorem of Combes-Bertrand-Rateau. The concept of specific speed is introduced and examples of homologous turbomachines presented. Water turbopumps. The elements, construction types, characteristic curves, regulations and operation of turbopumps are studied. Positive displacement machines. The different types of positive displacement machines are studied, including their elements, form of operation and characteristic curves. Pumping stations. The calculation and construction details of simple, compound and high pressure pump stations. Fans and ventilation facilities. The elements, construction types, characteristic curves, regulation and operation of fans are analysed, as well as their application to ventilation facilities. Hydroelectric power stations. The layout of hydroelectric power stations is described, and the types of waterfalls to consider are analysed, along with hydroelectric power plant types and main parts. A river flow rate calculation problem is also studied, as well as the different types of characteristic curves and regulation systems. Water turbines. The elements, construction types, characteristic curves, regulation and operation of water turbines are analysed. Wind farms. The general theory of wind turbines and Betz's law is explained, and the different types of available wind turbines described. Water supply and sanitary sewer networks. The collection, regulation, transport and distribution of water is studied, as well as the collection and distribution of wastewater.
Methodology

Teaching Method

Face-to-Face Teaching Hours

<table>
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<tr>
<th>Lectures</th>
<th>Seminars</th>
<th>Classroom practice</th>
<th>Lab. practice</th>
<th>Computer sessions</th>
<th>Clinical practice</th>
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Student Hours of Non Face-To-Face Activities

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<th>Classroom practice</th>
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</tbody>
</table>

Compulsory materials

Department’s notes. Set of department’s problems. Outline of laboratory practicals.

Bibliography

Basic Bibliography
- Turbomáquinas hidráulicas. Claudio Mataix. Editorial ICAI. 1975.-
- Nuevo manual de instalaciones de fontanería y saneamiento (adaptado al Código Técnico de la Edificación). Franco Martín Sánchez. AMV ediciones. 2008

In-depth Bibliography

Magazines
- Ingeniería del agua
- Tecnología del agua
- El instalador.
- Montajes e instalaciones.
- Fluidos.

Websites
- Hydraulic Institute. www.pumps.org
- Pump-Flo Co. www.pump-flo.com/manulist.asp
- Animated software company, www.animatedsoftware.com
- www.pump-zone.com
<table>
<thead>
<tr>
<th>Centre</th>
<th>University College of Engineering of Vitoria-Gasteiz</th>
</tr>
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<tbody>
<tr>
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<td>26091 – Industrial Chemistry</td>
</tr>
<tr>
<td>Qualification</td>
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<td>Department</td>
<td>Chemical and Environmental Engineering</td>
</tr>
<tr>
<td>Language</td>
<td>Spanish</td>
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</tbody>
</table>

**Outcomes / Objectives**

Utilisation and transformation of raw materials and energy resources

1. Be able to design and manage mass balance processes. TEQI1
2. Acquire knowledge to manage energy balance processes. TEQI1
3. Understand the transformation techniques of the main raw materials. TEQI2
4. Be able to design and manage procedures for the utilisation of energy resources TEQI3
5. Be able to design and manage manufacturing processes for various products. TEQI2
6. Be able to design and manage applied experimentation procedures and operate equipment and systems related to thermodynamic concepts in physical processes. TEQI5
7. Develop abilities and acquire skills to design compound synthesis processes applying safety standards. TEQI7.
8. Acquire the ability to apply the strategies of scientific methodology: propose hypotheses and solutions to solve chemical engineering problems. TEQI8
9. Use specific vocabulary and terminology to effectively communicate knowledge, procedures and results in the field of chemical engineering. TEQI9.
10. Work efficiently in multidisciplinary environments integrating capabilities and knowledge to make decisions in the field of chemical engineering. TEQI10
11. Have knowledge of, understand and apply legislation, specifications, and enforceable rules and regulations. TEQI11
12. Carry out measurements, calculations, studies and reports during and upon completion of each practical task carried out in the subject. TEQI12

**OBJECTIVES**

Apply the knowledge of the chemical properties of raw materials.

