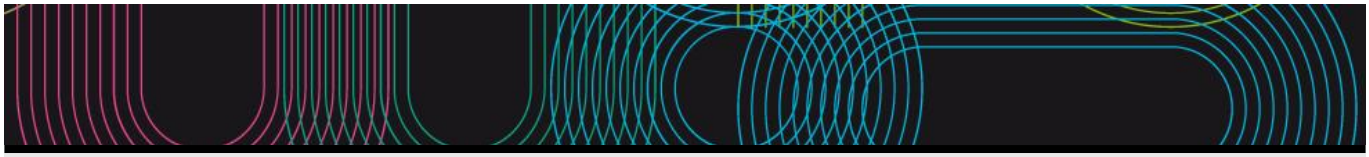

# (*)Escola de Enxeñería Industrial

| Information |
| --- |
| For additional information about the centre and its degres visit the centre's website https://eei.uvigo.es/ |

# Degree in Industrial Technologies Engineering

**Subjects**

**Year 2nd**

| Code | Name | Quadmester | Total Cr. |
| --- | --- | --- | --- |
| V12G363V01301 | Ciencia e tecnoloxía dos materiais | 1st | 6 |
| V12G363V01302 | Fundamentos de teoría de circuítos e máquinas eléctricas | 1st | 6 |
| V12G363V01303 | Teoría de máquinas e mecanismos | 1st | 6 |
| V12G363V01304 | Fundamentos de automática | 1st | 6 |
| V12G363V01305 | Fundamentos de organización de empresas | 1st | 6 |
| V12G363V01401 | Tecnoloxía electrónica | 2nd | 6 |
| V12G363V01402 | Fundamentos de sistemas e tecnoloxías de fabricación | 2nd | 6 |
| V12G363V01403 | Mecánica de fluídos | 2nd | 6 |
| V12G363V01404 | Resistencia de materiais | 2nd | 6 |
| V12G363V01405 | Termodinámica e trasmisión de calor | 2nd | 6 |

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Materials science and technology** | | | | |
| Subject | Materials science and technology | | | |
| Code | V12G363V01301 | | | |
| Study programme | Degree in Industrial Technologies Engineering | | | |
| Descriptors | ECTS Credits | Type | Year | Quadmester |
| | 6 | Mandatory | 2nd | 1st |
| Teaching language | Spanish<br>Galician | | | |
| Department | | | | |
| Coordinator | Pena Uris, Gloria María | | | |
| Lecturers | Díaz Fernández, Belén<br>Pena Uris, Gloria María | | | |
| E-mail | gpena@uvigo.es | | | |
| Web | http://faitic.uvigo.es | | | |
| General description | The aim of this subject is to introduce the main concepts of materials technology as well as to study applications of the most common materials | | | |

| Competencies | |
|---|---|
| Code | |
| CG3 | CG3 Knowledge in basic and technological subjects that will enable them to learn new methods and theories, and equip them with versatility to adapt to new situations. |
| CG4 | CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering. |
| CG6 | CG6 Capacity for handling specifications, regulations and mandatory standards. |
| CE9 | CE9 Knowledge of the fundamentals of the science, technology and chemistry of materials. Understand the relationship between microstructure, the synthesis, processing and properties of materials. |
| CT1 | CT1 Analysis and synthesis. |
| CT5 | CT5 Information Management. |
| CT9 | CT9 Apply knowledge. |
| CT10 | CT10 Self learning and work. |

| Learning outcomes | Competences | | |
|---|---|---|---|
| It comprises the fundamental concepts of link, structure and microstructure of the distinct types of materials | CG3 | CE9 | CT10 |
| It comprises the influence of the microstructure of the material on its mechanical , electrical, thermal and magnetic behaviour | CG3 | CE9 | |
| It comprises the mechanical behaviour of the metallic, ceramic, plastics and composite materials. | CG4<br>CG6 | | |
| It knows how to modify the material properties by means of mechanical processes and thermal treatments | CG4 | CE9 | CT9 |
| It knows the basic structural characterisation techniques for materials. | CG3<br>CG6 | CE9 | |
| To acquire skills in the handle of the diagrams and charts | | | CT1 |
| To acquire skills in the realisation of tests | CG6 | CE9 | CT10 |
| It analyses the results obtained and extracts conclusions from them | | | CT1<br>CT5<br>CT9 |
| It is able to apply norms of materials testing | CG6 | | CT1<br>CT9 |

| Contents | |
|---|---|
| Topic | |
| Introduction | Introduction to the Science and Technology of Material. Classification of the materials. Terminology. Orientations for the follow-up of the matter. |
| Crystalline arrangement. | Crystalline and amorphous solids. Crystalline lattices, characteristics and imperfections. Allotropic transformations. |

| | |
|---|---|
| Properties of materials. Laboratory practices. | Mechanical, chemical, thermal, electric and magnetic properties. Standars for materials analysis. Compressive and tensile deformation. Principles of fracture mechanisms. Toughness. Hardness. Main test methods. Fundamentals of thermal analysis. Fundamentals of non-destructive esting. Introduction to metallography. Binary isomorphous and eutectic systems. Microstructure in eutectic alloys. Analyses of practical situations. |
| Metallic materials. | Solidification. Constitution of alloys. Grain size. Main binary phase diagrams. Processing. Carbon steels: classification and applications. Cast iron alloys. Heat treatments: ims, fundamentals and classification. Annealing, normalizing, quenching and tempering. Nonferreous alloys. |
| Polymers and composites | General concepts. Classification. Properties. Types of polymers. Processing. Classification of composite materials. Polymer matrix composite materials. Processing of composite materials. Problems related to polymeric and composite materials. |
| Ceramic materials | Structure and bonding in ceramic materials. Silicates structure. Glasses. Properties of ceramic materials. Processing of ceramic materials. Applications. |

**Planning**

| | Class hours | Hours outside the classroom | Total hours |
|---|---|---|---|
| Introductory activities | 1.5 | 0 | 1.5 |
| Lecturing | 31 | 55.8 | 86.8 |
| Laboratory practical | 18 | 18 | 36 |
| Autonomous problem solving | 0 | 12 | 12 |
| Objective questions exam | 0.5 | 0.5 | 1 |
| Problem and/or exercise solving | 1 | 0.95 | 1.95 |
| Problem and/or exercise solving | 1.25 | 1.5 | 2.75 |
| Essay | 0.5 | 7.5 | 8 |

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

**Methodologies**

| | Description |
|---|---|
| Introductory activities | Presentation of the subject. Introduction to materials science and technology. |
| Lecturing | Exhibition by the lecturers of the main contents of the subject, theoretical bases and/or projects guidelines. Hands on science methodology. |
| Laboratory practical | Practical application of the theoretical contents. Practical exercises in the materials laboatory. |
| Autonomous problem solving | Formulation of a practical activity related to the subject. The student must be able to resolve them by himself. |

**Personalized assistance**

| **Methodologies** | **Description** |
|---|---|
| Lecturing | |
| Laboratory practical | |
| **Tests** | **Description** |
| Problem and/or exercise solving | |
| Essay | |

**Assessment**

| | Description | Qualification | Evaluated Competencess | | |
|---|---|---|---|---|---|
| Laboratory practical | Attendance, participation and periodical assignments. | 2 | CG3<br>CG6 | CE9 | CT1<br>CT9<br>CT10 |
| Problem and/or exercise solving | In the final exam, short questions will be included. The final exam will be<br>hold the day fixed by the school. | 40 | CG3<br>CG4<br>CG6 | CE9 | CT1<br>CT9<br>CT10 |
| Problem and/or exercise solving | Exercises will be assessed along the course (25%). The final exam will include similar exercises (20%). | 50 | CG3<br>CG4<br>CG6 | CE9 | CT1<br>CT9<br>CT10 |
| Essay | The main guidelines to successfully develop short projects will be given. | 8 | CG3<br>CG4<br>CG6 | CE9 | CT1<br>CT9<br>CT10 |

## Other comments on the Evaluation

***EvaluaciÃ*n Continuous**

The *evaluaciÃ*ncontinua makeÃ during the period of *impartiÃ*n of the subject, *segÃ*nlos criteria established in the previous section and corresponds with 30%of the final note. To surpass the subject beÃ necessary to have reached *unapuntuaciÃ*n *mÃ*nima of 40% in the proof made in the date previously *fijadapor the centre, that corresponds with 70% of the final note. Those students *queno receive to the *evaluaciÃ*n continuous (previous *autorizaciÃ*n of the *direcciÃ*n *dela *EEI) beÃ*n evaluated with a final examination on the contents of *latotalidad of the matter, that *supondrÃ 100% of the note.

**Examination of Julio (2*Â* *EdiciÃ*n)**

In the examination *deJulio *tendrÃ in account the *evaluaciÃ*n continuous (VÃ*lida only in the course 2019-20). The examination *tendrÃ the same *caracterÃ*sticasque the previous and makeÃ in the previously fixed date by the centre. Those students *quequieran renounce to the *evaluaciÃ*n continuous beÃ*n evaluated with an examination *finalsobre the contents of the whole of the matter (*teorÃ*to + *prÃ*ctica) *quesupondrÃ 100% of the note.

**Extraordinary examination**

Examination on *loscontenidos of the whole of the matter (*teorÃ*to + *prÃ*ctica) that *supondrÃ 100%of the note.

**Commitment Ã*tico:**

It expects that the present student a behaviour Ã*tico suitable. In *casode detect a behaviour no Ã*tico (copy, plagiarism, *utilizaciÃ*n of *aparatoselectrÃ*nicos unauthorised, etc.), considerÃ that the student no *reÃ*ne *losrequisitos necessary to surpass the matter. In this case, the *calificaciÃ*nglobal in the present course *acadÃ*mico beÃ of suspense (0.0).

No allowÃ the *utilizaciÃ*n of *ningÃ*n device *electrÃ*nico *durantelas proofs of *evaluaciÃ*n, except *autorizaciÃ*n expresses. The fact of *introducirun device *electrÃ*nico unauthorised in the classroom of examination beÃ *consideradomotivo of no *superaciÃ*n of the matter in the present course *acadÃ*mico and *lacalificaciÃ*n global beÃ of suspense (0.0).

## Sources of information

**Basic Bibliography**

Callister, William, **Materials Science and Engineering: an introduction**, Wiley,

Askeland, Donald R, **The science and engineering of materials**, Cengage Learning,

Shackelford, James F, **Introduction to materials science for engineers**, Prentice-Hall,

**Complementary Bibliography**

Smith, William F, **Fundamentals of materials science and engineering**, McGraw-Hill,

AENOR, **Standard tests**,

Montes J.M., Cuevas F.G., Cintas J., **Ciencia e Ingeneiría de Materiales**, Paraninfo,

## Recommendations

**Subjects that continue the syllabus**

Materials engineering/V12G380V01504

**Subjects that are recommended to be taken simultaneously**

Fundamentals of manufacturing systems and technologies/V12G380V01305
Fluid mechanics/V12G380V01405
Thermodynamics and heat transfer/V12G380V01302

**Subjects that it is recommended to have taken before**

Computer science: Computing for engineering/V12G350V01203
Physics: Physics I/V12G380V01102
Physics: Physics II/V12G380V01202
Mathematics: Algebra and statistics/V12G380V01103
Mathematics: Calculus I/V12G380V01104
Chemistry: Chemistry/V12G380V01205

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Basics of circuit analysis and electrical machines** | | | | |
| Subject | Basics of circuit analysis and electrical machines | | | |
| Code | V12G363V01302 | | | |
| Study programme | Degree in Industrial Technologies Engineering | | | |
| Descriptors | ECTS Credits | Type | Year | Quadmester |
| | 6 | Mandatory | 2nd | 1st |
| Teaching language | English | | | |
| Department | | | | |
| Coordinator | Villanueva Torres, Daniel | | | |
| Lecturers | Villanueva Torres, Daniel | | | |
| E-mail | dvillanueva@uvigo.es | | | |
| Web | http://FAITIC | | | |
| General description | -- | | | |

| Competencies |
|---|
| Code |
| CG3 CG3 Knowledge in basic and technological subjects that will enable them to learn new methods and theories, and equip them with versatility to adapt to new situations. |
| CE10 CE10 Knowledge and use of the principles of circuit theory and electrical machines. |
| CT2 CT2 Problems resolution. |
| CT6 CT6 Application of computer science in the field of study. |
| CT10 CT10 Self learning and work. |
| CT14 CT14 Creativity. |
| CT17 CT17 Working as a team. |

| Learning outcomes | | | |
|---|---|---|---|
| Learning outcomes | Competences | | |
| Comprise the basic appearances of the operation of the circuits and the electrical machines | CG3 | CE10 | CT10 CT17 |
| Know the experimental process used when it works with electrical circuits and scheme electrical | | CE10 | |
| Know the available current technicians for the analysis of electrical circuits | CG3 | | CT2 CT6 |
| Know the technicians of measure of the electrical circuits | | CE10 | CT2 CT17 |
| Purchase skills on the process of analysis of electrical circuits | CG3 | | CT2 CT14 |

