Universidad del País Vasco Euskal Herriko Unibertsitatea

ENGLISH FRIENDLY COURSES (EFC) 2022-2023 – CAMPUS OF BIZKAIA

https://www.ehu.eus/en/web/bilboko-ingeniaritza-eskola/hasiera
Coordinator: ingenieria.internacional@ehu.eus

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

English Friendly Courses taught in SPANISH:

FACULTY OF ENGINEERING – BILBAO (306)

	COURSE	SEMESTER	CREDITS	SCHEDULE[1]	LINK TO SYLLABUS
Common courses					
27323	Proyectos de Ingeniería	Annual	6	A	→
Bachelor`s Degree in Industrial Technology Engineering					
27315	Teoría de Mecanismos y Vibraciones Mecánicas	Annual	9	M	→
27317	Elasticidad y Resistencia de Materiales	Sep. 2022- Jan. 2023	6	M	→
27318	Automática y Control	Sep. 2022- Jan. 2023	6	M	→
27325	Materiales Estructurales: Comportamiento en servicio y mecánica de la fractura	Sep. 2022- Jan. 2023	6	A	→
27328	Cálculo de Máquinas	Sep. 2022- Jan. 2023	6	A	→
26047	Tecnología Mecánica	Jan. 2023- May 2023	6	A	→
27322	Cálculo Elástico de Sólidos	Jan. 2023- May 2023	6	M	→
Bachelor's Degree in Telecommunications Engineering					
27359	Arquitectura de Redes y Servicios de Telecomunicación	Annual	9	A	→
27308	Fundamentos de Ciencia de los Materiales	Sep. 2022- Jan. 2023	6	A	

[1] SCHEDULE: Morning (M)/ Afternoon (A): begins at 13.30.

Universidad del País Vasco Euskal Herriko Unibertsitatea

FACULTY OF ENGINEERING – BILBAO (306)					
	COURSE	**SEMESTER**	**CREDITS**	**SCHEDULE[1]**	**LINK TO SYLLABUS**
27352	Automatización y Comunicaciones Industriales	Sep. 2022- Jan. 2023	4,5	A	
27360	Electrónica de Circuitos	Sep. 2022- Jan. 2023	6	M	
27373	Comunicaciones ópticas	Sep. 2022- Jan. 2023	4,5	A	
27377	Redes y Servicios Móviles	Sep. 2022- Jan. 2023	4,5	A	
27383	Laboratorio de Sistemas Digitales	Sep. 2022- Jan. 2023	4,5	A	
27384	Análisis de Circuitos	Sep. 2022- Jan. 2023	4,5	M	
27386	Antenas y Propagación	Sep. 2022- Jan. 2023	4,5	A	
27389	Diseños basados en Microprocesadores	Sep. 2022- Jan. 2023	4,5	A	
26850	Sistemas de alta frecuencia	Jan. 2023- May 2023	6	M	
27347	Óptica Aplicada a las Telecomunicaciones	Jan. 2023- May 2023	6	A	
27362	Despliegue y Gestión de Redes y Servicios	Jan. 2023- May 2023	4,5	A	
27364	Laboratorio de Electrónica de Comunicaciones	Jan. 2023- May 2023	4,5	A	
27365	Teoría de la Comunicación	Jan. 2023- May 2023	7,5	A	
27374	Redes de Acceso	Jan. 2023- May 2023	6	M	
27375	Redes de Transporte	Jan. 2023- May 2023	6	M	
27376	Sistemas de Radiocomunicación	Jan. 2023- May 2023	6	M	
27380	Servicios Telemáticos Avanzados	Jan. 2023- May 2023	6	M	
27385	Campos Electromagnéticos	Jan. 2023- May 2023	6	A	
27388	Radar y sistemas de navegación por satélite	Jan. 2023- May 2023	4,5	A	
27390	Electrónica para la conversión de Energía	Jan. 2023- May 2023	6	M	
27833	Circuitos de Telecomunicación	Jan. 2023- May 2023	4,5	A	
Bachelor's Degree in Environmental Engineering					
27421	Reactores Químicos y Biológicos	Jan. 2023- May 2023	6	M	
27440	Gestión Ambiental en la Industria	Jan. 2023- May 2023	4,5	A	

Universidad del País Vasco Euskal Herriko Unibertsitatea

FACULTY OF ENGINEERING – BILBAO (306)