Operate equipment and systems applying basic techniques and operations and chemical processes

Have knowledge of the main production processes in the chemical sector.

Relate energy and production aspects to their environmental impact.

Minimise the harmful effects of large-scale production of materials.
Syllabus

Unit 1. The chemical industry. Raw materials. Raw materials in the chemical industry. Main chemicals.

Methodology

Teaching Method

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Seminars</th>
<th>Classroom practice</th>
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Student Hours of Non Face-To-Face Activities

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Assessment System

General criteria

→ Practical tasks (exercises, case studies or problems)
→ Individual assignments
→ Group assignments
→ Presentation of assignments, reading...
Clarification regarding assessment

The subject is divided into two parts. Each part has a theory exam comprising several essay questions and/or problems.
Type of exam: descriptive questions. About processes, reactions and applications of the substances studied.
There will be individual assignments on the field practice experience.
There will be a group assignment on a sector of industrial chemistry, which is presented orally, in group.
Assessment:
Midterm partial exam passing score: 4.0 ≤ exam.
Exam < 4.0. » this part is taken in the final exam.
Requirement for passing the subject by passing the midterm exams:
10.0 ≤ Σ midterm exams
The final grade is based on the average of the two midterm exams.
There will be a final exam of the entire subject and any unpassed or missed midterms in June and July.
Midterm exams passed in June do not need to be retaken in July.
If students have passed any midterm exams but failed the subject, they must retake the entire subject the following year.
Requirements to pass the subject in the final exam in June or July:
1. 4.0 ≤ exam
2. Final grade = ( Σ midterm exams / 2) x 0.75 + ( Σ assignments / n) x 0.15 + (assignment on a single topic) + oral presentation) x 0.10
3. 5 ≤ final grade
Field practice assignments are valid for the following year. After two years they must be undertaken again.

Bibliography

Basic Bibliography
➢ Basic Bibliography (SPANISH)

In-depth Bibliography
➢ Stocchi, E. Industrial Chemistry. Ellis Horwood, Nueva York, 1990
➢ Maria R. Gómez Antón y col. Química Inorgánica y orgánica de interés industrial

Magazines
Chemical Engineering
➢ http://www.rbi.es/publicaciones/ingenieria-quimica.htm
Water Technology
➢ http://www.rbi.es/publicaciones/tecnologia-agua.htm

Websites
Federación de Industrias Químicas de España
➢ http://www.feique.org/
Website on the major companies in the sector
➢ http://www.quimicainfo.com/
Outcomes / Objectives


Syllabus

Methodology

Teaching Method

Face-to-Face Teaching Hours

<table>
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</tbody>
</table>

Assessment System

General criteria

Clarification regarding assessment

Bibliography

Basic Bibliography

- Ogata, K., Sistemas de control en tiempo discreto, 3ª Ed. Prentice Hall. 1996.

In-depth Bibliography


Magazines

- Automática (Elsevier) International Journal of Control
- Control System Magazine (IEEE)

Websites

- O in its original version (in English): http://www.engin.umich.edu/group/ctm/
Description and context of the subject:

**Profile of the subject.** In the education system promoted by the EEES, the centre of the educational process moves from the professor (teacher) to the student (learner), i.e., the driver in the learning process becomes the student. Furthermore, this learning process must not only be focused on whether the student acquires certain knowledge of the field of study, he/she should also be stimulated to develop general skills and personal qualities that allow him/her to adapt to a constantly changing society and, at the same time, continue learning in a continuous way, teach, communicate and apply the knowledge acquired to new situations that arise throughout his/her life.

In this respect, degree courses should prepare the student for entry into the labour market. This means that the emphasis is on general training for a professional future with the tools and knowledge required so that the student can learn and adapt to the changing labour market.

The subject Introduction to Mechanics plays its role within this general training, providing basic knowledge of mechanics to adapt to new technological developments. Furthermore, the procedures and the rigour of the scientific method will be given as the framework for carrying out the engineer's work.

It also provides the knowledge to undertake other subjects in the syllabus.