| Contents | |
|---|---|
| Topic | |
| SUBJECT 1. INTRODUCTION And AXIOMS | 1.1 Magnitudes and units.<br>1.2 References of polarity.<br>1.3 Concept of electrical circuit.<br>1.4 Axioms of Kirchhoff. |
| SUBJECT 2. ANALYSIS OF LINEAR CIRCUITS RESISTIVES | 2.1 Ideal Elements: definition, representation and mathematical model.<br>2.2 Models of real sources.<br>2.3 Equivalent Dipoles: conversion of sources.<br>2.4 Association of resistors: concept of voltage divider and current divider.<br>2.5 Association of sources and resistors.<br>2.6 Topological Concepts: knot, branch, bow and mesh.<br>2.7 Number and election of circular and nodal equations linearly independent.<br>2.8 Analyses by meshes and knots of circuits with resistors.<br>2.9 Topological Transformations.<br>2.10 Power and energy in resistors, ideal sources and real sources.<br>2.11 Fundamental theorems. |

| | |
|---|---|
| SUBJECT 3. ANALYSIS OF CIRCUITS WITH ELEMENTS THAT STORE ENERGY | 3.1 ideal Condenser: definition, representation and mathematical model.<br>3.2 magnetic Circuits: units, magnetic flow, strength magnetomotive and reluctance.<br>3.3 ideal Coil: definition, representation and mathematical model.<br>3.4 Association series and parallel of coils and capacitors.<br>3.5 Circuits with elements that store energy. Circuits RL, RC and RLC. |
| SUBJECT 4. ANALYSIS OF CIRCUITS IN SINUSOIDAL STEADY-STATE REGIME | 4.1 Forms of periodic wave and values associated: sinusoidal wave.<br>4.2 Determination of the sinusoidal steady-state regime.<br>4.3 Response of the basic passive elements to sinusoidal excitations: concept of impedance and complex admittance.<br>4.4 Law of Ohm and axioms of Kirchhoff in sinusoidal steady-state regime.<br>4.5 Association of elements.<br>4.6 Analyses by knots and by meshes of circuits in sinusoidal steady-state regime.<br>4.7 Power and energy in sinusoidal steady-state regime. Instantaneous power, half or active power and energy in the passive elements: coils, capacitors, resistances and complex impedances.<br>4.8 Power and energy in the dipoles. Apparent power, reactive power and complex power.<br>4.9 Theorem of conservation of the complex power (theorem of Boucherot).<br>4.10 The power factor and his importance in the electrical systems. Correction of the power factor.<br>4.11 Measurement of the active and reactive power: wattmeters and varmeters.<br>4.12 Fundamental Theorems in sinusoidal steady-state regime. |
| SUBJECT 5: MAGNETIC ADJUSTMENTS | 5.1 Magnetic joined up coils: definitions, equations of flows, own and mutual inductances. Representations and mathematical models.<br>5.2 Analyses by meshes of circuits of alternating current with coils joined up. |
| SUBJECT 6: BALANCED THREE-PHASE SYSTEMS | 6.1 Introduction. Three-phase voltage system. Sequence of phases.<br>6.2 Generators and three-phase loads: star and triangle connections. Voltages and currents.<br>6.3 Equivalent transformations star-triangle.<br>6.4 Analyses of balanced three-phase systems. Equivalent single-phase circuit.<br>6.5 Power in balanced three-phase systems. Compensation of the power factor. |
| SUBJECT 7. ELECTRICAL MACHINES | 7.1 Transformer and autotransformers.<br>7.2 Rotational electrical machines: synchronous machine, asynchronous machine and DC machines. |
| PRACTICES | 1. Use of lab equipments.<br>2. Measures in resistive circuits.<br>3. Introduction to the analysis and simulation of circuits by means of Matlab.<br>4. Determination of a linear model of a real coil with core of air. Real coil with core of iron. Cycle of magnetic hysteresis.<br>5. Simulation of transient regime by means of Matlab.<br>6. Measures of active and reactive power in monophase systems. Compensation of the power factor. |

**Planning**

| | Class hours | Hours outside the classroom | Total hours |
|---|---|---|---|
| Laboratory practical | 18 | 9 | 27 |
| Problem solving | 10 | 10 | 20 |
| Autonomous problem solving | 0 | 23 | 23 |
| Lecturing | 22 | 44 | 66 |
| Essay questions exam | 4 | 0 | 4 |
| Practices report | 0 | 10 | 10 |

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

**Methodologies**

| | Description |
|---|---|
| Laboratory practical | It will be performed circuit assembly corresponding to the knowledges acquired in class of theory, or it will be seen in the laboratory complementary aspects not treated in the theoretical classes. |

| | |
|---|---|
| Problem solving | It will solved type problems and exercises in class of big groups and the student will have to solve similar exercises. |
| Autonomous problem solving | The student will have to solve on his own a series of exercises and questions of the matter proposed by the professor. |
| Lecturing | The professor will explain in the classes of big groups the contents of the matter. |

**Personalized assistance**

| Methodologies | Description |
|---|---|
| Laboratory practical | The professor will attend personally the doubts and queries of the students during the tutorial hours. |
| Problem solving | The professor will attend personally the doubts and queries of the students during the tutorial hours. |

**Assessment**

| | Description | Qualification | Evaluated Competencess |
|---|---|---|---|
| Essay questions exam | They will realise a 'written final exam' that will cover the full contents of the subject. | 80 | CG3 CE10 CT2 CT10 CT14 |
| Practices report | It will be valued positively the realisation of a memory of each one of the practices of laboratory that will include: objectives, procedure followed, materials employed, results obtained and interpretation of them. The realisation of practices and the presentation of the memories are part of the process of continuous evaluation of the student. However, the students that have not realised the practices along the course, or wish to improve the mark obtained, will be able to opt to realise an additional written exam with questions regarding the development of the practices and to the educational contents explained during them. The value of this exam is the 20% of the final mark, in the same way as the continuous evaluation. | 20 | CE10 CT2 CT6 CT10 CT14 CT17 |

**Other comments on the Evaluation**

For the second opportunity of June-July it is kept the qualification in the continuous evaluation obtained during the own course, without prejudice that, to the equal that at the earliest opportunity of December - January,can be surpassed by the realisation of the written exam additional that is proposed to this effect.

Each new enrolment in the subject supposes to put a zero the qualifications in the activities of continuous evaluation obtained in previous courses.

Ethical commitment:

It expects that the student presents a suitable ethical behaviour. In the case to detect a no ethical behaviour (copy, plagiarism,utilisation of unauthorised electronic devices, for example) it will be considered the student does not gather the necessary requirements to surpass the matter. In this case the global qualification in the present academic course will be of suspense (0.0).

It will not be allowed the utilisation of any electronic device during the proofs of evaluation except with explicit permission. The fact to enter an unauthorised electronic device in the classroom of examination will be considered reason of no surpass the matter in the current academic course and the global qualification will be of suspense (0.0).

Responsible professor: DANIEL VILLANUEVA TORRES

**Sources of information**

**Basic Bibliography**

A. Bruce Carson, **Teoría de Circuitos**, Thomson Editores, S.A., 2001

A. Pastor, J. Ortega, V. Parra y A. Pérez, **Circuitos Eléctricos**, Universidad Nacional de Educación a Distancia., 2003

Suarez Creo, J. y Miranda Blanco, B.N., **Máquinas Eléctricas. Funcionamiento en régimen permanente**, 4ª, Editorial Tórculo., 2006

Jesus Fraile Mora, **Circuitos eléctricos**, Pearson, 2012

E. González, C. Garrido y J. Cidrás, **Ejercicios resueltos de circuitos eléctricos.**, Editorial Tórculo, 1999

**Complementary Bibliography**

**Recommendations**

**Other comments**

It is very recommended that the students have sufficient knowledge of the algebra of the complex numbers, linear algebra, linear differential equations and have attended to the subject of Physics along the whole first course. Requirements: To enrol in this matter it is necessary to have surpassed or be enrolled of all the matters of the inferior courses to the course in which it is situated this matter.

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Mechanism and machine theory** | | | | |
| Subject | Mechanism and machine theory | | | |
| Code | V12G363V01303 | | | |
| Study programme | Degree in Industrial Technologies Engineering | | | |
| Descriptors | ECTS Credits | Type | Year | Quadmester |
| | 6 | Mandatory | 2nd | 1st |
| Teaching language | Spanish<br>Galician<br>English | | | |
| Department | | | | |
| Coordinator | Fernández Vilán, Ángel Manuel<br>Segade Robleda, Abraham | | | |
| Lecturers | González Baldonedo, Jacobo<br>López Campos, José Ángel<br>Segade Robleda, Abraham | | | |
| E-mail | asegade@uvigo.es<br>avilan@uvigo.es | | | |
| Web | http://faitic.uvigo.es | | | |
| General description | This subject is intended to provide the students with basic knowledge about Mechanism and Machine Theory as well as his applications in the field of Mechanical engineering. It also covers and provides the students with the most important concepts related with Mechanism and Machine Theory. The students will know and apply kinematic and dynamic analysis methods for mechanical systems both with graphical and analytical methods and also through effective use of simulation software. Furthermore, this subject serves as an introduction of some aspects about machinery design; a topic that will be cover thoroughly in future subjects of the Degree. | | | |

| Competencies |
|---|
| Code |

| Learning outcomes | |
|---|---|
| Learning outcomes | Competences |

| Contents | |
|---|---|
| Topic | |
| Introduction to mechanism and machine theory | Introduction<br>Definition of Machine, Mechanism and Kinematic Chain Link/part and linkage/joint<br>Classification<br>Kinematic Diagram, modeling, and symbology (nomenclature)<br>Mobility<br>Degrees of freedom<br>Synthesis of mechanisms |
| Geometrical analysis of mechanisms. | Introduction<br>Calculation methods of placement<br>Loop closure equations |
| Kinematic analysis of mechanisms | Fundamentals<br>Graphical methods<br>Analytical methods<br>Matrix methods |
| Static analysis of mechanisms | Fundamentals<br>Force reduction (Graphical Methods)<br>Work/Power Virtual Methods |
| Dynamic analysis of mechanisms | Fundamentals<br>Machine general dynamics<br>Machine Work and Power<br>Balanced Dynamics of rotors |
| Cam mechanisms | Fundamentals<br>Flat cams<br>Cam synthesis |
| Power transmission mechanisms | Fundamentals<br>Gears Mechanism<br>Other mechanisms |

| Planning | | | |
|---|---|---|---|
| | Class hours | Hours outside the classroom | Total hours |
| Lecturing | 23 | 19.5 | 42.5 |
| Problem solving | 9.5 | 30 | 39.5 |
| Laboratory practical | 18 | 47 | 65 |
| Essay questions exam | 3 | 0 | 3 |

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

| Methodologies | |
|---|---|
| | Description |
| Lecturing | Clase magistral en la que exponen los contenidos teóricos. |
| Problem solving | Resolución de problemas utilizando los conceptos teóricos presentados en aula. |
| Laboratory practical | Realización de tareas prácticas en laboratorio docente o aula informática |

| Personalized assistance | |
|---|---|
| **Methodologies** | **Description** |
| Lecturing | Group or individual tutorials will be held during office hours to strengthen the acquired knowledge and to guide and assess the proposed works/papers . |
| Problem solving | Group or individual tutorials will be held during office hours to strengthen the acquired knowledge and to guide and assess the proposed works/papers. |
| Laboratory practical | Group or individual tutorials will be held during office hours to strengthen the acquired knowledge and to guide and assess the proposed works/papers. |

| Assessment | | | |
|---|---|---|---|
| | Description | Qualification | Evaluated Competencess |
| Laboratory practical | Attendance and participation as well as practices reports, papers, and tests will be rated. However, to be evaluated, students must attend a minimum of 7 practice sessions; otherwise, students won't be evaluated and will get 0 points.<br>Learning outcomes: all will be graded | 20 | |
| Essay questions exam | Final and mid-term tests will be focused on the contents taught at classes and laboratory sessions.<br>Learning outcomes: all will be graded. | 80 | |

**Other comments on the Evaluation**

Students must achieve a 5 or higher grade* to pass the subject, following these rules:

1. Students are required to attend and utilized the laboratory/Computer room. Practices reports, papers, and tests for each practice session as well as proposed works/papers from tutorials will be evaluated and graded with a maximum of 2 points of the final grade. This grade will be kept for the second term in the student's evaluation records (July). To be evaluated, students must attend a minimum of 7 practice sessions; otherwise, students won't be evaluated and will get 0 points.
2. For those students who have been officially granted the right to waive their continued evaluation, there will be a mandatory final test where they will be able to get a maximum grade of 2 points. However, an advanced request must be made to the professor to prepare the necessary materials for this test.
3. The final test will have a maximum grade of 8 points.

* Grades are calculated using a system of numerical qualification from 0 to 10 points conforming to the Spanish current legislation (RD 1125/2003, 5 September; BOE 18 September).

Ethical commitment: An adequate ethical behaviour of the student is expected at all times. In case an unethical behaviour is detected (copying, plagiarism, unauthorized use of electronic devices, and others); the student will be considered unfit to meet the necessary requirements to pass the subject. In this case, the overall qualification in the current academic year will be a Fail grade (0.0).
The use of any electronic devices during tests is completely forbidden unless is specified and authorized. The fact of introducing unauthorized electronic devices in the examination room will be considered reason enough to fail the subject in the current academic year and the overall qualification will be a Fail grade (0.0).

Tests Schedule: This information can be found along with any updates at the center (university) webpage.