	COURSE	SEMESTER	CREDITS	SCHEDULE[1]	LINK TO SYLLABUS
Common courses in Technical and Industrial Engineering					
27682	Mecánica aplicada	Annual	9	A	→
27684	Gestión de Proyectos	Sep. 2022- Jan. 2023	6	A	→
Bachelor`s Degree in Mechanical Engineering					
27720	Ampliación de Expresión Gráfica	Sep. 2022- Jan. 2023	6	M	
27723	Tecnología Mecánica	Sep. 2022- Jan. 2023	6	M	→
26621	Estructuras y Construcciones Industriales	Jan. 2023- May 2023	9	M	→
27724	Diseño de máquinas	Jan. 2023- May 2023	9	M	→
27728	Mecánica de Fluidos Computacional	Jan. 2023- May 2023	6	A	→
Bachelor's Degree in Industrial Electronics and Automation Engineering					
25996	Sistemas electrónicos digitales	Jan. 2023- May 2023	6	M	→
Bachelor's Degree in Computer Engineering in Management and Information Systems					
26025	Sistemas de Gestión de Seguridad de Sistemas de Información	Sep. 2022- Jan. 2023	6	M	→
27700	Estructura de Datos y Algoritmos	Sep. 2022- Jan. 2023	6	A	→
27709	Administración de Sistemas	Sep. 2022- Jan. 2023	6	A	→
27710	Aspectos Profesionales de la Informática	Sep. 2022- Jan. 2023	6	M	→
27711	Minería de datos	Sep. 2022- Jan. 2023	6	A	→
27706	Administración de Bases de Datos	Jan. 2023- May 2023	6	M	→
27712	Desarrollo Avanzado de Software	Jan. 2023- May 2023	6	A	→
Bachelor's Degree in Civil Engineering					
27792	Infraestructura del Transporte	Annual	10,5	M	→

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FACULTY OF ENGINEERING – BILBAO (306)					
	COURSE	**SEMESTER**	**CREDITS**	**SCHEDULE[1]**	**LINK TO SYLLABUS**
26589	Ingeniería y Morfología del Terreno	Sep. 2022- Jan. 2023	6	A	
26595	Ingeniería Ambiental	Sep. 2022- Jan. 2023	6	A	
28357	Aplicaciones BIM en la Ingeniería Civil	Jan. 2023- May 2023	4,5	A	
27783	Acústica y Control de Ruido para Obras Civiles	Jan. 2023- May 2023	4,5	A	
27786	Sistemas de Información Geográfica	Jan. 2023- May 2023	4,5	A	

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GITECI30 - Bachelor`s Degree in Industrial Technology Engineering **Year** Fourth year

COURSE

26047 - Mechanical Technology **Credits, ECTS:** 6

COURSE DESCRIPTION

MANUFACTURING TECHNOLOGY subject is taught in 4th Course Degree in Industrial Technology and is the introduction to advanced subjects dealing with manufacturing processes at the Faculty of Engineering of Bilbao.
The course introduces students to the capabilities of key manufacturing processes (machining, forging, casting ...) and machine tools and equipment necessary to perform them. In addition, given its link with manufacturing, special attention is given to measurement technologies (Dimensional Metrology). Within this context, the course aims to address the need for students to be able to justify what manufacturing processes could be used for the production of a certain component.
On the other hand, it is intended that students can describe the equipment and calculate the most important parameters of a particular manufacturing process, and propose, under clear reasons, orders of magnitude of the fundamental parameters.
Finally, it is also intended that students can describe the drive systems and control of the machines used in the manufacture of parts. All this taking as general context the importance of the industry and machine tool accessories in the Basque Country and surroundings.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

M02R9 specific competence: Basic knowledge of production systems and manufacturing.

From these competences the following learning outcomes are derived:
-To be able to integrate the design requirements of a component in the productive means available in a particular manufacturing plant.
-To be able to design components and sets of machine tools, as well as to address the modifications in them to extract the maximum productive yield of them.
-To be able to integrate the techniques of metrology and quality control in the production chain.
-To be able to optimize the machining, casting and plastic deformation processes.
-To be able to select and design the tools and equipment needed to manufacture a specific component.
-To be able to obtain the maximum added value for a given component through the selection of the most suitable process.
-To be able to understand the consequences of the material -manufacturing process interaction, valuing the modification of functional and service properties that can suffer a certain component after the forming operations.

CONTENIDOS TEÓRICO-PRÁCTICOS

MODULE I. FOUNDRY
Lesson 1. Sand Casting
Lesson 2. Development of sand casting
Lesson 3. Permanent mold casting

MODULE II. PLASTIC FORMING
Lesson 4. General
Lesson 5. The forging process
Lesson 6. Forming sheet
Lesson 7. continuous and semi-continuous processes

MODULE III. MACHINING
Lesson 8. Turning (I): Process
Lesson 9. Turning (II): Machines
Lesson 10. Milling
Lesson 11. Drilling
Lesson 12. Cutting Tools
Lesson 13. Grinding
Lesson 14. Numerical Control

MODULE IV. DIMENSIONAL METROLOGY
Lesson 15. Introduction to Dimensional Metrology
Lesson 16. Operational and instruments
Lesson 17. Metrology surface finish

MODULE V. OTHER TECHNOLOGIES

Lesson 18. Sintering
Lesson 19. Introduction to welding processes

TEACHING METHODS

The teaching of the subject is articulated through the following instruments:

- Theoretical and practical classes (M and GA) taught in the classroom, where the teacher will explain the main concepts.