**Location in the syllabus.** Introduction to Mechanics will provide a solid basis to work on a series of subjects that the student will take at a later stage, e.g. Fluid Mechanics, Aerodynamics or Calculation and Design of automotive structures. As can be seen, Introduction to Mechanics is a core subject for Engineering studies.

**Competences**

The ability of the student to undertake a series of specific tasks that will be useful in the exercise of his/her work. The competences provide by the subject to an Engineering student are general and not limited to specific professional skills.

Below we list the basic competences that the student needs to acquire after taking this subject, at three different levels.

**General competences**

1. Apply knowledge of physics, mathematics and chemistry to engineering-
2. Adapt to new techniques and tools of engineering.
3. Develop the ability to design and perform experiments, and to analyse the results.

**Cross-cutting competences**

1. Acquire the ability to learn in a quick and efficient manner.
2. Learn to work in groups and communicate the results obtained by the group in a coherent and summary form.
3. Acquire autonomy and independence when taking on the work assigned.

**Specific competences**

1. Interpret the major theories of physics to describe natural processes.
2. Identify situations that are different in terms of physics but that show analogies, to use already-known solutions for new problems.
3. Solve problems and analyse solutions to them in groups or on an individual basis, and clearly evaluate their orders of magnitude.
4. Obtain, describe, analyse and evaluate critically, in groups or individually, experimental data obtained in the laboratory.
5. Estimate the uncertainty of any medium and of the results of physical calculations and process experimental data to obtain quantitative relations of cause-effect within the scope of the subject.
Outcomes / Objectives

- Install and configure a DBMS
- Define user accounts and associated resources and privileges
- Make backup copies and recover the state of the DB after a system failure
- Establish and manage audit controls
- Understand the notion of transaction and its ACID properties. Basic concurrency control concepts
- Have knowledge of concurrency control mechanisms
- Define links between databases on different nodes and work with the multiple databases

Syllabus

The Database Administrator:
The general problems of a DBMS and basic administrator tasks are presented. A DBMS is installed and configured ready for start-up.

Security:
The difference between user account and user role. The two DB access control models are presented: privilege-based and level-based, with a focus on the former.

Audit:
The options for performing a DB audit are presented

Recovery:
The options for making backup copies are explained, and how to recover a consistent DB state after a system failure. The notion of Journal is explained, as well as its role in the recovery of a consistent DB state.

Transactions and Concurrency Control:
The concept of transaction is presented. Several concurrency control protocols are presented: reservations, timestamps and validation

Tuning:
Recommendations for DB optimisation are presented. The characteristics offered by DBMS for application performance analysis and tuning of DB settings are analysed.

Distributed data management:
The characteristics offered by DBMS for managing data distribution and replication are presented.
Methodology

Teaching Method

Face-to-Face Teaching Hours

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Student Hours of Non Face-To-Face Activities

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Assessment System

General criteria

→ Written essay exam
→ Practical tasks (exercises, case studies o problems)
→ Individual assignments
→ Group assignments

Clarification regarding assessment

Assessment of students in the REGULAR exam session will be by continuous assessment. The final subject grade is calculated based on the scores achieved in 3 midterm exams and exercises and laboratory practice carried out throughout the course.

Students will be deemed to have taken the REGULAR exam session if they have sat at least 2 of the above midterm exams. If a student has not sat at least the 2 midterm exams, the grade will be Not Sat. In any case, students must sit ALL midterm exams to pass the subject. An exam on the entire subject content is not allowed in the regular exam session, except in those cases where an exception is made to the assessment mode as mentioned below.

Students who do not pass in the regular exam session must sit a SUPPLEMENTARY exam where they will be assessed in an exam covering the entire subject content.

EXCEPTION to assessment mode:
- Students may only sit a single exam accounting for 100% of the final grade in exceptional cases where justification has been submitted at the beginning of the year as per article 43 of the current regulations concerning the assessment of students.
- Exceptional cases must be notified to the lecturer at the beginning of the year or as soon as the exceptional circumstance occurs if it takes place after commencement of the term.
- Supporting documentation must be provided to appropriately justify a request for exception.
- No exception requests will be accepted afterwards.
Bibliography

Basic Bibliography

- Oracle database 10g new features : Oracle 10g reference for advanced tuning & administration / Mike Ault, Daniel Liu, Madhu Tumma, 2008.