## Sources of information

### Basic Bibliography


Munir Khamashta, **Problemas resueltos de cinemática de mecanismos planos**, UPC,

Munir Khamashta, **Problemas resueltos de dinámica de mecanismos planos**, UPC,

Calero Pérez, R. y Carta González, J.A., **Fundamentos de mecanismos y máquinas para ingenieros**, McGraw-Hill,


### Complementary Bibliography


García Prada, J.C. Castejón, C., Rubio, H., **Problemas resueltos de Teoría de Máquinas y mecanismos**, THOMSON,

Cardona, S. y Clos D., **Teoría de Máquinas.**, UPC,

Shigley, J.E.; Uicker J.J. Jr., **Theory of Machines and Mechanisms**, McGraw-Hill,

Hernández A, **Cinemática de mecanismos: Análisis y diseño**, SÍNTESIS,

Lamadrid Martínez, A.; Corral Sáiz, A., **Cinemática y Dinámica de Máquinas**, E.T.S.I.I.T,

Mabie, Reinholtz, **Mechanisms and dynamics of machinery**, Limusa-wyley,

Nieto, j., **Síntesis de Mecanismos**, AC,

Erdman, A.G.; Sandor, G.N.,, **Mechanism Design: Analysis and Synthesis**, PRENTICE HALL,

Simon A.; Bataller A; Guerra .J.; Ortiz, A.; Cabrera, J.A., **Fundamentos de teoría de Máquinas**, BELLISCO,

Kozhevnikov SN, **Mecanismos**, Gustavo Gili,


## Recommendations

### Subjects that continue the syllabus

Machine design I/V12G380V01304
Automobiles and railways/V12G380V01941
Design of hydraulic machines and oleo-pneumatic systems/V12G380V01914
Machine design II/V12G380V01911
Computer-aided mechanical design/V12G380V01915
Transport engineering/V12G380V01945
Thermal engines and machines/V12G380V01913
Systems for data analysis, simulation and validation/V12G380V01933
Hybrid and electric automotive vehicles/V12G380V01944

### Subjects that it is recommended to have taken before

Graphic expression: Graphic expression/V12G380V01101
Physics: Physics I/V12G380V01102
Mathematics: Algebra and statistics/V12G380V01103
Mathematics: Calculus I/V12G380V01104
Mathematics: Calculus II and differential equations/V12G380V01204

### Other comments

Requirements: to enrol in this subject, it is mandatory to have passed or at least, to be enrolled of all first year subjects.
In case of discrepancies, the Spanish version of this guide prevails.

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Automation and control fundamentals** | | | | |
| Subject | Automation and control fundamentals | | | |
| Code | V12G363V01304 | | | |
| Study programme | Degree in Industrial Technologies Engineering | | | |
| Descriptors | ECTS Credits | Type | Year | Quadmester |
| | 6 | Mandatory | 2nd | 1st |
| Teaching language | Spanish | | | |
| Department | | | | |
| Coordinator | Espada Seoane, Angel Manuel | | | |
| Lecturers | Espada Seoane, Angel Manuel<br>Rodríguez Diéguez, Amador | | | |
| E-mail | aespada@uvigo.es | | | |
| Web | http://faitic.uvigo.es | | | |
| General description | In this matter present the basic concepts of the systems of industrial automation and of the methods of control, considering like central elements of the same the programmable programmable logic controller and the industrial controller, respectively. | | | |

| Competencies |
|---|
| Code |

| Learning outcomes | |
|---|---|
| Learning outcomes | Competences |

| Contents | |
|---|---|
| Topic | |
| 1. Introduction the industrial automation. | 1.1 Introduction to automation of tasks.<br>1.2 Types of control.<br>1.3 The programmable logic controller.<br>1.4 Diagram of blocks. Elements of the programmable logic controller.<br>1.5 Cycle of operation of the programmable logic controller. Time of cycle.<br>1.6 Ways of operation. |
| 2. Introduction the programming of programmable logic controllers. | 2.1 Binary, octal, hexadecimal and BCD systems. Real numbers.<br>2.2 Addressing and access to periphery.<br>2.3 Instructions, variables and operands.<br>2.4 Forms of representation of a program.<br>2.5 Types of modules of program.<br>2.6 Linear and structured programming. |
| 3. Programming of programmable logic controllers with I/O. | 3.1 Binary variables. Inputs, outputs and memory.<br>3.2 Binary combinations.<br>3.3 Operations of allocation.<br>3.4 Creation of a simple program.<br>3.5 Timers and counters.<br>3.6 Arithmetical operations.<br>3.7 Examples. |
| 4. Modelling of systems for the programming of programmable logic controllers . | 4.1 Basic principles. Modelling technics.<br>4.2 Modelling by means of Petri Networks.<br>4.2.1 Definition of stages and transitions. Rules of evolution.<br>4.2.2 Conditional election between several alternatives.<br>4.2.3 Simultaneous sequences. Concurrence. Resource shared.<br>4.3 Implementation of Petri Networks.<br>4.3.1 Direct implementation.<br>4.3.2 Normalised implementation (Grafcet).<br>4.4 Examples. |

| | |
|---|---|
| 5. Basic concepts of automatic control. Representation and modelling of continuous systems. | 5.1 Systems of regulation in open loop and closed loop.<br>5.2 Control typical loop. Nomenclature and definitions.<br>5.3 Physical systems and mathematical models.<br>5.3.1 Mechanical systems.<br>5.3.2 Electrical systems.<br>5.3.3 Others.<br>5.4 Modelling in state space.<br>5.5 Modelling in transfer function. Laplace transform. Properties. Examples.<br>5.6 Blocks diagrams. |
| 6. Analysis of dynamic systems. | 6.1 Stability.<br>6.2 Transient response.<br>6.2.1 First order systems. Differential equation and transfer function. Examples.<br>6.2.2 Second order systems. Differential equation and transfer function. Examples.<br>6.2.3 Effect of the addition of poles and zeros.<br>6.3 Systems reduction.<br>6.4 Steady-state response.<br>6.4.1 Steady-state errors.<br>6.4.2 Input signals and system type.<br>6.4.3 Error constants. |
| 7. Controllers and parameters tuning. | 7.1 Basic control actions. Proportional effects, integral and derivative.<br>7.2 PID controller.<br>7.3 Empirical methods of tuning of industrial controllers.<br>7.3.1 Open loop tuning: Ziegler-Nichols and others.<br>7.3.2 Closed loop tuning: Ziegler-Nichols and others.<br>7.4 Controllers design state space. Pole assigment. |
| P1. Introduction to STEP7. | Introduction to the program STEP7, that allows to create and modify programs for the Siemens PLC S7-300 and S7-400. |
| P2. Programming in STEP7. | Modelling of simple automation system and implementation in STEP7 using binary operations. |
| P3. Implementation of PN in STEP7. | Petri Networks modelling of simple automation system and introduction to the implementation of the same in STEP7. |
| P4. PN Modelling and implementation in STEP7. | Petri Networks modelling of complex automation system and implementation of the same in STEP7. |
| P5. GRAFCET modelling and implementation with S7-Graph. | Petri Networks normalised modelling and implementation with S7-Graph. |
| P6. Control systems analysis with MATLAB. | Introduction to the control systems instructions of the program MATLAB. |
| P7. Introduction to SIMULINK. | Introduction to SIMULINK program, an extension of MATLAB for dynamic systems simulation. |
| P8. Modelling and transient response in SIMULINK. | Modelling and simulation of control systems with SIMULINK. |
| P9. Empirical tuning of an industrial controller. | Parameters tuning of a PID controller by the methods studied and implementation of the control calculated in an industrial controller. |

**Planning**

| | Class hours | Hours outside the classroom | Total hours |
|---|---|---|---|
| Laboratory practical | 18 | 30 | 48 |
| Problem solving | 0 | 15 | 15 |
| Lecturing | 32.5 | 32.5 | 65 |
| Essay questions exam | 3 | 19 | 22 |

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

**Methodologies**

| | Description |
|---|---|
| Laboratory practical | Actividades de aplicación de los conocimientos adquiridos en las clases de teoría a situaciones concretas que puedan ser desarrolladas en el laboratorio de la asignatura. |
| Problem solving | El profesorado resolverá en el aula problemas y ejercicios y el alumnado tendrá que resolver ejercicios similares para adquirir las capacidades necesarias. |
| Lecturing | Exposición por parte del profesor de los contenidos de la materia. |

**Personalized assistance**

| Methodologies | Description |
|---|---|

| | |
|---|---|
| Lecturing | For a effective use of the dedication of the student body, the faculty will attend personally the doubts and queries of the same. Said attention will take place so much in the classes of theory, problems and laboratory as in the tutorials (in a schedule prefixed). |
| Laboratory practical | For a effective use of the dedication of the student body, the faculty will attend personally the doubts and queries of the same. Said attention will take place so much in the classes of theory, problems and laboratory as in the tutorials (in a schedule prefixed). |
| Problem solving | For a effective use of the dedication of the student body, the faculty will attend personally the doubts and queries of the same. Said attention will take place so much in the classes of theory, problems and laboratory as in the tutorials (in a schedule prefixed). |
| **Tests** | **Description** |
| Essay questions exam | For a effective use of the dedication of the student body, the faculty will attend personally the doubts and queries of the same. Said attention will take place so much in the classes of theory, problems and laboratory as in the tutorials (in a schedule prefixed). |

## Assessment

| | Description | Qualification | Evaluated Competencess |
|---|---|---|---|
| Laboratory practical | It will evaluate each practice of laboratory between 0 and 10 points, in function of the fulfillment of the aims fixed in the billed of the same and of the previous preparation and the attitude of the students. Each practical will be able to have distinct weight in the total note. | 20 | |
| Essay questions exam | Final examination of the contents of the matter, that will be able to include problems and exercises, with a punctuation between 0 and 10 points. | 80 | |

## Other comments on the Evaluation

- Continous Assesment of student work practices along established laboratory sessions will be held in the semester, with the assistance to them mandatory. In the case of not overcome, a review of practices will take place in the second call. <br /> - The assesment of the practices for students who officially renounces Continuous Assesment will be carried out in a review of practices in the two calls. <br /> -  It may demand previous requirements to the realisation of each practice in the laboratory, so that they limit the maximum qualification to obtain. <br /> - It must pass both tests (script and practices) to pass the matter, give the total score at the rate indicated above. In case of no longer than two or one test, scaling may be applied to partial notes that the total does not exceed 4.5. <br /> - In the final exam may establish a minimum score on a set of issues to overcome. <br /> - In the second call of the the same course, students should examine the tests (script and/or practices) not passed in the first one, with the same criteria of that. <br /> - According to the Rule of Continuous Assesment, the subject students to Continuous Assesment that present to some activity evaluable collected in the Teaching Guide of the matter, will be considered like "presented". <br /> - Ethical commitment: student is expected to present an adequate ethical behavior. If you detect unethical behavior (copying, plagiarism, unauthorized use of electronic devices, and another ones), it follows that the student does not meet the requirements for passing the subject. In this case the global qualification in the present academic course will be of suspense (0.0).

## Sources of information

### Basic Bibliography

E.MANDADO, J.MARCOS, C. FERNANDEZ, J.I.ARMESTO, **Autómatas Programables y Sistemas de Automatización**, 1ª, Marcombo, 2009

MANUEL SILVA, **Las Redes de Petri en la Automática y la Informática**, 1ª, AC, 1985

R. C. DORF, R. H. BISHOP, **Sistemas de Control Moderno**, 10ª, Prentice Hall, 2005

### Complementary Bibliography

PORRAS A., MONTANERO A., **Autómatas programables : fundamento, manejo, instalación y prácticas**, McGraw-Hill, 2003

ROMERA J.P., LORITE J.A., MONTORO S., **Automatización : problemas resueltos con autómatas programables**, 4ª, Paraninfo, 2002

BARRIENTOS, ANTONIO, **Control de sistemas continuos: Problemas resueltos**, 1ª, McGraw-Hill, 1997

OGATA, KATSUIKO, **Ingeniería de Control Moderna**, 5ª, Pearson, 2010

## Recommendations

### Subjects that continue the syllabus

Product design and communication, and automation of plant elements/V12G380V01931

### Subjects that are recommended to be taken simultaneously

Electronic technology/V12G380V01404

**Subjects that it is recommended to have taken before**

Computer science: Computing for engineering/V12G380V01203
Mathematics: Calculus II and differential equations/V12G380V01204
Fundamentals of electrical engineering/V12G380V01303

**Other comments**

- Requirements: To enrol in this subject is necessary to had surpassed or well be enrolled of all the subjects of the inferior courses to the course in the that is summoned this subject.