- Industrial workshop practices (TI): Students will be able to analyze the manufacturing processes of different workpieces, perform calculations corresponding to real problems and use instruments and machines similar to those that can be found in an industrial manufacturing workshop.

- Seminars (S): Students will be able to carry out calculations corresponding to machining problems to strengthen the knowledge acquired in the magistral lessons related to the machining module.

The contents of both the industrial workshop practices and the seminars are a necessary complement to the magistral lessons in order to establish the differences between different manufacturing processes and to observe real applications of these to industrial components. Given the importance of both, their content is a subject of examination, as well as the contents of magistral lessons (M) and classroom practices (GA). The industrial workshop practices and the seminars will be carried out by groups in the official schedules of the subject.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	6	15					9	
Horas de Actividad No Presencial del Alumno/a	45	9	22,5					13,5	

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 30%
- Multiple choice test 60%
- Teamwork assignments (problem solving, Project design) 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

There are two methods of evaluation:

CONTINUOUS EVALUATION
The acquisition of skills and the success of learning outcomes are ensured through continuous work of the student throughout the semester. Therefore we have designed a system of continuous evaluation with two objectives:
- Distribute student effort throughout the 15 weeks of the semester.
- Allow the self-assessment of learning outcomes.

Continuous assessment is based on the following milestones:
MILESTONE 1 week 7-8
- Test.
- Contents: Modules I and II (Items 1 to 7)
- Weight on the whole course: 30%

MILESTONE 2, week 12-14
- Numerical solution of a machining case-study
- Contents: Module III (Topics 8 to 12)
- Weight on the whole course: 30%

MILESTONE 3 Week 15
- Test.
- Contents: Modules III, IV and V
- Weight on the whole course: 30%

MILESTONE 4 Week 15
- Assistance to industrial workshop practices and delivery of the corresponding exercises conducted throughout the entire course as well as attending seminars.
- Weight on the whole course: 10%

The approved in the Continuous Assessment will be achieved if the following conditions are met:
- That the average of the marks is equal to or greater than 5.
- That the marks, in each and every one of the milestones, is equal to or greater than 4.5.

The approval of the Continuous Assessment exempts students of the final examination, with the score obtained in the continuous assessment.

Students who having made partially or completely continuous assessment, wish to resign must expressly inform teachers of their group.

FINAL EXAM
Students who do not achieve the results required in continuous learning assessment should take the final exam of the subject on the official dates. Under no circumstances partial Milestones of Continuous Assessment will involve release of material for the final exam.

The final exam will consist of:
- a test with the content of all modules, weight 60%
- a numerical resolution of a machining problem, weight 40%

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The extraordinary call is a single final exam. The criteria used are similar to those used in the Final Examination of ordinary calls.

MANDATORY MATERIALS

Teaching Guide available for free on the platform of Virtual Teaching at the UPV / EHU Student Guide, Course notes, Sheets practices and general information.

BIBLIOGRAFÍA

Basic bibliography

•American Society for Metals; Casting Design Handbook; American Society for Metals (ASM), 1962
•Beeley, P.R.; Foundry Technology; Butterworth-Heinemann, 2001
•American Society for Metals; Powder Metal Technologies and Applications ASM Handbook, Vol. 7, 1998
•Byrer, T.G., Semiatin, S.L., Vollmer, D.C.; Forging Handbook; Forging Industry Association/American Society for Metals, 1985
•Wick, C., Benedict, J.T., Veilleux, R.F.; Tool and Manufacturing Engineers Handbook. Vol 2. Forming; SME, 1984
•American Welding Society, Welding handbook, varios volúmenes.
•Jeffus, L., Welding. Principles and applications, Delmar Publishers, Inc., 1993.
•Davim, J. Paulo (Ed.); Machining Fundamentals and Recent Advances; Springer 2008.
•Metals Handbook. 9th Ed. Vol 16 Machining; ASM International, 1989
•Boothroyd, G., Knight, W.A.; Fundamentals of Machining and Machine tools, 2nd edition; Marcel Dekker, 1989.
•Arnone, M.; Mecanizado de alta velocidad y gran precisión. El Mercado técnico SL, 2000.
•Dotson C. L.; Fundamentals of Dimensional Metrology; Delmar Cengage Learning, 2006
•Farago, F.T.; Handbook of Dimensional Measurement. Industrial Press, 1982