In-depth Bibliography

Journals

Websites

- Oracle Web: technet.oracle.com
SUBJECT
25973 - Statistical Methods of Engineering

DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT
"Statistical Methods for Engineering" explores concepts of both probability and statistics that allow us knowing better random events. These methods will permit the student to plan experimental studies, collect and analyze data, as well as assess critically the results.

This is common subject for Industrial Engineering (first year) and Informatics & Management Science (second year) and forms part of the module devoted to "basic training", in particular, inside the unit of "mathematics".

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT
During the course, some deterministic methods concerning "Probability and Statistics" aimed at planning and analyzing experiments and surveys will be revised.

As for the competences that students will acquire, the following ones can be stressed:
C1.- Application of the scientific method in problems related with random data.
C2.- Understanding of real problems and ability to model them mathematically under different circumstances.
C3.- Employ specific mathematic tools.
C4.- Interpretation of the real work by means of the numerical values of some features.

THEORETICAL/PRACTICAL CONTENT
Chapter 1. Data description and graphic methods.
Chapter 2. Linear regression.
Chapter 3. Probability.
Chapter 4. Discrete distributions.
Chapter 5. Continuous distributions.
Chapter 7. Testing hyphotheses.

METHODS
During part of the sessions, the lecturer will explain the concepts related with each chapter and propose points of discussion with students, therefore, participative sessions will be greatly encouraged. Complementarily, some sessions will be dedicated to practical exercises. The students will also work in groups developing a personal case study that will be part of the evaluation.

All teaching material will be available in the virtual classroom and students will have at their disposal a wide range of virtual tools for studying and communicating with their colleagues and with the lecturer.

TYPES OF TEACHING

<table>
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<th>Type of teaching</th>
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Legend:
GCL: Clinical Practice     TA: Workshop     TI: Ind. workshop     GCA: Field workshop

ASSESSMENT SYSTEMS
- Final assessment system

TOOLS USED & GRADING PERCENTAGES
- Extended written exam  70%
- Practical work (exercises, case studies & problems set)  20%
- Team work (problem solving, project design)  10%

ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT
Final exam: 70%.
Continuous evaluation by means of exercises gathered along the semester (30%: 20% in a partial exam + 10% by activities along the term).
Students who do not want to follow the aforementioned evaluation system will have the possibility to be evaluated only with a final exam.

Students will abide with all pertinent rules about the evaluation, in particular they will keep in mind the following norms:
- Student's regulation: https://www.ehu.eus/documents/3026289/3106907/Reglamento_Alumnado_UPV_EHU.pdf
- Regulation for students' evaluation: https://www.ehu.eus/es/web/estudiosdegrado-gradukoikasketak/ebaluaziorakoarautegia
- Code of ethics: https://www.ehu.eus/documents/2100129/0/6.-+b%29+Protocolo+plagio+cas++.pdf/11f13960-d46acf5a-ac13-e8b5ad10ac

Students will carry their calculators for the exam, as well as some basic materials for drawing (e.g. a ruler) in order to improve the drawing up of charts.

**EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT**

By means of a written exam (100% of the mark). Previous work done along the semester will not be considered in the extraordinary call.

**COMPULSORY MATERIALS**

Materials in the virtual classroom.

**BIBLIOGRAPHY**

**Basic bibliography**

"An introduction to Statistical Methods and Data Analysis"
Ott, Longnecker
Ed. Brooks/Cole

"Introduction to probability and statistics for science, engineering, and finance"
Walter A. Rosenkrantz.
Ed. CRC-Press

**In-depth bibliography**

"Probability, Statistics and Reliability for Engineers and Scientists"
Bilal M Ayyub, Richard H MacCuen, Richard H McCuen
Ed. CRC-Press