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Fundamentos de organización de empresas** | | | | |
| Subject | Fundamentos de organización de empresas | | | |
| Code | V12G363V01305 | | | |
| Study programme | Grao en Enxeñaría en Tecnoloxías Industriais | | | |
| Descriptors | ECTS Credits | Type | Year | Quadmester |
| | 6 | Mandatory | 2 | 1c |
| Teaching language | | | | |
| Department | Organización de empresas e márketing | | | |
| Coordinator | Doiro Sancho, Manuel | | | |
| Lecturers | Doiro Sancho, Manuel<br>Lozano Lozano, Luis Manuel<br>Mejías Sacaluga, Ana María | | | |
| E-mail | mdoiro@uvigo.es | | | |
| Web | | | | |
| General description | | | | |

| Competencias |
|---|
| Code |

| Resultados de aprendizaxe | |
|---|---|
| Learning outcomes | Competences |

| Contidos |
|---|
| Topic |

| Planificación | | | |
|---|---|---|---|
| | Class hours | Hours outside the classroom | Total hours |
| *The information in the planning table is for guidance only and does not take into account the heterogeneity of the students. | | | |

| Metodoloxía docente |
|---|
| Description |

| Atención personalizada |
|---|

| Avaliación | | |
|---|---|---|
| Description | Qualification | Evaluated Competencess |

| Other comments on the Evaluation |
|---|

| Bibliografía. Fontes de información |
|---|
| **Basic Bibliography** |
| **Complementary Bibliography** |

| Recomendacións |
|---|

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Electronic technology** | | | | |
| Subject | Electronic technology | | | |
| Code | V12G363V01401 | | | |
| Study programme | Degree in Industrial Technologies Engineering | | | |
| Descriptors | ECTS Credits | Type | Year | Quadmester |
| | 6 | Mandatory | 2nd | 2nd |
| Teaching language | English | | | |
| Department | | | | |
| Coordinator | Soto Campos, Enrique | | | |
| Lecturers | Soto Campos, Enrique | | | |
| E-mail | darzveidar@yahoo.com | | | |
| Web | http://faitic.uvigo.es | | | |
| General description | The objective of this course is to provide the students with the theoretical and practical fundamental knowledge in electronics' five main areas: analog electronics, digital electronics, industrial sensors, power electronics and communications electronics.<br><br>In case of any discrepancy between this translation of the guide and the Spanish version, the valid one is the Spanish version. | | | |

| Competencies |
|---|
| Code |
| CG3 CG3 Knowledge in basic and technological subjects that will enable them to learn new methods and theories, and equip them with versatility to adapt to new situations. |
| CE11 CE11 Knowledge of the fundamentals of electronics. |
| CT2 CT2 Problems resolution. |
| CT9 CT9 Apply knowledge. |
| CT10 CT10 Self learning and work. |
| CT17 CT17 Working as a team. |

| Learning outcomes | | | |
|---|---|---|---|
| Learning outcomes | | Competences | |
| Know the operation of the electronic devices. | CG3 | CE11 | CT2<br>CT9<br>CT10 |
| Know the electronic systems of conditioning and acquisition of data. | | CE11 | CT10 |
| Identify the different types of industrial sensors. | | | CT10 |
| Know the digital electronic systems basic. | | CE11 | CT2<br>CT9<br>CT17 |
| Know the electronic circuits for the communication of information. | CG3 | | CT10 |

| Contents | |
|---|---|
| Topic | |
| Introduction | - Control and supervision of industrial systems by means of electronics<br>- Some representative cases |
| Electronic devices, circuits and systems | - Electronics components and devices<br>- Active and passive electronic devices<br>- Analog and digital electronic circuits<br>- Electronic systems |
| Diodes and rectification | - The diode<br>- Operation modes and characteristics<br>- Diodes types<br>- Operation Models<br>- Analysis of circuits with diodes<br>- Rectifier circuits<br>- Filtering for rectifier circuits<br>- Thyristors |

| | |
|---|---|
| Transistors | - The Bipolar Junction Transistor (BJT.) Operation principles and characteristic curves<br>- Work zones<br>- Quiescent point design<br>- The transistor operating as a switch<br>- The transistor operating as an amplifier<br>- Field Effect Transistors (FET). |
| Amplification | - Amplification concept<br>- Feedback concept<br>- The Operational Amplifier (OA)<br>- Basic circuits with OA<br>- The Instrumentation Amplifier |
| Digital Electronics I | - Numbering Systems<br>- Boolean Algebra<br>- Combinatorial logic functions. Analysis, synthesis and reduction |
| Digital electronics II | - Flip-flops<br>- Sequential logic circuits<br>- Programmable Systems<br>- Microprocessors<br>- Memories |
| Electronic Sensors | - Sensors<br>- Types of sensors as function of the measuring magnitude<br>- Some sensors of special interest in industry applications<br>- Electrical model of some common sensors<br>- Study of some examples of coupling sensors and CAD system |
| Analog - Digital Converters | - The Analog and Digital Signals.<br>- The Analog to Digital Converter (ADC)<br>- Sampling, quantification and digitization<br>- More important ADC characteristics: number of bits, sampling speed, conversion range and cost |
| Industrial Communications | - Introduction to Industrial Communications<br>- Industrial data buses. |
| Power Electronics | - Circuits for Power Conversion<br>- Rectifiers<br>- Lineal and Switched Power Sources |

**Planning**

| | Class hours | Hours outside the classroom | Total hours |
|---|---|---|---|
| Lecturing | 25 | 0 | 25 |
| Problem solving | 8 | 0 | 8 |
| Previous studies | 0 | 49 | 49 |
| Autonomous problem solving | 0 | 46 | 46 |
| Laboratory practical | 18 | 0 | 18 |
| Objective questions exam | 1 | 0 | 1 |
| Essay questions exam | 3 | 0 | 3 |

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

**Methodologies**

| | Description |
|---|---|
| Lecturing | These sessions will be held in the rooms and dates fixed by the direction of the school. They will consist in an oral explanation by the professor of the most important parts of the course, all related with the materials that the student had to work previously. This is intended to favor the active participation of the students, that will have occasion to rise doubts and questions during the sessions. Active participation is desired during all the sessions. |
| Problem solving | During these sessions, in the classroom, interleaved with the lectures, the professor will proceed to solve examples and/or exercises that properly illustrate the problems to solve. As long as the number of participants in the classroom allows, active participation will be promoted. |
| Previous studies | Previous preparation of the theoretical sessions:<br>Prior to the start of the theoretical sessions, the students will have available a series of materials that have to prepare, as the sessions will relay on them.<br><br>Previous preparation of the laboratory sessions:<br>It is mandatory that the students make all the assigned previous tasks prior to access the laboratory. These task are intended to greatly improve the laboratory knowledge acquisition. The achieved report will be taken into account when the laboratory session is to be evaluated. |

| | |
|---|---|
| Autonomous problem solving | Self study and review of the theoretical sessions for knowledge consolidation:<br>The student must study, in a systematic time schedule, after each lecture session, in order to dissipate any doubts. Any doubts or unsolved questions will have to be expose to the professor as soon as possible in order to enhance the feedback of the learning process. |
| Laboratory practical | Laboratory sessions will be held in the time schedule established by the school's head teacher. Students will work in groups of two students each. The sessions will be supervised by a professor, who will control the assistance and will also evaluate the harnessing of it. During the laboratory sessionsthe students will make activities of the following kinds:<br>- Assembling electronics circuits<br>- Use of electronic instrumentation<br>- Measure of physical variables on circuits<br>- Do calculations related to the circuit and/or the measurements<br>- Collect data and represent it (diagrams, charts, tables)<br>At the end of each laboratory session each group will deliver the corresponding score sheets. |

**Personalized assistance**

| Methodologies | Description |
|---|---|
| Laboratory practical | Tutoring Sessions: During the established schedule of each professor, students will be able to speak freely about course issues with the professor. Also the will receive orientation and academic support, if needed. Email: The students also will be able to request orientation and support by means of email to the professors of the course. This way of attention is advisable for indications and short doubts of punctual type. |

**Assessment**

| | Description | Qualification | Evaluated Competencess | | |
|---|---|---|---|---|---|
| Laboratory practical | Assessment of the laboratory sessions:<br><br>The laboratory sessions will be evaluated in a continuous way, on each session. The applied criteria are:<br><br>- A minimum attendance of 80%<br>- Punctuality<br>- Previous task preparation of the sessions<br>- Make the most of the session<br><br>The practical sessions will be held in groups of two students. The documents of the practices will be available prior to the sessions.<br>The students will fill report, that will be delivered when the session ends. This report serves to justify both the attendance and how they have done the work asked for. | 20 | | CE11 | CT9<br>CT10<br>CT17 |
| Objective questions exam | Evaluation of Blocks of Topics: This part is intended to emphasize the self learning process and provide feedback to the students. It's main aim is to provide honest and objective information about the learning process. These individual exams will be held by electronics means, if possible. It can consists on a wide set of test questions, short answers and analytical numerical problems. | 20 | CG3 | CE11 | CT2<br>CT9<br>CT10 |
| Essay questions exam | Individual Exam: It will consist on an individual written exam near the end of the semester, in the dates established by the head teachers. The exam will be a combination of any of the following types of exercises:<br>- Test Questions<br>- Short Answer Questions<br>- Analysis Problems<br>- Practical Cases | 60 | CG3 | CE11 | CT2<br>CT9<br>CT10 |

**Other comments on the Evaluation**

Evaluation:

All the students will be evaluated of continuous way by means of the following procedure:

Along the semester the students will realise several partial proofs and will obtain a note by each proof. The note of partial (NP) will obtain of the average of the notes of the proofs.

Also the long of the semester the students will do practices of laboratory and will obtain a note by each practice. The sessions without assistance will be marked with a zero. The note of laboratory (NL) will obtain of the average of the notes of

the practices, with the following exceptions:

a) If the assistance to the sessions of practices is inferior to 80% the total note of the same (NL) will be zero.

b) If the average of the notes obtained in the partial proofs (*NP) is inferior to 3,33, the note of laboratory (NL) will be zero.

Also along the semester partial exams will be made. Each partial exam will have a grade. The grade of these exams (NP) is the average of the grades in each one.

The qualification of continuous evaluation (CC) procedure will be calculated with this formula:

CC = 0,8 x NP + 0,2 x NL

The students can opt to that qualification CC becomes the qualification in records (CA), without need to take any additional exam, as long as they fulfil all the following requirements:

a) The average grade of the partial exams (NP) must be great or equal than 6,25 points.

b) The grade obtained in all the partial exams must be at least 3,75 points.

c) Obtain a laboratory grade (NL) great or equal to 7 points.

A final exam (EF) will be held in scheduled dates in June and July.

The grades in records (CA) for those students that do not want to or can not opt to the note of continuous qualification method will be obtained with arrangement to the following formula:

CA = 0,2 x NP + 0,2 x NL + 0,6 x EF

For the present academic year, grades NL and NP obtained in the previous two academic courses are still valid with the following exceptions:

- Those students that want to use the previous NL grade with less than 7 points can not apply for the continuous evaluation procedure, and must pass the final exam (EF)

- Those student that want to use the previous NP grade can not apply for the continuous evaluation procedure, and must pass the final exam (EF)

-Those students that attend any laboratory session along the academic year can not opt to keep valid the laboratory qualification from the previous academic years.

-Those students that take any partial test along the academic year can not opt to keep valid the partial test qualification from the previous academic years.

Those students granted with an exemption from the school direction not to take part on the continuous evaluation process, will be evaluated at the same day and time established by the school direction board, in the following way:

- A two part test

1- A written exam identical to the final examination, with a weight of 70% on the final grade and lasting a maximum of two hours.

2- A specific laboratory test, with a weight of 30% on the final grade and lasting a maximum of two hours. This take will take place immediately after the written exam in the laboratories of the same school.

In the final year examination, students will take a written exam that will weigh 70% on the final grade. The remaining 30% will be obtained from the qualification of a laboratory test.

To pass the course, in any of the previous cases, it is necessary to achieve a final grade equal or higher than 5 points.

Recommendations:

It is very important that the students keep updated the profile in the FAITIC platform. All communications related with this course will be made through this platform. All individual communications will be made through the email listed in this platform.

The students can solve doubts related with the laboratory previous activities in the personal attention hours (tutoring time), or by any other contact procedure available in FAITIC.

The students must meet the deadlines for all the activities.

All the achieved results must be justified, in any of the exams or activities. None of the achieved results will be taken for good if no explanation is given about the method used to find them. The selected method for solving a problem is considered when grading the solution.

When writing the solutions and answers in reports and tests, avoid spelling mistakes and unreadable symbols.

Exams lacking some of the sheets will not be graded.

Use of cell phones, notes or books is forbidden during exams.