Detailed bibliography

•Lopez de Lacalle, L.N.; Lamikiz, A. (Eds.); Machine Tools for High Performance; Springer 2009.
•Bucher J. L.; The Metrology Handbook; ASQ Quality Press, 2012.
•Casting Design Handbook; American Society for Metals (ASM).
•Campbell, J.; Castings; Butterworths-Heinemann, 1991.
•Byrer, T.G., Semiatin, S.L., Vollmer, D.C.; Forging Handbook; American Society for Metals (ASM).
•Pearce, R.; Sheet Metal Forming. Adam Hilger, 1991.
•Metals Handbook, 9th edition, vol. 14. Forming and forging. ASM International.
•López de Lacalle, L.N., Sánchez, J.A., Lamikiz, A.; Mecanizado de alto rendimiento: Procesos de arranque. Ediciones Técnicas Izaro, 2004
•Kieff, H.B. Manual de CNC. Gran Duc. 1998
•Galyer J.F.W., Shotbolt, C.R.; Metrology for engineers. Cassell Publishers Limited, 1990.

Journals

Scientific journals with articles directly related to the subject content and accessible from the library of the University of the

Basque Country UPV/EHU.

* Advanced Materials and Processes.
* Annals of the International Institution for Production Engineering Research (CIRP).
* IMHE (Información de Máquinas-Herramienta, Equipos y Accesorios).
* International Journal of Machine Tool and Manufacture
* Journal of Engineering Materials & Technology.
* Journal of Material & Processing Technology.
* International Journal on Production Research.

Web sites of interest

www.ehu.es/manufacturing

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Not Applicable

COURSE

26850 - High-frequency Systems **Credits, ECTS:** 6

COURSE DESCRIPTION

"High frequency systems" subject is one of the basic subjects of the 3rd year of Telecommunications Engineering Degree. It is located within the module called Telecommunication systems and it follows the ‘Electromagnetic Fields’ subject.

In this course, the main concepts and basic techniques of microwave engineering are studied, learning and analysing the behaviour of the circuits and the subsystem used with high frequency signals.

This course allows getting a knowledge of the technology of the microwave components which are part of a communication system that works with high frequency signals.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Ability to built, use and manage the networks, services, processes and applications of telecommunications, when they are understood as an acquisition systems, transportation, representation, processing, storage, management and presentation of multimedia information, from the point of view of the transmission systems.

Ability to apply the techniques in which the networks, services and applications of telecommunications are based, in both fixed and mobile scenarios, personal, local or long distance, with different bandwidths, including telephony, broadcast, television and data, from the point of view of the transmission systems.

Ability to analyze the components and their specifications for guided and no-guided communication systems.

Ability to select circuits, subsystems and systems of radiofrequency, microwave, broadcast, radio-link and radiodetermination.

Ability to select antennas, equipments and transmission systems, guided and no guided waves propagation by electromagnetic, radiofrequency or optical ways and the corresponding management of the radio electric space and the frequency allocation

Ability to analyze, encode, process and transmit multimedia information using analog and digital signal process techniques

CONTENIDOS TEÓRICO-PRÁCTICOS

High Frequency Technology:
- Smith chart
- Lines: Microstrip, stripline
- Impedance Mathing

High frequency network characterization
- S parameters
- High frequency circuits analysis

Passive devices:
- Resonators
- Power dividers and directional couplers
- Microwave filters

Active devices
- Detectors and mixers
- Control circuits bases on PIN diodes
- Amplifiers
- Osillators

LABORATORY PRACTICE: waveguide measurements, network analyser, passive devices measurements, active devices measurements.

TEACHING METHODS

In the lectures of this course the required knowledge will be explained in order to solve problems. The most of the class time will be devoted to solving problems.

In laboratory practice knowledge and skills will be acquired which complement the knowledge acquired in class.

In the event that health conditions prevent the performance of a teaching activity and / or evaluation in person, will activate a mode of non-presence of which students will be informed promptly.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30		7,5	22,5					
Horas de Actividad No Presencial del Alumno/a	45		11,25	33,75					

Legend:

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Exercises, cases or problem sets 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation has 2 sections:

Section 1) Evaluation by a final written exam of the lectures and classrooms practices

Section 2) Evaluation of the Laboratory practices
(attendance compulsory)
- Continuous assessment:
* Proposed practices reports
* Final written exam
-
+ Students have the right to be assessed by final assessment: they must report a written statement for such a claim, with a deadline of 9 weeks, starting from the beginning of the teaching period.
- Final assessment:
* Lab exam after the written exam (in the official examination date).
* Final written exam
-
Final mark of the subject: the course is passed with a global score equal to or greater than 5 points out of 10, being necessary to obtain a minimun mark of 5 of 10 in sections 1 and 2.

When the two sections are passed, the final mark will be calculated by the following formula:
0,6*(Section 1) + 0,4* (Section 2)

When one of the sections is failed, its mark is taken as the final mark.

The laboratory practice section mark, regarding Continuous assessment, is only available for the ordinary and extraordinary calls, it will not be saved for following calls.