"Introduction to probability and statistics using R"
G Jay Kerns

**Journals**
http://www.seio.es/TEST.html

**Useful websites**
https://www.ehu.eus/es/web/dma

**REMARKS**

Some interesting link for revising base mathematics:
http://personales.unican.es/gonzaleof/
http://ocw.innova.uned.es/matematicas-industriales/
https://ocw.ehu.eus/course/view.php?id=112
FLUID MECHANICS
(EFC course)

STUDENT GUIDE
ACADEMIC YEAR 2019/2020

Degree in Mechanical Engineering
Degree in Automotive Engineering
Degree in Electronic and Automatic Control Engineering
Degree in Chemical Engineering

Department of Nuclear Engineering and Fluid Mechanics
University College of Engineering
University of Basque Country (EHU/UPV)
Vitoria-Gasteiz

Instructor: Iñigo Errasti Arrieta
1. INTRODUCTION

Fluid mechanics is a key subject of the Second grade in Industrial Engineering in the University College of Engineering at Vitoria-Gasteiz with 6 ECTS credits.

**Fluid mechanics** deals with the study of all fluids under static and dynamic situations. Fluid mechanics is a branch of continuous mechanics which deals with a relationship between forces, motions, and static conditions in a continuous material. This study area deals with many and diversified problems such as surface tension, fluid statics, flow in enclose bodies, or flow round bodies (solid or otherwise), flow stability, etc.

Fluid mechanics is widely used both in everyday activities and in the design of modern engineering systems from vacuum cleaners to supersonic aircraft. Therefore, it is important to develop a good understanding of the basic principles of fluid mechanics.

An ordinary house is, in some respects, an exhibition hall filled with applications of fluid mechanics. The piping systems for cold water, natural gas, and sewage for an individual house and the entire city are designed primarily on the basis of fluid mechanics. The same is also true for the piping and ducting network of heating and air-conditioning systems. A refrigerator involves tubes through which the refrigerant flows, a compressor that pressurizes the refrigerant, and two heat exchangers where the refrigerant absorbs and rejects heat. Fluid mechanics plays a major role in the design of all these components.

All components associated with the transportation of the fuel from the fuel tank to the cylinders—the fuel line, fuel pump, fuel injectors, or carburettors—as well as the mixing of the fuel and the air in the cylinders and the purging of combustion gases in exhaust pipes are analyzed using fluid mechanics. Fluid mechanics is also used in the design of the heating and air-conditioning system, the hydraulic brakes, the power steering, automatic transmission, and lubrication systems, the cooling system of the engine block including the radiator and the water pump, and even the tires.

On a broader scale, fluid mechanics plays a major part in the design and analysis of aircraft, boats, submarines, rockets, jet engines, wind turbines, biomedical devices, the cooling of electronic components, and the transportation of water, crude oil, and natural gas. It is also considered in the design of buildings, bridges, and even billboards to make sure that the structures can withstand wind loading. Numerous natural phenomena such as the rain cycle, weather patterns, the rise of ground water to the top of trees, winds, ocean waves, and currents in large water bodies are also governed by the principles of fluid mechanics.

**COURSE SKILLS**

The following course skills are developed:

C3 (Knowledge of basic and technological subjects that enables students to learn new methods and theories, providing them with versatility to adapt to new situations),

C4 (Capacity to solve problems using initiative, decision making, creativity, critical thinking, and to communicate and convey knowledge, abilities and skills in the field of Industrial Engineering), and the cross-curricular competencies
C12 (Adopt a responsible and organised attitude towards work and a willingness to learn taking into account the challenge of the necessary continuous training),

C13 (Apply scientific method strategies: analyse qualitatively and quantitatively the problem situation, propose hypotheses and solutions using industrial engineering models, speciality mechanics), and

C14 (Work efficiently in a group, integrating skills and knowledge to make decisions in the field of industrial engineering).

The competencies and key knowledge that this course programme offers can be used in the following subjects of the grade in Industrial Engineering:

- Hydraulic machinery
- Hydraulic installations
- Pneumatic and hydraulic systems

Graduates from Industrial Chemistry Engineering will use Fluidomechanics knowledge in other subjects of the third year, such as Physicochemistry, Chemical Process Control, or Chemical Engineering Testing. Likewise, automotive engineering graduates will use their knowledge in the third-year Aerodynamic.