Competencies Acquisition and Its Influence on Assesments

In this subject all the different activitiesare designed to assess the students in the competencies, and the acquisition ofthe competencies defines the final mark. Here follows a description of how thecompetencies and activities are related.
CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
The acquisition of this competency is providedby the contents of the topics of the subject. All activities ofself-assessment, the laboratory sessions and the different test are elaborated to evaluate the knowledge of the technical subjects.
CE11 Knowledge of the fundamentals ofelectronics.
This competency is warrant to be acquired along all the lectures, the laboratory sessions, the self-assessment activities andt he tests.
CT2 Problems resolution.
The students will exercise this competency by means of the following activities: self-assessment activities, bulletin of problems and previous theoretical solution of experiments to be made at the laboratory. This competency is also acquired along all thetest (for each block and the individual one), as they mainly are composed by problems to be solved.
CT9 Apply Knowledge
This competency is mainly acquired during the laboratory sessions, where the theoretical knowledge from problems, designs and simulations should match the assembly of circuits and real measures. Laboratory sessions are evaluated one by one, scoring an average of marks, if there is a minimum number of attended sessions with a minimum score.
CT10 Self learning and work
The self learning process is fundamental to achieve the score to approve the subject. In order to motivate students in the task of acquiring the theoretical knowledgeneed, self-assessment test (on line), lectures based on the remote learningplatform (faitic) and bulletins of problems have been created. Theself-assessment test also provide feedback to the professors about the main difficulties found by students. On thelaboratory sessions, the previous preparation is an explicit method of evaluation. In order to made this preparation, each of the laboratory sessions has its specific documentation and tutorials.
CT17 Working as a team
The students exercise this competency at the laboratory sessions, by making teamsof two people. Cooperation in most of the sessions is needed to perform the assembly of circuits, make the measurements and take notes. The professor in charge of the laboratory session verifies the previous work and how each session is going along, watching that both members cooperate to achieve the best possible result. Scores for students can be different if the professor detects that one of the team member is not cooperating.

| **Sources of information** |
|---|
| **Basic Bibliography** |
| Malvino, Albert; Bates, David J., **Principios de Electrónica**, 7ª, |
| Boylestad, R. L.; Nashelsky, L., **ELECTRÓNICA: TEORIA DE CIRCUITOS Y DISPOSITIVOS ELECTRONICOS**, 10ª, |
| Rashid, M.H., **CIRCUITOS MICROELECTRONICOS: ANALISIS Y DISEÑO**, 2ª, |
| TOCCI, RONALD J., NEAL S. WIDMER , GREGORY L. MOSS, **Sistemas digitales. Principios y aplicaciones**, 10ª, |
| Lago Ferreiro, A.; Nogueiras Meléndez, A. A., **Dispositivos y Circuitos Electrónicos Analógicos: Aplicación práctica en laboratorio**, |
| **Complementary Bibliography** |

Malik N. R., **Electronic Circuits. Analysis, simulation, and design**,
Wait, J.; Huelsman, L.; Korn, G., **INTRODUCCION AL AMPLIFICADOR OPERACIONAL**, 4ª,
Pleite Guerra, J.; Vergaz Benito, R.; Ruíz de Marcos; J. M., **Electrónica analógica para ingenieros.**,

## Recommendations

### Subjects that are recommended to be taken simultaneously

Fundamentals of automation/V12G380V01403

### Subjects that it is recommended to have taken before

Physics: Physics I/V12G380V01102
Physics: Physics II/V12G380V01202
Mathematics: Algebra and statistics/V12G380V01103
Mathematics: Calculus I/V12G380V01104
Mathematics: Calculus II and differential equations/V12G380V01204
Fundamentals of electrical engineering/V12G380V01303

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Fundamentals of manufacturing systems and technologies** | | | | |
| Subject | Fundamentals of manufacturing systems and technologies | | | |
| Code | V12G363V01402 | | | |
| Study programme | Degree in Industrial Technologies Engineering | | | |
| Descriptors | ECTS Credits | Type | Year | Quadmester |
| | 6 | Mandatory | 2nd | 2nd |
| Teaching language | Spanish | | | |
| Department | | | | |
| Coordinator | Diéguez Quintas, José Luís | | | |
| Lecturers | Ares Gómez, José Enrique<br>Diéguez Quintas, José Luís<br>Queimaño Piñeiro, David<br>Rodríguez Paz, Rafael | | | |
| E-mail | jdieguez@uvigo.es | | | |
| Web | http://faitic.uvigo.es | | | |
| General description | The educational aims of Foundations of Systems and Technologies of Manufacture, in his fundamental and descriptive appearances, centre in the study and the application of scientific knowledges and technicians related with the processes of manufacture of components and conjoint whose functional purpose is mechanical, as well as the evaluation of his dimensional precision and the one of the products to obtain, with a determinate quality. All this including from the phases of preparation until the ones of utilisation of the instruments, the tools, toolings, teams, machines tool and necessary systems for his realisation, in accordance with the norms and specifications established, and applying criteria of optimisation.<br><br>To reach the aims mentioned will give the following thematic educational:<br><br>- Foundations of dimensional metrology. Measure of length, angles, forms and elements of machines.<br>- Study, analysis and evaluation of the dimensional tolerances. Chain of tolerances. Optimisation of the tolerances. Systems of adjust and tolerances.<br>- Processes of conformed of materials by means of start of material, operations, scheme, teams and tooling<br>- Processes of conformed by means of plastic deformation, operations, scheme, teams and tooling<br>- Processes of conformed by *moldeo, operations, scheme, teams and tooling<br>- Processes of conformed no conventional, operations, scheme, teams and tooling.<br>- Conformed of polymers, and other no metallic materials, operations, scheme, teams and tooling<br>- Processes of union and assembling, operations, scheme, teams and tooling<br>- Foundations of the programming of scheme with *CNC, used in the mechanical manufacture. | | | |

| Competencies |
|---|
| Code |

| Learning outcomes | |
|---|---|
| Learning outcomes | Competences |

| Contents | |
|---|---|
| Topic | |
| DIDACTIC UNIT 1. INTRODUCTION To THE TECHNOLOGIES And SYSTEMS OF MANUFACTURE. | Lesson 1. INTRODUCTION To THE ENGINEERING OF *FABRICACION. The productive cycle. Classification of industries. Technologies of manufacture. |

| | |
|---|---|
| DIDACTIC UNIT 2.<br>*METROTECNIA. | Lesson 2. PRINCIPLES OF DIMENSIONAL METROLOGY.<br>Introduction. Definitions and concepts. The International System of Units. Physical magnitudes that covers the Dimensional Metrology. Elements that take part in the measurement. Classifications of the methods of measure. Patterns. The chain of *trazabilidad. *Calibración. Uncertainty. Chain of *calibración and transmission of the uncertainty. Relation between tolerance and uncertainty. Expression of the uncertainty of measure in *calibración.<br><br>Lesson 3. INSTRUMENTS And METHODS OF MEASURE.<br>Introduction. Patterns. Instruments of verification. Patterns *interferométricos. Principles of *interferometría. Instruments of direct measure. Methods and instruments of indirect measure.<br><br>Lesson 4. MEASUREMENT BY COORDINATES. MEASUREMENT BY IMAGE. SUPERFICIAL QUALITY.<br>Machines of measurement by coordinates. Concept. Principles of the MMC. Classification of the machines. Main components of the MMC. Process to be followed for the development of a measure. Systems of measurement by image. Superficial quality. Methods of measure of the *rugosidad. Parameters of *rugosidad. |
| DIDACTIC UNIT 3.<br>PROCESSES OF CONFORMED BY START OF MATERIAL | Lesson 5. INTRODUCTION To THE CONFORMED BY START OF MATERIAL.<br>Introduction. Movements in the process of start of material. Factors to take into account in the election of the tool. Geometry of tool. Materials of tool. Mechanism of training of the shaving. Types of shavings. Power and strengths of court. Wear of tool. Criteria of wear of tool. Determination of the life of the tool. Flowed of court.<br><br>Lesson 6. TURNING: OPERATIONS, SCHEME And TOOLING.<br>Introduction. Main operations in lathe. The machine-tool: the lathe. Main parts of the lathe. Setting or subjection of pieces. Typical tools of the lathe. Special lathes.<br><br>Lesson 7. MILLED: OPERATIONS, MACHINES And TOOLING.<br>Introduction. Description and classification of the operations of milled. Parts and main types of *fresadoras. Types of strawberries. Setting of the tool. Subjection of pieces. Different configurations of *fresadoras. *Fresadoras Special.<br><br>Lesson 8. MECHANISED OF HOLES And WITH RECTILINEAR MAIN MOVEMENT: OPERATIONS, MACHINES And TOOLING.<br>Introduction to the operations of mechanised of holes. Punches. *Mandrinadoras. General characteristics of the processes of mechanised with rectilinear main movement. *Limadora. *Mortajadora. *Cepilladora. *Brochadora. Saws.<br><br>Lesson 9. CONFORMED WITH ABRASIVE: OPERATIONS, MACHINES And TOOLING.<br>Introduction to the operations of mechanised of holes. You grind abrasive. Operation of rectified. Types of *rectificadoras. *Honeado. *Lapeado. Polishing. Burnished. *Superacabado<br><br>Lesson 10. PROCESSES OF MECHANISED NO CONVENTIONAL.<br>Introduction. The mechanised by electroerosion or *electro-download. Mechanised electrochemical. Mechanised by laser. Mechanised by *chorro of water. Court by arch of plasma. Mechanised by ultrasounds. Milled chemist. |
| DIDACTIC UNIT 4.<br>AUTOMATION And MANAGEMENT OF THE PROCESSES OF MANUFACTURE. | Lesson 11. NUMERICAL CONTROL OF MACHINES TOOL.<br>Introduction. Advantages of the application of the *CN in the machines tool. Necessary information for the creation of a program of *CN. Manual programming of *MHCN. Types of language of *CN. Structure of a program in code ISO. Characters employed. Preparatory functions (G__). Auxiliary functions (M__). Interpretation of the main functions. Examples. Automatic programming in numerical control. |

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|---|---|
| DIDACTIC UNIT 5.<br>PROCESSES OF CONFORMED OF MATERIALS IN LIQUID STATE And GRANULATE. | Lesson 12. GENERAL APPEARANCES OF THE CONFORMED BY FOUNDRY OF METALS.<br>Introduction. Stages in the conformed by foundry. Nomenclature of the main parts of the mould. Materials employed in the conformed by foundry. Flow of the fluid in the system of feeding. Solidification of the metals. Contraction of the metals. The *rechupe. Procedure of calculation of the system distribution of *colada. Considerations on design and defects in pieces melted.<br><br>Lesson 13. PROCESSES OF MANUFACTURE BY FOUNDRY.<br>Classification of the processes of foundry. *Moldeo In sand. *Moldeo In shell. *Moldeo In plaster. *Moldeo In ceramics. *Moldeo To the CO2. *Moldeo To the stray wax<br>Foundry in full mould. *Moldeo *Mercast. *Moldeo In permanent mould. Foundry injected. Foundry *centrifugada. Ovens employed in foundry.<br><br>Lesson 14. METALLURGY OF DUSTS (*PULVIMETALURGIA).<br>Introduction. Manufacture of the metallic dusts. Characteristics and properties of the metallic dusts. Dosage and mix of metallic dusts. *Compactación. *Sinterizado. Ovens of sintering. *Sinterizado By download *disruptiva. *Presinterizado. Back operations. Considerations of design. Products *obtenibles by sintering.<br><br>Lesson 15. CONFORMED OF PLASTICS.<br>Introduction. Polymeric material classification. Physical properties of polymers. Classification of the processes. *Moldeo By extrusion. *Moldeo By injection. *Moldeo By compression. *Moldeo By transfer. *Moldeo Rotational. *Termoconformado. |
| DIDACTIC UNIT 6.<br>PROCESSES OF CONFORMED BY UNION. | Lesson 16. PROCESSES OF WELDING.<br>Introduction to the processes of welding. Welding with electrical arch. Welding by resistance. Welding with oxygen and gas fuel .Welding with temperature of fusion of metal of lower contribution that the one of the metals to join.<br><br>Lesson 17. PROCESSES OF UNION And SETTING WITHOUT WELDING.<br>Processes of union by means of adhesive. Resistance to the adhesion. Conditions for the hit. Design of unions Types of adhesive according to origin and composition. Processes of mechanical union. Removable mechanical unions and permanent. |
| DIDACTIC UNIT 7.<br>PROCESSES OF CONFORMED BY PLASTIC DEFORMATION OF METALS. | Lesson 18. GENERAL APPEARANCES OF THE CONFORMED BY PLASTIC DEFORMATION.<br>Introduction. Curves of effort-deformation. Expressions of the deformation. Proof of the volume. Approximate models of the curve encourage real-natural deformation. State of flat deformation. Primary and secondary processes. Processes of work in hot and in cold. Conditions and control of the process.<br><br>Lesson 19. PROCESSES OF *LAMINACIÓN And FORGES.<br>*Laminación: Foundations; temperature of *laminación; teams for the *laminación in hot; characteristics, quality and tolerances of the products *laminados in hot; *laminación in cold. It forges: free; in matrix of impression; in press; by *recalcado; header in cold; by *laminación; in cold.<br><br>Lesson 20. EXTRUSION, *EMBUTICIÓN And AFFINE.<br>Extrusion. Pulled of bars and tubes. *Trefilado. Reduction of section. *Embutición. *Repujado In lathe. Attainable pieces by *repujado: considerations of design. Forming by pulled. Forming with pads of rubber and with liquid to pressure. Forming to big power.<br><br>Lesson 21. CONFORMED OF METALLIC SHEET.<br>*Curvado Or bent of sheets. *Curvado With rollers. Conformed with rollers. *Enderezado. *Engatillado. Operations of cut of sheet. |

| | |
|---|---|
| PROGRAM OF PRACTICES | Practice 1.- Utilisation of the conventional devices of metrology. Measurement of pieces using foot of normal king and of depths and micrometer of outsides and inner. Employment of clock comparator. *Comprobación Of flat surfaces. Use of calibrate raisin/does not happen, rules, squares and *calas pattern. Measurement and *comprobación of threads. Realisation of metric measurements and in English units.<br>Practice 2.-Indirect measurements.<br>*Comprobación Of a cone using rollers and a foot of king, measurement of a tail of *milano using rollers, measurement of the angles of a double tail of *milano and measurements using a rule of breasts. Direct measurements with goniometer.<br>Practice 3.- Machine of measurement by coordinates.<br>Establish a system of coordinates. Check measures in piece, using a machine to measure by coordinates. Verify tolerances forms and position.<br>Practice 4.- Manufacture with machines conventional tools.<br>Manufacture of a piece employing the lathe, the *fresadora and the *taladro conventional, defining the basic operations and realising them on the machine.<br>Practice 5.- Selection of conditions of computer-aided court.<br>Realisation of leaves of process of three pieces using program of planning of Practical computer-aided<br>processes 6, 7 and 8.- Initiation to the numerical control applied to the lathe and to the *fresadora.<br>Realisation of a program in *CNC using a simulator, with the main orders and simpler; realising at the end diverse pieces so much in the lathe as in the *fresadora of the classroom workshop.<br>Practice 9.- Welding.<br>Knowledge of different teams of electrical welding. *Soldeo Of different materials employed the technicians of electrode *revestido, *TIG and *MIG. |