Declining to sit: not attending the final exam call will be considered equivalent to a withdrawal (no examination attempt is used).

In case of health conditions do not allow the face-to-face teaching and/or evaluation activity, and on-line modality will be prepared and the students will be informed.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The students who have passed one section in the ordinary call are not required to do that section exam in the extraordinary call, although they have the option to do it.

In case of the student who does the pass section exam in the extraordinary call, the mark obtained in that section exam of the extraordinary call will be taken to calculate the final mark, even if it is lower than the obtained in the ordinary call.

Declining to sit: not attending the final exam call will be considered equivalent to a withdrawal (no examination attempt is used).

In case of health conditions do not allow the face-to-face teaching and/or evaluation activity, and on-line modality will be prepared and the students will be informed.

MANDATORY MATERIALS

Pozar D.M. "Microwave Engineering" Addison-Wesley

Scott A. W. "Understanding microwaves";John Wiley & Sons, Inc, 1993

Collin R.E. "Foundations for Microwave Engineering". McGraw-Hill

BIBLIOGRAFÍA

Basic bibliography

W. S. Cheung and F. I-I. Levien, "Microwaves Made Simple, Principles and Applications", Artech House, 1986.

S. Algery, W. S. Cheung and L. A. Stark, "Microwaves Made Simple, The Workbook", Artech House, 1986.

F. E. Gardiol, "Introduction to Microwaves", Artech House, 1984.

Detailed bibliography

K. F. Sander, "Microwaves Components and systems", Addison-Wesley, 1987

Bahl I. "Microwave Solid State Circuit Design"- John Wiley & Sons

Combes P.F. "Microwave Components, Devices and Active Circuits". John Wiley & Sons

Rizzi P.A. "Microwave Engineering: Passive Circuits". Prentice Hall

Chang K. "Microwave Solid State Circuits and Applications". John Wiley

Journals

Microwave and Wireless Components Letters, IEEE

Microwave Magazine, IEEE

Microwave Theory and Techniques, IEEE Transactions on

Microwaves, Antennas & Propagation, IET

Microwaves, Optics and Acoustics, IEE Journal on

Web sites of interest

Microwaves & RF http://mwrf.com

Minicircuits http://www.minicircuits.com/homepage/homepage.html

AMTI Microwave Circuits http://www.diplexers.com

Agilent Technologies http://www.home.agilent.com

http://www.engr.uky.edu/~gedney/courses/ee523/

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GITECI30 - Bachelor`s Degree in Industrial Technology Engineering **Year** Third year

COURSE

27315 - Theory of Mechanisms and Mechanical Vibrations **Credits, ECTS:** 9

COURSE DESCRIPTION

A mechanical engineer has the capacity of designing machines and solving several mechanical problems. To do so, an engineer must have a deep theoretical and practical knowledge. In particular, he/she must be able to explain the relation between structural topology, geometry, forces and motion of mechanisms and machines. All these concepts are the target of study of the subject Mechanism Theory and Mechanical Vibrations.

The aim of this subject is to teach students how to solve common problems in Mechanism Kinematics, as well as understanding the approaches in Machine Dynamics for solid or deformable bodies. Besides, the basic concepts of mechanical design are explained so that the students are introduced to the synthesis of mechanisms in charge of carrying out specific mechanical functions.

The knowledge acquired in this subject are of great relevance in the professional world of an engineer, covering several fields such as vibration analysis of automotive suspension systems, vibration modes testing in structural models, design and development of mechanisms and industrial robots destined to aeronautical aplications, motor vehicles manufacturing, object manipulation (Pick&Place applications), flight simulatior, etc.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The main goal of this subject consists in acquiring:

- Knowledge and abilities for computing, designing and testing machines.

The learning skills of the subject are:

- Understand the structures of both planar and spatial mechanisms; that is, the elements and kinematics pairs forming the mechanism, the number of degrees of freedom and the concept of kinematic chain.

- Learn the fundamental theorems of planar motion, which complement the concepts already illustrated in prior subjects as Mechanics and Applied Mechanics, to achieve the theoretical basis for the analysis and dimensional synthesis of mechanisms.

- Achieve the ability to perform kinematic analysis of planar and spatial mechanisms basing on the analytic and matrix-based procedures respectively. Study of rotation capacity, singular position analysis and quality indicators related to motion and force transmission of mechanisms.

- Use the classical methods for planar mechanism dimensional synthesis: function generation synthesis, trajectory-based synthesis and rigid solid guidance synthesis. Design of mechanisms intended for specific applications.

- Perform direct and inverse dynamic analysis of planar mechanisms (rigid solid hypothesis) basing on the principles studied in Applied Mechanics and specific procedures for desmodromic mechanisms.