2. THEORETICAL AND PRACTICAL CONTENT

In order to get the background knowledge, abilities and skills, the course’s content is divided into five blocks of learning units: Hydrostatics, Kinematics and Dynamics, Dimensional analysis, similitude and viscous flows, Flow Hydraulic machinery and Installations in pipes and open channels

Theoretical content (chapters):

5. Pneumatic and hydraulic circuits
6. Statics of compressible fluids in the gravitational field.
7. Fluid forces on surfaces.
8. Fluid forces on submerged and floating bodies.
11. Fundamental equation of Fluid Dynamics.
12. Bernoulli equation.
15. Applications of the momentum equation.
16. Dimensional analysis and dynamical similarity.
17. Viscous flows.
18. Head losses in pipes.
24. Hydraulic pumps.

**Practical content:**

The students will perform 16 laboratory experiments.

1. Measurement of viscosity of a fluid
2. Rigid-body rotation of fluids
3. Fluid forces on surfaces
4. Verification of Bernoulli equation
5. Discharge in tanks
6. Study of Flow meters
7. Use of Weirs
8. Forces exerted by fluid jets
9. Study of primary (friction) head losses in pipes.
10. Study of secondary (minor) head losses in pipes.
11. Determination of cavitation in pipes.
12. Analysis of Pelton turbines
13. Analysis of centrifugal pumps
15. Time to empty a tank containing a liquid.
16. Wind tunnel
17. Water hammer.

Required materials (background, instructions, and lab report template) are posted on the course. Students will be assigned into groups/teams formed by three students, to perform the experiments. Group lab reports will be submitted after finish the lab.

Attendance to the laboratory sessions is compulsory.

**3. COURSE OBJECTIVES**

The course objectives are:

To introduce definitions, concepts, properties, principles, laws, observations and models of ideal and real fluids at rest and in motion.

To provide basis for understanding fluid behavior at rest and in motion (laminar, turbulent) and for engineering design and control of fluid systems.

To develop competence with mass, energy and momentum balances for determining resultant interactions of flows and engineered and natural systems.

To develop basis for correlating experimental data, designing tests, and using scale models of fluid flows.

To learn nature of rotation, circulation, resistance (viscous, turbulent), boundary layers and separation with applications to drag and lift on objects.

To learn methods for computing head losses (friction and fitting losses) and flows in
simple pipes and channels.

To learn the fundamentals of pumps and hydraulic turbines and the way they operate.

To contribute primarily to the students' knowledge of college-level mathematics and/or basic sciences and provide experimental experience.

The student will be able:

To interpret, define and solve practical problems related with the nature of different types of fluids and their interactions on engineered and natural systems in order to develop technical projects.

To identify, interpret and explain the terminology, the structural characteristics, key parts, operation and application fields of pumps and hydraulic turbines and manage that knowledge to choose the suitable machine for every installation, according to technical criteria.

To prepare, present, defend, orally and in writing, and make reports on the subject working individually or in groups.

To analyze, interpret and synthesize a Technical Project related to Fluid Mechanics.

4. METODOLOGY

The course is geared towards self-learning and uses participatory approaches as much as possible. A cooperative learning (AC, Aprendizaje cooperativo) methodology will be used, including lecture/presentation, group work, demonstrations, case studies, problem solving practical sessions (hands-on practice), small and large group exercises and role plays. The attendees' roles and responsibilities will be change in the group/team.

The following individual or group assignments will be made along the course

- Initial opinion survey on the subject
- Group/team meeting minutes
- 5/6 homework assignments
- Individual pop quizzes
- A partial exam along the semester classes
- Project Design sheet (planning sheet)
- First part of the Project Report
- Final Project Report
- Public presentation of the project

An evaluation will be expected at the end of the semester for students to give feedback on the course, and to outline what they have learned:

- Evaluation sheet
- Final Opinion survey/questionnaire

5. COURSE ASSESSMENT

Subject assessment will be continuous, based on two mid-term examinations, weekly
homework assignments, pop quizzes, and the realization of a laboratory report and a technical project based on the design of a pumping system.