**Planning**

| | Class hours | Hours outside the classroom | Total hours |
|---|---|---|---|
| Lecturing | 32.5 | 0 | 32.5 |
| Laboratory practical | 18 | 0 | 18 |
| Objective questions exam | 0 | 2 | 2 |
| Laboratory practice | 0 | 50 | 50 |

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

**Methodologies**

| | Description |
|---|---|
| Lecturing | Las clases teóricas se realizarán combinando las explicaciones de pizarra con el empleo de vídeos y presentaciones de ordenador. La finalidad de estas es complementar el contenido de los apuntes, interpretando los conceptos en estos expuestos mediante la muestra de ejemplos y la realización de ejercicios. |
| Laboratory practical | Las clases prácticas de laboratorio se realizarán en 9 sesiones de 2 horas, salvo los alumnos del curso puente que realizarán las prácticas en las 6 sesiones que contempla su horario particular, en grupos de 20 alumnos máximo, y empleando los recursos disponibles de instrumentos y máquinas, combinándose con las simulaciones por ordenador. |

**Personalized assistance**

| **Methodologies** | **Description** |
|---|---|
| Lecturing | |
| Laboratory practical | |
| **Tests** | **Description** |
| Objective questions exam | |
| Laboratory practice | |

**Assessment**

| Description | Qualification | Evaluated Competencess |
|---|---|---|

| | | |
|---|---|---|
| Objective questions exam | It TESTS TYPE To (for all the students -60% final note-)<br>The character of this proof is written and face-to-face, is compulsory for all the students, with or without continuous evaluation.<br>It will be composed this proof by 20 ask type test on the theoretical and practical contents.<br>The assessment of tests it type test will realise in a scale of 6 points, what represents 60% of the total note, being necessary to obtain at least 2 points, so that together with the practical proofs can obtain at least 5 points and surpass the matter The note of this test will obtain adding 0,3 points by each properly answered question and will subtract 0,1 points if the question is resolved of wrong form. The questions in white do not mark. | 60 |
| Laboratory practice | It TESTS TYPE *B (continuous evaluation -30% final note-):<br>Two test type test to realise in the schedule of class, consistent in 5 questions on the matter given until the moment, each correct question will cost 0,3 points and the wrong will subtract 0,1 points. The questions in white do not mark. Each proof will be therefore 15% of the final note.<br><br>It TESTS TYPE C (continuous evaluation -10% final note-):<br>A proof written or work to propose by the professor along the *cuatrimestre. This proof will value with a maximum of 1 point, 10% of the final note. These notes will add to the qualification of tests it type test, to be able to obtain at least 5 points and surpass the matter.<br><br>It TESTS TYPE (renunciation to the continuous evaluation -40% final note-):<br>Resolution of several practical problems, whose value will be 40% of the final note, or was at most 4 points, being necessary to obtain a minimum of 1 point in this second proof so that the qualification can add to the one of tests it type test, and if it equalises or surpasses 5 points, approve the matter.<br>This tests type D, will realise it the students to which have conceded them the renunciation to the continuous evaluation, and will realise the same day that realise tests it compulsory test, after this have finalised. | 40 |

**Other comments on the Evaluation**

<*p>APPROVED</*p><*p>Students described by means of continuous evaluation:</*p><*p>To surpass this matter is necessary at least obtain 5 points adding the punctuation of test them types □To□, □*B□ and □C□. </*p><*p>All the students in principle will have to follow the procedure of continuous evaluation, except those that on purpose renounce in the term and form that mark the school. </*p><*p>&*nbsp;Students described with renunciation conceded to the continuous evaluation:</*p><*p>To surpass this matter is necessary at least obtain 5 points adding the punctuation of test them types □To□ and □D□.</*p><*p>ASSISTANCE To PRACTICAL CLASSES</*p><*p>The assistance to practical classes is not compulsory, but will be always matter of examination the in them given.</*p><*p>ANNOUNCEMENT OF 2º EDITION</*p><*p>Students with continuous evaluation, qualification in the announcement of 2º edition: </*p><*p>&*nbsp;This second edition of the ordinary announcement will describe as the following way: </*p><*p>- By means of the realisation of the compulsory proof type □To□ </*p><*p>- conserve the qualifications of the two test type □*B□ in this 2ª opportunity, but will be able to , if it wishes , improve this qualification, by means of the repetition of these test type □*B□ when finalising tests it type □To□.</*p><*p>- Will keep the punctuation reached in tests it type □C□ by maximum value of 1 point, but will be able to improve this note if it wishes by means of a proof written or work to propose by the professor, to deliver before the day of the announcement of this second edition.</*p><*p>To surpass this matter is necessary at least obtain 5 points adding the three previous proofs. </*p><*p>The notes of the proofs of continuous evaluation, corresponding to 40% of the final qualification, will not conserve of a course for another. </*p><*p>Students without continuous evaluation, qualification in the announcement of 2º edition: </*p><*p>The students that do not realise continuous evaluation, due to the fact that the centre has accepted them the renunciation, always will have to realise in all the announcements tests it type □To□ (by value of 6 points) and tests it type □D□ (by value of 4 points), in the terms specified in the previous sections. </*p><*p>To surpass this matter is necessary at least obtain 5 points adding the two previous proofs. </*p><*p>EXTRAORDINARY ANNOUNCEMENT: </*p><*p>This proof will be equal for all the students and will consist in one tests it type □To□ (by value of 6 points) and tests it type □D□ (by value of 4 points), in the terms specified in the previous sections. </*p><*p>To surpass this matter is necessary at least obtain 5 points adding the two previous proofs. </*p><*p>ETHICAL COMMITMENT:</*p><*p>expects that the present student a suitable ethical behaviour, free of fraud. In case to detect a no ethical behaviour (copy, plagiarism, utilisation of unauthorised electronic devices, for example) will consider that the student does not gather the necessary requirements to surpass the matter. In this case the global qualification in the present academic course will be of suspense (0.0).</*p>

**Sources of information**

**Basic Bibliography**

**Complementary Bibliography**

Dieguez, J.L.; Pereira, A.; Ares, J.E:, ´**Fundamentos de fabricación mecánica**,

Alting, L., **Procesos para ingenieria de manufactura**,
De Garmo; Black; Kohser, **Materiales y procesos de fabricación**,
Kalpakjian, Serope, **Manufactura, ingeniería y tecnología**,
Lasheras, J.M., **Tecnología mecánica y metrotecnia**,

## Recommendations

### Subjects that continue the syllabus

Manufacturing engineering and dimensional quality/V12G380V01604

### Subjects that are recommended to be taken simultaneously

Materials science and technology/V12G350V01305

### Other comments

Requirements: To enrol of this matter is necessary to have surpassed or be enrolled of all the matters of the inferior courses to the course to the that is *emplazada this matter.

In case of discrepancies, will prevail the version in Spanish of this guide.

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Fluid mechanics** | | | | |
| Subject | Fluid mechanics | | | |
| Code | V12G363V01403 | | | |
| Study programme | Degree in Industrial Technologies Engineering | | | |
| Descriptors | ECTS Credits | Type | Year | Quadmester |
| | 6 | Mandatory | 2nd | 2nd |
| Teaching language | English | | | |
| Department | | | | |
| Coordinator | Meis Fernández, Marcos | | | |
| Lecturers | Meis Fernández, Marcos | | | |
| E-mail | mmeis@uvigo.es | | | |
| Web | | | | |
| General description | This syllabus presents information the Fluid mechanics course that belongs to the 2nd year of the degree in Industrial Technologies Engineering, 2019-2020, in accordance to the marked guidelines by the European Space of Upper Education.<br>This is a first course in fluid mechanics, focusing on the topics that are relevant to Industrial Technologies Engineering applications.<br>The course is intended to acquire essential knowledge needed to analyze devices with fluid as a working material, such us hydraulic machinery, lubrication devices, heating and cooling systems, pipes systems, pneumatic systems, aero and hydrodynamics devices, windturbines, etc.<br>It includes stress and strain rate descriptions, fluid statics, use of differential and finite control volume analysis with continuity, momentum, and energy equations, Bernoulli and Euler equations, incompressible viscous flow using Navier-Stokes equations, dimensional analysis, laminar and turbulent pipe flow. | | | |

| Competencies | |
|---|---|
| Code | |
| CG4 | CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering. |
| CG5 | CG5 Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works. |
| CE8 | CE8 Knowledge of the basic principles of fluid mechanics and their application to solving problems in the field of engineering. Calculation of pipes, channels and fluid systems. |
| CT2 | CT2 Problems resolution. |
| CT9 | CT9 Apply knowledge. |
| CT10 | CT10 Self learning and work. |

| Learning outcomes | Competences | | |
|---|---|---|---|
| Knowledge for the realisation of measurements, calculations, assessments, evaluations, studies, reports, plans of works and other analogous works | CG4<br>CG5 | CE8 | CT2<br>CT9<br>CT10 |
| Capacity to: solve problems with initiative and creativity, take decisions, develope critical reasoning and capacity to communicate and transmit knowledge and skills in the field of the industrial engineering | CG4<br>CG5 | CE8 | CT2<br>CT9<br>CT10 |
| Knowledge of the basic principles of the fluid mechanics and his application to the resolution of problems in the field of the engineering. Intended learning outcomes are, understanding of the basics of flow behaviour in engineering systems, awareness of the physical laws that govern fluid motion and development of analytical skills for simple flow systems, e.g. calculation of pipes, channels and fluid systems | CG4<br>CG5 | CE8 | CT2<br>CT9<br>CT10 |
| Resolution of problems | CG4<br>CG5 | CE8 | CT2<br>CT9<br>CT10 |

| Contents |
|---|
| Topic |

| | |
|---|---|
| 1. Introduction | 1.1 Fundamental Concepts<br>1.1.1 Stress tensor. Newton Law<br>1.2 The Fluid as a Continuum<br>1.3 Viscosity<br>1.3.1 Newtonian Fluids and non Newtonian fluids<br>1.4 Characteristics of the flows<br>1.4.1 Different types of flows<br>1.4.1.1 Geometrical conditions<br>1.4.1.2 Kinematic conditions<br>1.4.1.3 Mechanical conditions<br>1.4.1.4 Compressibility<br>1.5 Stresses on a fluid<br>1.5.1 Tensorial and vectorial magnitudes<br>1.5.1.2 Volumetric Forces<br>1.5.2.2 Surface Forces<br>1.5.2.3 The stress tensor<br>1.5.2.4 Concept of pressure |
| 2. Basic Physical Laws of Fluid Mechanics | 2.1 Velocity field<br>2.2 Streamlines and pathlines<br>2.3 Systems and Control volumes<br>2.4 Integrals extended to Fluid volumes. The Reynolds Transport Theorem<br>2.5 Conservation of Mass. Integral and Differential Equation<br>2.6 The Linear Momentum Equation. Integral and Differential Equation.<br>2.7 Navier-Poisson Law<br>2.8 The Energy Equation. Integral and Differential Equation. Frictionless Flow: The Bernoulli Equation |
| 3. Dimensional Analysis. Similarity concepts | 3.1 Introduction<br>3.2 The Pi Theorem<br>3.3 Applications<br>3.4 Fundamental Nondimensional Numbers in Fluid Mechanics<br>3.4.1 Physical meaning of the nondimensional numbers<br>3.5 Similarity in Fluid dynamics<br>3.5.1 Partial Similarity<br>3.5.2 Scaling effect |
| 4. Laminar viscous flow | 4.1 Introduction<br>4.2. Fully developed flow<br>4.2.1 Hagen-Poiseuille Flow<br>4.2.2 Viscous flow in circular ducts<br>4.2.3 Flow in Noncircular Ducts<br>4.3 Entrance region effect<br>4.4 Losses in Pipe Systems<br>4.4.1 Friction coefficient<br>4.5 Stability of laminar flow |
| 5. Turbulent Flow in ducts | 5.1 Introduction<br>5.2 Pipe-head Loss in turbulent regime<br>5.2.1 Nikuradse chart<br>5.2.2 Moody chart<br>5.2.3 Empirical Formulas for flow in circular ducts. Hydraulic diameter |
| 6. Minor Losses in Pipe Systems | 6.1 Introduction<br>6.2 Minor Losses6.2.1 Loss at the entrance of a pipe<br>6.2.2 Loss at the exit of a pipe<br>6.2.3 Loss at contractions<br>6.2.4 Loss at expansions<br>6.2.5 Loss at elbows<br>6.2.6 Losses at bends, elbows, tees and valves<br>6.3 Pipes in series<br>6.4 Pipes in parallel<br>6.5 The three-reservoir pipe junction problem<br>6.6 Pipings netwoks<br>6.7 Nonsteady effects in duct flows<br>6.7.1 Emptying time of a tank<br>6.7.2 Setting of the steady flow in a pipe<br>6.7.3 Water hammer |

| | |
|---|---|
| 7. Open-Channel Flow | 7.1 Introduction<br>7.2 Uniform Flow<br>7.2.1 Pipes used like channels<br>7.3 Non uniform flow<br>7.3.1 The hydarulic jump<br>7.3.2 Fast transitions<br>7.3.3 Flow over a gate<br>7.3.4 Flow under a gate<br>7.3.5 Section of control |
| 8. Experimentation withFflows. Discharge Measurement. Pressure Measurement. Speed Measurement | 8.1 Pressure Gauge<br>8.1.1 Simple pressure gauge<br>8.1.2 Bourdon pressure gauge<br>8.1.3 Transductor of pressure<br>8.2 Speed measurement<br>8.2.1 Pitot tube<br>8.2.2 Prandtl tube<br>8.2.3 Rotative anemometer<br>8.2.4 Hot thread anemometer<br>8.2.5 Laser-doppler anemometer<br>8.3 Flow measurement<br>8.3.1 Differential pressure: diaphragm, venturi, nozzle<br>8.3.2 Other types |