- Perform the dynamic analysis of deformable solids of one or more degrees of freedom. Characterizing the systems subjected to mechanical vibrations taking into consideration different types of excitations such as impulse-based input, ramp-based input, step-based input, harmonic input or general type input.

- Achieve the ability to analyze vibratory systems with various degrees of freedom. Understand the concepts of vibration modes, natural frequencies and natural coordinates. Solve the systems subjected to free or forced vibrations.

- Obtain the knowledge related to the experimental vibrations measurement, describing the components forming the same. Achieve the capacity to test and justify the results obtained from the experimental analysis.

CONTENIDOS TEÓRICO-PRÁCTICOS

Part A: MECHANISM KINEMATICS

CHAPTER I: BASIC CONCEPTS ON MECHANISMS AND THEIR DESIGN
1.1. Basic concepts regarding mechanisms, machines and their design.
1.2. Classification of elements and kinematic joints.
1.3. Kinematic chains, mechanisms and inversions.
1.4. Grübler and Malishev criteria. Limitations.

1.5. Methods for structural synthesis of mechanisms.

CHAPTER II: PLANAR MOTION GEOMETRY
2.1. Planar motion of a rigid body. Acceleration and velocity fields.
2.2. Aronhold-Kennedy Theorem or Three centers Theorem.
2.3. Hartmann's Theorem. Euler-Savary Formula.
2.4. Bobillier's Theorem.
2.5. Conjugate profiles, Generalisation of the Euler-Savary Formula.
2.6. Main circles: inflections, Bresse and return circles.

CHAPTER III: KINEMATIC ANALYSIS OF PLANAR LINKAGES
3.1. Introduction: general problems of mechanisms kinematics.
3.2. Position analysis resolution. Rotability analysis.
3.3. Quality indicators: transmission angle and mechanical advantage.
3.4. Analytical methods for kinematic analysis.

CHAPTER IV: DIMENSIONAL SYNTHESIS OF PLANAR LINKAGES
4.1. Function generation synthesis.
4.2. Trajectory generation synthesis.
4.3. Rigid body guidance synthesis.

CHAPTER V: KINEMATICS ANALYSIS OF SPATIAL ROBOTS
5.1. Representation of an object location: transformation matrices.
5.2. Matrix-based method.
5.3. Position analysis of spatial mechanisms.
5.4. Accelerations and velocities analysis.

Part B: MACHINE DYNAMICS

CHAPTER I: MECHANISM DYNAMICS (rigid body dynamics)
1.1. Introduction to Machine Dynamics.
1.2. Inverse dynamic problem.
1.3. Direct dynamic problem.
1.4. Flywheels.
1.6. Machine balancing

CHAPTER II: THEORY OF VIBRATIONS (deformable body dynamics)
2.1. Introduction to Theory of Vibrations.
2.2. Modelization of mechanical systems.
2.3. Single degree of freedom systems I: free vibrations.
2.4. Single degree of freedom systems II: harmonic vibrations.
2.5. Single degree of freedom systems III: convolution integral.
2.6. Single degree of freedom systems IV: Fourier transformation.
2.7. Single degree of freedom systems V: vibrations isolation.
2.8. Multi-degree of freedom systems I: free vibrations.
2.9. Multi-degree of freedom systems II: forced vibrations.
2.10. Introduction to experimental measurement of vibrations.

TEACHING METHODS

The teaching program of the subject is composed of theoretical lectures, practical lessons, seminars, practical lectures and labs.

The practical lectures reinforce and complement the knowledge acquired from the theoretical lectures and seminars, and constitute an essential part of the learning process. Practical lectures consist in using computational simulation software and experimental analysis systems to solve some practical cases of mechanical systems' analysis and design. In the first term, Part A, two practical lectures (each of 2,5 hours) using specific software are given. In the second term, Part B, one practical lecture of 2,5 hours is given in the mechanical lab.

These lectures are given in the computer rooms of the University, and in the labs belonging to Department of Mechanical Engineering.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	45	7,5	30		5			2,5	
Horas de Actividad No Presencial del Alumno/a	67,5	11,25	45		7,5			3,75	

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 95%
- Exercises, cases or problem sets 5%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

According to the regulations of the University of the Basque Country, a continuous evaluation has been established, which consists in:

- Practicals in mechanical labs and laboratories. In order to pass the practicals the student must attend to all of them and present the corresponding report, adequately completed, in the established date.

- An exam related to the first part of the subject; Mechanisms Kinematics. To pass the exam the student must get a mark equal or higher than 5. Passing this exam implies that the student is released of the corresponding part of the subject during the current academic course.

- A final exam.

Notes about the final exam:

a) In the case of the students that have passed the exam of Mechanisms Kinematics, the final exam will consist of the remaining contents of the subject, that is, Machine Dynamics. To pass the exam the student must get a mark equal or higher than 5.

b) The students that have not passed the exam of Mechanisms Kinematics, they will have a final exam that covers the total programme of the subject. To pass the exam the student must get a mark equal or higher than 5.

c) If someone does not attend to the final exam, then the result will be "Not Attended".