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
<th>Team work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework assignments</td>
<td>20%</td>
<td>Team work</td>
</tr>
<tr>
<td><strong>Partial exam</strong></td>
<td>30%</td>
<td>Chapters: 1-17+21.</td>
</tr>
<tr>
<td>Laboratory Report</td>
<td>15%</td>
<td>Team work</td>
</tr>
<tr>
<td>Technical Project</td>
<td>35%</td>
<td>Team work</td>
</tr>
</tbody>
</table>

20% Submission and assessment of homework assignments (deliverables or tasks assigned for the different topics). When students submit less than 80% of homework assignments, they will receive the grade Not submitted. The quality of the group assignment will also be taken into account.

30% Students will take a partial exam prior to carrying out the project.

15% Report on laboratory practice, carried out in groups/teams. Completion of lab practice and corresponding report is compulsory in order to pass the subject. The quality of team work will also be taken into account.

35% Technical Project. Oral and written presentation of the Project and quality of the team work will be taken into account.

**Notice**

To pass the course, students are required to pass most of the individual exercises/exams. Only the students fulfilling the requirements of the Official College Management Regulations (Article 43.1, Section c) will have the right to take a final ordinary exam. The students not attending to class or laboratory sessions or project classes or submitting less than 80% of the homework assignments will be Not evaluated.

There will be a final ordinary exam at the end of the course semester (in May). The student failing the course will also have the choice to take a final extraordinary exam in June.

Students will have the right to be assessed by final evaluation which is not an evaluation considered as continuous assessment. In order to exercise this right, the student will have to submit a written report to the teacher indicating that he refuses to be assessed by means of a continuous assessment. The student will have a period of nine weeks to submit the report from the start of the academic period classes according to the Engineering School’s calendar.

However, students which can not continue their teaching activity in a continuing manner due to work or reasons included in the Official Management Regulations are required to contact the teacher in order to try to develop an adapted program of competences and teaching objectives.

**SOME REMARKS:**

- Final exam in June’s call: for the student who does not pass the subject by continuous assessment. 100% of the mark.
For students to justify the impossibility of continuous evaluation in the direction of the School:

- Final exam (call for May and June). 100% of the mark.

Article 43 of the Management Regulations for the teaching of undergraduate and first and second cycle, provides the proper reasons for non-participation in the continuous assessment (work reasons, victims of domestic violence, birth, adoption, foster care or daughters and children under three years in charge, care of dependent family member, students with disabilities equal to or greater than 33%, high-level athlete, artistic / cultural activities that involve travel or dedication, compatibility with other higher education, compatibility with political office, union, student representation, associations, NGOs, or other)

Once the student has taken part in a partial continuous assessment tests, it is assumed that you are following the continuous evaluation and get a final score calculated by weighting all tests. ONLY if they are not present at any of the tests, you get a rating of "not presented".

The student may waive the subject by not doing the partial exams or not submitting the homework assignments, lab report or project report.

6. COURSE RESOURCES

Teacher resource books (3 volumes)
Tables and diagrams
Laboratory manual
PowerPoint presentations (slides)
Solved exams
Problem statements and solutions
Student guide, course project guide
Appendices (minutes, forms, sheets...)
Homework assignments

Some part of the course text, notes and resources will be posted on the Internet-based e-learning application tool E-gela/Moodle:

7. BIBLIOGRAPHY


Part of the bibliography listed for the subject and more can be found on the signature 532 in the ‘Biblioteca de las Nieves’ library.