**Planning**

| | Class hours | Hours outside the classroom | Total hours |
|---|---|---|---|
| Lecturing | 32.5 | 70.5 | 103 |
| Problem solving | 5.6 | 15 | 20.6 |
| Mentored work | 5.8 | 0 | 5.8 |
| Laboratory practical | 12 | 0 | 12 |
| Essay questions exam | 1.5 | 0 | 1.5 |
| Laboratory practice | 5.6 | 0 | 5.6 |
| Objective questions exam | 1.5 | 0 | 1.5 |

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

**Methodologies**

| | Description |
|---|---|
| Lecturing | They explain the foundations of each subject needed to solve practical problems. It includes mainly lectures baut can also includes:<br>Readings<br>bibliographic Review<br>Solution of problems<br>Conferences<br>Oral Presentations |
| Problem solving | They will apply the concepts tackled in the lectures. It includes activities such as:<br>Readings<br>Seminars<br>Solution of problems<br>Team working<br>Study of practical cases |
| Mentored work | Works of practical applications, projects, design, creative and novelty subjects of practical applications of fluid mechanics |
| Laboratory practical | Fundamentally, they will consist on activities of experimentation, although they also can include:<br>Practical cases<br>Simulation<br>Solution of problems<br>Team working |

**Personalized assistance**

| Methodologies | Description |
|---|---|
| Lecturing | Personalized attention will be given to the students during class (throughout the possible questions that could arise) and during the specific timetable of the teacher for tutorships. Updated information of the tutorships timetables will be given to the students (Faitic) |

| | |
|---|---|
| Laboratory practical | Personalized attention will be given to the students during class (throughout the possible questions that could arise) and during the specific timetable of the teacher for tutorships. Updated information of the tutorships timetables will be given to the students (Faitic) |

| Assessment | | | | | |
|---|---|---|---|---|---|
| | Description | Qualification | Evaluated Competencess | | |
| Problem solving | Resolutions of practical problems related with the contained imparted in one specific topic of theory | 8 | CG4 | | CT2<br>CT9 |
| Mentored work | Works of application and demonstration of basic principles of fluid mechanics | 2 | CG4 | | CT9 |
| Essay questions exam | Proof written that it will be able to consist of:<br>theoretical questions<br>practical questions<br>resolution of exercises/problems<br>fear to develop | 80 | CG4<br>CG5 | CE8 | CT2<br>CT9<br>CT10 |
| Laboratory practice | Practical realization in Laboratory. Report of the activities realized in the sessions of laboratory, results of the experimentation, etc. | 5 | CG4<br>CG5 | CE8 | CT2<br>CT9<br>CT10 |
| Objective questions exam | Short written proofs, that can be of practical questions of laboratory or of conteptos of theor | 5 | CG4 | CE8 | CT9 |

**Other comments on the Evaluation**

Continuous evaluation: it represents 20% of the note. Except official indication from the center direction of the renunciation of the student to the continuous evaluation, the student follows the course in this modality.

Continuous evaluation is considered until July, so the qualifications achieved in all the activities previously carried out are kept until the July Final Exam. The exact percentages may deviate slightly from those indicated due to the management, or feasibility of carrying out the different practical tests, and attributing to the complementary activity (work and projects) a higher qualification and, may even exceed 10 as the maximum qualification achievable.

In any case, the weight of 80% of the long answer test will remain unchanged.

The student is expected to exhibit adequate ethical behaviour. In case of noticing a non-ethical behaviour (copy, plagiarism, utilisation of unauthorised electronic devices, and others) it will be considered that the student does not gather the necessary requirements to pass the course. In this case, the global qualification of the present academic course will be failed (0.0). The use of any electronic device during the evaluation tests will not be allowed unless expressly authorized. The fact of introducing an electronic device not authorized in the exam room will be considered a reason for not passing the subject in this present academic course and the global qualification will be failed (0.0).

**Sources of information**

**Basic Bibliography**


Frank M White, **Mecánica de Fluidos/Fluid Mechanics**, VI,

Robert L. Mott, **Mecánica de fluidos**, VI,

Antonio Crespo, **Mecánica de fluidos**,


**Complementary Bibliography**


Robert W. Fox, Alan T. McDonald, **Introducción a la mecánica de fluidos**,

Merle C. Potter, David C. Wiggert ; con Miki Hondzo, Tom I.P. Shih, **Mecánica de fluidos/Mechanics of Fluids**, III,

Victor L. Streeter, E. Benjamin Wylie, Keith W. Bedford, **Mecánica de fluidos/Fluid Mechanics**, IX,

Yunus A. Çengel, John M. Cimbala, **Mecánica de fluidos : fundamentos y aplicaciones**,

Elena Martín Ortega, Concepción Paz Penín, **Prácticas de laboratorio de mecánica de fluidos**,

Philip M. Gerhart, Richard J Gross, , Jonh I. Hochstein, **FUNDAMENTOS DE MECANICA DE FLUIDOS**, II,


**Recommendations**

**Subjects that are recommended to be taken simultaneously**

Thermodynamics and heat transfer/V12G380V01302

**Subjects that it is recommended to have taken before**

Physics: Physics I/V12G380V01102
Physics: Physics II/V12G380V01202
Mathematics: Algebra and statistics/V12G380V01103

Mathematics: Calculus I/V12G380V01104
Mathematics: Calculus II and differential equations/V12G380V01204

**Other comments**

Recommends to the student:
Attend to class
Spend the hours outside the classroom studying the subject

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Mechanics of materials** | | | | |
| Subject | Mechanics of materials | | | |
| Code | V12G363V01404 | | | |
| Study programme | Degree in Industrial Technologies Engineering | | | |
| Descriptors | ECTS Credits | Type | Year | Quadmester |
| | 6 | Mandatory | 2nd | 2nd |
| Teaching language | Spanish<br>Galician | | | |
| Department | | | | |
| Coordinator | Caamaño Martínez, José Carlos<br>Riveiro Rodríguez, Belén | | | |
| Lecturers | Caamaño Martínez, José Carlos<br>Riveiro Rodríguez, Belén<br>Sánchez Rodríguez, Ana | | | |
| E-mail | jccaam@uvigo.es<br>belenriveiro@uvigo.es | | | |
| Web | http://faitic.uvigo.es | | | |
| General description | Introduction to linear elastic materials, and analysis of internal loadings, stress and strain relationships. Study of the fundamentals of mechanics of materials and particularization for shafts and beam structures. | | | |

| Competencies |
|---|
| Code |

| Learning outcomes | |
|---|---|
| Learning outcomes | Competences |

| Contents | |
|---|---|
| Topic | |
| 1. Introduction | 1.1 Introduction<br>1.2 Review of statics fundamentals and applied concepts for further progress in solid mechanics and stress analysis |
| 2. Basic principles of elasticity and mechanics of materials. | 2.0 Stress and strain. Linear elastic materials<br>2.1. Normal stress in an axially loaded prismatic bar.<br>2.2. Equilibrium of a deformable body.<br>2.3. Stress-Strain diagram of ductile materials. Hooke’s Law.<br>2.4. Stress resultants. Diagrams. |
| 3. Axial loads | 3.1. Normal forces.<br>3.2. Elastic deformation of an axially loaded member.<br>3.3. Statically governed problems.<br>3.4. Statically indeterminate problems.<br>3.5. Thermal stress and assembly misfits. |
| 4. Bending and shear | 4.1 Beams: definition and types. Loads on beams.<br>4.2 Internal shear forces and bending moments.<br>4.3 External load, shear force and bending moment relationships.<br>4.4 Shear and moment diagrams<br>4.5 Pure bending and non-uniform bending. Hypothesis and limitations.<br>4.6. Normal stresses in unsymmetric bending.<br>4.7 Symmetric bending. The flexure formula (Navier’s Law).<br>4.8 Section modulus of a beam. Ideal beam cross-section.<br>4.9 Deflection of beams and shafts. Slope and deflection.<br>4.10 Hyperstatic bending.<br>4.11 The shear formula. |
| 5. Introduction to compressive buckling | 4.1. Definition<br>4.2. Critical load. Euler's formula.<br>4.3. Limitations of Euler's formula.<br>4.4. Practical applications. |
| 6. Introduction to torsion | 6.1. Definition.<br>6.2. Torsion in circula shafts.<br>6.3. Torque diagrams..<br>6.4. Torsional stresses and deformations. |

| Planning | | | |
|---|---|---|---|
| | Class hours | Hours outside the classroom | Total hours |
| Lecturing | 32.5 | 49 | 81.5 |
| Laboratory practical | 9 | 23 | 32 |
| Project based learning | 9 | 24.5 | 33.5 |
| Essay questions exam | 3 | 0 | 3 |

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

| Methodologies | |
|---|---|
| | Description |
| Lecturing | Lecture where theoretical principles are presented using digital media, videos and blackboard. |
| Laboratory practical | Activities of application of the knowledge to concrete situations and of acquisition of basic skills and procedural skills related with the subject of study. |
| Project based learning | Resolution of problems related to real case studies |

| Personalized assistance | |
|---|---|
| **Methodologies** | **Description** |
| Laboratory practical | Resolution of doubts and personalized attention during office hours. |

| Assessment | | | |
|---|---|---|---|
| | Description | Qualification | Evaluated Competencess |
| Laboratory practical | A) it will evaluate the attendance and active participation in all the practicals of the semester, as well as the correct delivery (time and form) of all the documentation requested (reports, exercises, etc.).<br>Practical sessions will be held in a fixed date, so it is not possible to attend the practical in a later date. Whether the student does not attend to a practical, he/she must demonstrate that the absence was due to unavoidable reasons (e.g. medical reasons). Practicals will marked with the value indicated, only when the student reaches the minimum mark in the written exam, which is 45%. (See following section: 'Other comments') | 2.5 | |
| Project based learning | C) Written tests to evaluate the individual work delivered by the student. It will be compulsory the attendance to the 90% of the practicals to obtain the marks given in section C. The marks obtained in the sections A will proportionally affect to the marks of the section C. The section C will be marked with a maximum value of 12,5% of the total mark, only when the student reach the minimum mark in the written exam, which is 45%.<br>(See following section: 'Other comments') | 12.5 | |
| Essay questions exam | Written exam in the dates established by the School. | 85 | |

## Other comments on the Evaluation

Students resigning continuum assessment (after School aproval) will be evaluated only through the written exam which will be graded with 100% of final mark.

Continuum assessment is composed of sections A and C. The maximum mark for continuum assessment (NEC) is 15%, which will be computed from the following equation: NEC (%) = 0,25·(A) + 1,25·(C)·(A) ; where A and C are granted 0-1.

Ethical commitment: it is expected an adequate ethical behavior of the student. In case of detecting unethical behaviour (copying, plagiarism, unauthorized use of electronic devices, etc.) shall be deemed that the student does not meet the requirements for passing the subject. In this case, the overall rating in the current academic year will be Fail (0.0).

The use of any electronic device for the assessment tests is not allowed unless explicitly authorized. The fact of introducing unauthorized electronic device in the examination room will be considered reason for not passing the subject in the current academic year and will hold overall rating (0.0).

## Sources of information

### Basic Bibliography

Hibbeler, R., **Mechanics of materials**,

Manuel Vázquez, **Resistencia de materiales**,

**Complementary Bibliography**

Ortiz Berrocal, L., **Resistencia de materiales**, Ed. McGraw-Hill,

González Taboada, J.A., **Tensiones y deformaciones en materiales elásticos**, Ed. Autor,

González Taboada, J.A., **Fundamentos y problemas de tensiones y deformaciones en materiales elásticos**, Ed. Autor,

**Recommendations**

**Other comments**

Requirements: To register for this module the student must have passed or be registered for all the modules of the previous year.