Mark of the subject once the final written exam has been passed:

a) To those students that have passed the written exam related to Mechanisms Kinematics:
- 95% arithmetic average of the 2 written exams (Exam of Mechanisms Kinematics and exam of Machine Dynamics).
- 5% mark of the practicals.

b) To those students that have not passed the written exam related to Mechanisms Kinematics:
- 95% final written exam.
- 5% mark of the practicals.

Conditions to pass the subject:

Pass the written final exam and obtain a mark of the subject equal or higher than 5.

Attendance to exams:
In the face of any circumstance that does not allow the student to attend the exam, this fact will be regulated according to the current regulations of the UPV/EHU.

Claim of exams:
The marks are published in Egela and, in the case of the final exams, they are simultaneously published in GAUR system. Once the marks have been published, the students who want to claim the exam have to indicate it in the established

period of time. The claims of the students that do not indicate it, or that despite of indicating they do not come in the corresponding revision day at established timetable, will not be heeded. All this is done with the purpose of dedicating the necessary time to the revision process, and giving an equitable and fair solution to each claim.

Resignation:
As it is specified in the "Normativa Evaluación de Enseñanzas de Grado" any student that wants to resign from the continuous evaluation in order to do the final evaluation, then he/she has to present the resignation document to the teachers in charge of the subject in the period of 18 weeks counting from the starting of the course, according to the academic calendar of the faculty. The final evaluation implies a unique final exam which is the 100% of the final grade.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

According to the regulations of the University of the Basque Country, a continuous evaluation has been established, which consists in:

- Practicals in mechanical labs and laboratories. In order to pass the practicals the student must attend to all of them and present the corresponding report, adequately completed, in the established date.

- An exam related to the first part of the subject; Mechanisms Kinematics. To pass the exam the student must get a mark equal or higher than 5. Passing this exam implies that the student is released of the corresponding part of the subject during the current academic course.

- A final exam.

Notes about the final exam:

a) In the case of the students that have passed the exam of Mechanisms Kinematics, the final exam will consist of the remaining contents of the subject, that is, Machine Dynamics. To pass the exam the student must get a mark equal or higher than 5.

b) The students that have not passed the exam of Mechanisms Kinematics, they will have a final exam that covers the total programme of the subject. To pass the exam the student must get a mark equal or higher than 5.

c) If someone does not attend to the final exam, then the result will be "Not Attended".

Mark of the subject once the final written exam has been passed:

a) To those students that have passed the written exam related to Mechanisms Kinematics:
- 95% arithmetic average of the 2 written exams (Exam of Mechanisms Kinematics and exam of Machine Dynamics).
- 5% mark of the practicals.

b) To those students that have not passed the written exam related to Mechanisms Kinematics:
- 95% final written exam.
- 5% mark of the practicals.

Conditions to pass the subject:

Pass the written final exam and obtain a mark of the subject equal or higher than 5.

Attendance to exams:
In the face of any circumstance that does not allow the student to attend the exam, this fact will be regulated according to the current regulations of the UPV/EHU.

Claim of exams:
The marks are published in Egela and, in the case of the final exams, they are simultaneously published in GAUR system. Once the marks have been published, the students who want to claim the exam have to indicate it in the established period of time. The claims of the students that do not indicate it, or that despite of indicating they do not come in the corresponding revision day at established timetable, will not be heeded. All this is done with the purpose of dedicating the necessary time to the revision process, and giving an equitable and fair solution to each claim.

Resignation:
As it is specified in the "Normativa Evaluación de Enseñanzas de Grado" any student that wants to resign from the continuous evaluation in order to do the final evaluation, then he/she has to present the resignation document to the

teachers in charge of the subject in the period of 18 weeks counting from the starting of the course, according to the academic calendar of the faculty. The final evaluation implies a unique final exam which is the 100% of the final grade.

MANDATORY MATERIALS

The work material of the subject that is available to the students, directly given by the teachers, is the following:

- The Student Guide of the subject.

- Guides for the preparation and accomplishment of the practical lectures of the subject.

- Simulation software for the computer-based practical lectures:

GIM, software for kinematic analysis and simulation of planar mechanisms (COMPMECH Research Group: Hernández, A.; Altuzarra, O.; Pinto, Ch.; Petuya, V.; Amezua, E.; Macho, E; Corral, J.; Diez, M.; Urízar, M.; Herrero, S.; Campa, F.J.)

User guide of GIM software (COMPMECH Research Group) Available in electronic format in Egela web site.

- ABB IRB 120 Robot.

- ADEPT Cobra e-vario 600 Robot.