8. JOURNALS

- Computers and Fluids.
- El instalador.
- Environmental Fluid Mechanics
- Experimental Thermal and Fluid Science
- Experiments in Fluids
- Flow Measurement and Instrumentation
- Fluid Dynamics Research
- Fluidos
- Geophysical and Astrophysical Fluid Dynamics
- Ingeniería Del Agua
- International Journal of Multiphase Flow
- International Journal of Heat and Fluid Flow
- International Journal of Heat and Mass Transfer
- Journal of Fluids Engineering
- Journal of Hydraulic Engineering
- Journal of Non-Newtonian Fluid Mechanics
- Montajes e Instalaciones
- Physicochemical Hydrodynamics
- Physical review A. Statistical physics, plasmas, fluids, and related interdisciplinary topics
- Physical review E. Statistical physics, plasmas, fluids, and related interdisciplinary topics
- Physics of fluids
- Physics of fluids A. Fluid dynamics.
- Tecnología del agua
9. INTERNET RESOURCES

- Hydraulic Institute. www.pumps.org
- Pump-Flo Co. www.pump-flo.com/manulist.asp
- Animated software company, www.animatedsoftware.com
- IIHR- Hydroscience & Engineering, College of Engineering, The University of Iowa.
  http://www.iihr.uiowa.edu
- Enciclopedia básica sobre fluidos: http://hyperphysics.phy-astr.gsu.edu/hbase/fluid.html#flucon
- Principios de aeronáutica: http://wings.avkids.com/Libro/advanced.html
- Simulación de redes de distribución de fluidos: http://www.epa.gov/nrmrl/wswrd/dw/epanet.html
- UNESCO-IHE Institute for Water Education: http://www.unesco-ihe.org/
COURSE GUIDE 2019/20

Faculty: 163 - Faculty of Engineering - Vitoria-Gasteiz
Degree: GIAUTO10 - Bachelor's Degree in Automotive Engineering

COURSE

28132 - Finite Element Simulation and Analysis in Automotive Engineering

COURSE DESCRIPTION

This subject is the continuation of the one studied in the first four-month period "Calculation and design of automobile structures". In the subject of the first semester the basic theoretical knowledge of mechanical calculation will be explained and analytically applied.

In the present subject the students will work numerically, using a calculation software.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Knowledge and use of the principles of the strength of materials for the simulation and analysis using the Finite Element Method in automotive.

The expected learning results are:
- Apply knowledge of strength of materials applied to automotive examples and the use of appropriate computer tools.
- Solve the problems of strength of materials by means of qualitative and quantitative analysis and to propose suitable solutions using the appropriate models.
- Prepare written and oral reports, expressing adequately theoretical knowledge, methods of resolution and results obtained.
- Work on projects applying the appropriate legislation or regulations.
- Analyze and evaluate the social and environmental impact by applying sustainability criteria.

COURSE CONTENTS, THEORETICAL & APPLIED

- Structural analysis. The matrix method.
- Linear and non-linear analysis, application examples.
- Finite elements in dynamics. Modal analysis, theory of vibrations.

TEACHING METHODS

Theoretical contents based on the resistance of materials and the method of finite elements will be explained in master classes.

In classroom practices, exercises will be carried out first analytically and then numerically using the specific software. And finally results obtained will be compared.

The first sessions of computer practices will be an overview of some tools of finite element calculation software.

TYPES OF TEACHING

<table>
<thead>
<tr>
<th>Types of teaching</th>
<th>M</th>
<th>S</th>
<th>GA</th>
<th>GL</th>
<th>GO</th>
<th>GCL</th>
<th>TA</th>
<th>TI</th>
<th>GCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours of face-to-face teaching</td>
<td>15</td>
<td>15</td>
<td>30</td>
<td></td>
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<tr>
<td>Hours of student work outside the classroom</td>
<td>22.5</td>
<td>45</td>
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</tbody>
</table>

Legend:
M: Lecture-based
S: Seminar
GA: Applied classroom-based groups
GL: Applied laboratory-based groups
GO: Applied computer-based groups
GCL: Applied clinical-based groups
TA: Workshop
TI: Industrial workshop
GCA: Applied fieldwork groups

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Oral defence 10%
- Exercises, cases or problem sets 60%
- PRUEBA REALIZADA EN ORDENADOR 30%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

MANDATORY MATERIALS

- Teachers notes
BIBLIOGRAPHY

Basic bibliography
- Teachers notes

Detailed bibliography

Journals
-

Web sites of interest

OBSERVATIONS