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Termodinámica e trasmisión de calor** | | | | |
| Subject | Termodinámica e trasmisión de calor | | | |
| Code | V12G363V01405 | | | |
| Study programme | Grao en Enxeñaría en Tecnoloxías Industriais | | | |
| Descriptors | ECTS Credits | Type | Year | Quadmester |
| | 6 | Mandatory | 2 | 2c |
| Teaching language | Castelán | | | |
| Department | Enxeñaría mecánica, máquinas e motores térmicos e fluídos | | | |
| Coordinator | Santos Navarro, José Manuel | | | |
| Lecturers | Giraldez Leirado, Alejandro<br>Morán González, Jorge Carlos<br>Pazo Prieto, José Antonio<br>Santos Navarro, José Manuel | | | |
| E-mail | josanna@uvigo.es | | | |
| Web | | | | |
| General description | Na práctica totalidade dos procesos industriais requírese a aplicación dos Principios da Termodinámica e da Transferencia de Calor. O coñecemento destes principios é básico en Enxeñaría Térmica. Por exemplo, para a realización dunha análise enerxética (con determinación do rendemento enerxético e *exergético) de sistemas de potencia para a xeración de electricidade (ciclo combinado con *turbina de vapor e de gas), un ciclo de potencia mecánica, un ciclo en bomba de calor, etc. O coñecemento de se un proceso termodinámico pode ocorrer ou non na realidade é imprescindible para o deseño de novos procesos, así como o coñecemento das máximas prestacións que se poden obter nos diferentes dispositivos que compoñen unha instalación enerxética, e cales son as causas que imposibilitan obter esas máximas prestacións. Ademais, o estudo das propiedades termodinámicas dos fluídos de traballo que circulan polos dispositivos, auga, aire, *refrigerantes, gases e mestura de gases, é indispensable para analizar o comportamento dos sistemas térmicos. Así mesmo, o estudo do procedemento a seguir para a análise enerxética de instalacións enerxéticas de sistemas de refrixeración, acondicionamento de aire e en procesos de combustión é de gran interese.<br><br>Doutra banda, é interesante para o alumno coñecer os mecanismos polos cales se produce a transferencia da enerxía, principalmente debido a unha diferenza de temperaturas, centrándose en determinar a maneira e a velocidade á que se produce ese intercambio de enerxía. Neste sentido preséntanse o tres modos de transferencia de calor e os modelos matemáticos que permiten calcular as velocidades de transferencia de calor. Así se pretende que os alumnos sexan capaces de expor e resolver problemas *ingenieriles de transferencia de calor mediante o uso de ecuacións *algebraicas. Tamén se pretende que os alumnos coñezan outros métodos matematicamente máis complexos de resolución de problemas de transferencia de calor e saiban onde atopalos e como usalos en caso de necesitalos. | | | |

| Competencias |
|---|
| Code |

| Resultados de aprendizaxe | |
|---|---|
| Learning outcomes | Competences |

| Contidos |
|---|
| Topic |
| REVISIÓN DO PRIMEIRO E SEGUNDO PRINCIPIO DA TERMODINÁMICA |
| PROPIEDADES DE SUSTANCIAS PURAS: MANEXO DE TÁBOAS E *DIAGRAMAS |
| ANÁLISE DE SISTEMAS ABERTOS SEGUNDO A PRIMEIRA E SEGUNDA LEI DA TERMODINÁMICA |
| APLICACIÓNS DA ENXEÑARÍA TERMODINÁMICA: CICLOS DE POTENCIA E CICLOS DE REFRIXERACIÓN |
| CONCEPTOS E PRINCIPIOS FUNDAMENTAIS DA TRANSMISIÓN DE CALOR |
| TRANSMISIÓN DE CALOR POR CONDUCIÓN. CONDUCIÓN EN RÉXIME PERMANENTE *UNIDIRECCIONAL |

| |
|---|
| TRANSMISIÓN DE CALOR POR *CONVECCIÓN: FUNDAMENTOS E CORRELACIÓNS DE *CONVECCIÓN |
| TRANSMISIÓN DE CALOR POR RADIACIÓN: PRINCIPIOS XERAIS. RADIACIÓN TÉRMICA |
| APLICACIÓNS INDUSTRIAIS: INTERCAMBIADORES DE CALOR |

| **Planificación** | | | |
|---|---|---|---|
| | Class hours | Hours outside the classroom | Total hours |
| Lección maxistral | 32.5 | 65 | 97.5 |
| Prácticas de laboratorio | 6 | 0 | 6 |
| Resolución de problemas de forma autónoma | 0 | 18.5 | 18.5 |
| Resolución de problemas | 12 | 12 | 24 |
| Resolución de problemas e/ou exercicios | 0 | 3 | 3 |
| Exame de preguntas obxectivas | 1 | 0 | 1 |
| *The information in the planning table is for guidance only and does not take into account the heterogeneity of the students. | | | |

| **Metodoloxía docente** | |
|---|---|
| | Description |
| Lección maxistral | Exposición por parte do profesor dos contidos da materia obxecto de estudo, onde se procurará a máxima participación do alumno, a través da súa implicación directa na formulación de cuestións e/ou problemas, |
| Prácticas de laboratorio | Experimentación de procesos reais en laboratorio e que *complemantan os contidos da materia, completado con algunha práctica con software específico<br><br>CONTIDOS PRÁCTICOS: (polo menos realizaranse 3 das prácticas propostas)<br>1)Aplicacións do Primeiro Principio: Determinación Experimental dos Procesos *Isotermos e *Adiabáticos<br>2)Avaliando Propiedades Termodinámicas de Sustancias Puras mediante o uso de software informático<br>3)Estudo Experimental dun Ciclo de Vapor<br>4)Estudo Experimental dun Ciclo de Refrixeración por *Compresión de Vapor e funcionamento como Bomba de Calor<br>5)Cálculo Experimental da Condutividade Térmica en Placas<br>6)Avaliando a Transferencia de Calor por Radiación: Lei de *Stefan-*Boltzmann |
| Resolución de problemas de forma autónoma | Resolución de problemas e/ou exercicios relacionados coa materia que o alumno levará a cabo mediante a consulta da bibliografía |
| Resolución de problemas | Resolución de problemas e/ou exercicios relacionados coa materia que o alumno realizará en aula e/ou laboratorio. Resolveranse problemas de carácter "tipo" e/ou exemplos prácticos. Salientarase o traballo en expor métodos de resolución e non nos resultados. |

| **Atención personalizada** | |
|---|---|
| **Methodologies** | **Description** |
| Lección maxistral | Formulación de dúbidas en horario de *tutorias. O alumno exporá, durante o horario dedicado ás *tutorías, as dúbidas concernentes aos contidos que se desenvolven na materia, e/ou exercicios ou problemas que se expoñan relativos á aplicación dos contidos |
| Prácticas de laboratorio | Formulación de dúbidas en horario de prácticas. O alumno exporá, durante o horario dedicado ás prácticas, as dúbidas relativas aos conceptos e desenvolvemento das citadas prácticas |
| Resolución de problemas | Formulación de dúbidas en horario de *tutorias. O alumno exporá, durante o horario dedicado ás *tutorías, as dúbidas concernentes aos contidos que se desenvolven na materia, e/ou exercicios ou problemas que se expoñan relativos á aplicación dos contidos |

| **Avaliación** | | | |
|---|---|---|---|
| | Description | Qualification | Evaluated Competencess |

| | | |
|---|---|---|
| Resolución de problemas e/ou exercicios | Exame final escrito consistente na resolución de problemas de resposta extensa, ou exercicios e/ou cuestións teóricas, relativos aos contidos da materia desenvolvida (sesións de teoría, prácticas de laboratorio, etc.), e en tempo/condicións establecido/*as polo profesor<br><br>Este exame levará a cabo nas datas fixadas pola organización docente do centro<br><br>Resultados de aprendizaxe: Capacidade para coñecer, entender e utilizar os principios e fundamentos da termodinámica aplicada e a transmisión de calor | 80 |
| Exame de preguntas obxectivas | Ao longo do cuadrimestre realizaranse varias probas de seguimento.<br><br>A nota correspondente ás diferentes probas de seguimento estará baseada en probas escritas<br>de resposta curta.<br><br>Esta nota corresponderase coa denominación de Avaliación Continua | 20 |

**Other comments on the Evaluation**

***Modalidade de seguimiento por Avaliación Continua***.

A cualificación final (CF) do alumno determinarase sumando os puntos obtidos no exame final (EF) e os obtidos por avaliación continua (EC)

Non se esixirá unha nota mínima no exame final para sumar a correspondente nota de avaliación continua. En calquera caso é necesario obter unha cualificación final igual ou superior a 5 puntos para aprobar a materia.

Cada matricula na asignatura, no curso, supón a posta a cero das cualificacións nas actividades de avaliación continua obtida en cursos anteriores

Segundo a Normativa de Avaliación Continua, os alumnos suxeitos a Avaliación Continua que se presenten a algunha actividade evaluable recolleita na Guía Docente da asignatura, serán considerados como "presentados" e teráselles en conta para a cualificación final

Para a realización das probas consideradas como Avaliación Continua, a realizar ao longo do curso, o alumno deberá ir provisto dos materiais e/ou documentación necesarios pararealizarla: calculadora (non-programable), táboas e diagramas de propiedades daquelas sustancias que se estudan. Non se permitirá ningunha clase de formulario ou similar nestas probas

Nas diferentes probas de avaliación continua e exame final aconséllase ao alumnado que xustifiquen todos os resultados que consigan. Non se dará ningún resultado por ?sobreentendido? e terase en conta o método empregado para chegar á solución proposta

***Modalidade de renuncia á Avaliación Continua.***

Aqueles alumnos que obteñan oficialmente a renuncia á avaliación continua, utilizando as canles previstas pola escola, serán evaluados, nas datas oficiais fixadas polo centro das dúas convocatorias/edicións, mesmo día e hora, mediante unha avaliación específica. Esta proba de avaliación específica terá en conta todos os contidos impartidos na asignatura (teoría, problemas e prácticas de laboratorio), e supoñerá o 100% da nota máxima. Levarase a cabo da seguinte forma:

1.-Proba escrita (EF), cun peso do 80% sobre a cualificación final, idéntica ao exame final dos demais alumnos que seguen a avaliación continua

2.-Unha proba específica (EC), cun peso dun 20% sobre a cualificación final. Esta proba específica incluirá tanto os contidos de prácticas de laboratorio como os impartidos nas sesións de teoría

***Criterios de cualificación.***

En *primeira edición* da convocatoria ordinaria a cualificación do alumnado (CF) calcularase tendo en conta o criterio:

$CF = 0.2 \cdot EC + 0.8 \cdot EF$

En *segunda edición* da convocatoria ordinaria a cualificación do alumnado (CF) calcularase seguindo o criterio:

CF= máximo(N1, N2), sendo,

$N1 = 0.2 \cdot EC + 0.8 \cdot EF$

N2= EF

Empregarase un sistema de cualificación numérica de 0 a 10 puntos segundo a lexislación vigente (RD 1125/2003 de 5 de setembro, BOEde 18 de setembro)

Os exames da convocatoria fin de carreira poderán ter un formato de exame distinto ao detallado anteriormente.

Todas as probas, ben as correspondentes á Avaliación Continua como ao Exame Final, deberán realizarse a bolígrafo ou pluma, preferiblemente azul. Non se permitirá a entrega destas probas a lapis ou a bolígrafo vermello.

Non se permitirá, en todas a probas, ben consideradas de avaliación continua ou exame final, o uso de dispositivos electrónicos tales como tablet, smartphone, portátil, etc.

Compromiso ético .

Espérase que o alumno presente un comportamento ético adecuado. En caso de detectar un comportamento non ético (copia, plagio, utilización de aparellos electrónicos non autorizados, etc.), considerarase que o alumno non reúne os requisitos necesarios para superar a materia. Nese caso, a cualificación global no presente curso académico será de suspenso (0.0).

Nos e permitirá a utilización de ningún dispositivo electrónico durante as probas de avaliación, salvo autorización expresa. O feito de introducir un dispositivo electrónico non autorizado no aula de exame será considerado motivo de non superación da materia no presente curso académico e a cualificación global será de suspenso (0.0).

## Bibliografía. Fontes de información

### Basic Bibliography


Çengel, Yunus y Boles, Michael, **Termodinámica**, 7ª Edición, McGraw-Hill, 2012

Çengel Yunus A., Boles Michael A., **Thermodynamics : an engineering approach**, 7th ed, McGraw-Hill, 2011

Çengel Y.A., y Ghajar A.J., **Transferencia de Calor y Masa. fundamentos y aplicaciones**, 4ª edición, McGraw-Hill, 2011

Çengel, Yunus A., **Heat and mass transfer: a practical approach**, 4th ed, McGraw-Hill, 2011


### Complementary Bibliography


Çengel Y.A., **Introduction to Thermodynamics and Heat Transfer**, McGraw-Hill, 2008

Moran M.J. y Shapiro H.N., **Fundamentos de Termodinámica Técnica**, 2ª edición - castellano, Ed. Reverté, 2004

Merle C. Porter y Craig W. Somerton, **Termodinámica para ingenieros**, McGraw-Hill/Interamericana de España, 2004

Incropera F.P. y DeWitt D.P, **Introduction to Heat Transfer**, 2002

Wark, K. y Richards, D.E., **Termodinámica**, McGraw-Hill, 2010

Kreith J. y Bohn M.S, **Principios de Transferencia de Calor**, 2001,

Mills A.F., **Transferencia de calor**, 1995


## Recomendacións

### Subjects that it is recommended to have taken before

Física: Física II/V12G340V01202
Matemáticas: Cálculo I/V12G340V01104
Matemáticas: Cálculo II e ecuacións diferenciais/V12G340V01204