- Parallel robot Physik Instrumente H-840.

- FANUC S-10 Robot.

- Work material for the lab lecture:

Experimental system of one degree of freedom for the measurement of transmissibility.

Digital signal analyser DI 2200, accelerometers, bending beam models and simplified building models, excitation table, signal generator and stroboscope.

BIBLIOGRAFÍA

Basic bibliography

The teachers will use the following reading material to teach the subject:

- Hernández, A.; CINEMÁTICA DE MECANISMOS. ANÁLISIS Y DISEÑO. ISBN: 84-7738-224-0. Ed. Síntesis, 2004. Available at the publications' department of the University- Sección de publicaciones Escuela de Ingeniería de Bilbao, and in the bookshoop Bilbao Herriak (Licenciado Poza, 11), and Casa del Libro (Alameda Urquijo, 9).

- Hernández, A.; Aguirrebeitia, J.; Petuya, V.; Pinto, Ch.; DINÁMICA DE MÁQUINAS. ISBN: 978-84-9171-271-8. Editorial Síntesis, 2019. Publications' department of the University- Sección de publicaciones Escuela de Ingeniería de Bilbao

- Agirrebeitia, J.; Hernández, A.; Pinto, Ch.; Petuya, V.; BIBRAZIOEN TEORIA, OINARRIZKO JAKINGARRIAK. ISBN 84-95809-17-6. Publications' department of the University- Sección de publicaciones Escuela de Ingenierías de Bilbao, 2004.

- Compilation of exams. In Egela website.

Detailed bibliography

The students that are interested in studying some concepts in greater depth, have many books, journals, regulations and catalogs available at the university library and at the department of Mechanical Engineering. It is recommended to previously ask for advice to the teacher so that the student gets to know the best choice. A representative bibliography is the following:

- Uicker, J.J. (Jr.); Pennock, G.R.; Shigley, J.E. Theory of Machines and Mechanisms. Oxford University Press, 2003.
- Erdman, A. G.; Sandor, G. N.; Mechanism Design. Analysis and Synthesis. Prentice-Hall, 1997.
- Norton, R. L.; Diseño de Maquinaria, 1995.
- Waldron, K.J; Kinzel, G.L; Kinematics, Dynamics and Design of Machinery. John Wiley & Sons Inc, 1999.
- Shabana, A. A.; Theory of Vibration. An introduction. Springer, 1996.

Journals

- Mechanism and Machine Theory.
- Journal of Mechanisms and Robotics.

- IEEE Transactions on Robotics.
- Advanced Robotics.
- Robotica.
- Computer Applications in Engineering Education.
- Journal of Mechanical Design.

Web sites of interest

www.ehu.eus/compmech/software/
www.thinkmotion.eu
www.dmg-lib.org
http://kmoddl.library.cornell.edu
www.technologystudent.com
www.howstuffworks.com
www.biblioteka.ehu.eus

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GITECI30 - Bachelor`s Degree in Industrial Technology Engineering **Year** Third year

COURSE

27317 - Elasticity and Strength of Materials **Credits, ECTS:** 6

COURSE DESCRIPTION

The engineer dedicated to the design of structures and mechanical elements must own an important theoretical and practical knowledge. In particular, he should be able to explain the relationship between a particular structural member with the stresses to which it may be subjected, either in the form of applied forces, temperature variations, support displacements, etc., and the stresses and strains originated in the structure, all of which constitute the primary object of the "Elasticity and Strength of Materials". Among the different types of structures that could be considered, the course focuses on the analysis of structures formed by prismatic bars.
The content of the course is divided into two distinct blocks. After a first subject in which the student is introduced into the behavior of deformable solids and the concept of structure, in the following four topics the basics of the Theory of Elasticity are presented: stresses, strains, constitutive laws and elastic problem resolution, with particular attention to the problems of two-dimensional elasticity and a brief presentation of the most relevant experimental methods to obtain stresses and strains. This first block is concluded with a theme, theories of failure, which serves as a transition between the field of Elasticity and the following topics belonging more specifically to the Strength of Materials.
In the first topic of the second block, after describing the different types of structures formed by prismatic bars, the analysis of section forces and moments is addressed in these elements. A theme is dedicated to the analysis of simple lattices subjected to axial forces. In the last two themes the stresses and strains caused in pure bending and simple bending are studied, and this knowledge is applied to the resolution of isostatic structures.
This course is part of the curricular line of Mechanical Engineering and, therefore, is based on the subjects of 2nd course "Mechanics" and "Applied Mechanics" whose knowledge and mastery are essential to understand the behavior of structures and other mechanical parts considered as deformable solids. Obviously, the student should also have a good grasp of the fundamental concepts of "Algebra" and "Calculus" studied in the first year. Another link can also be found with another subject taught in the third year, "Theory of Mechanisms and Mechanical Vibrations", a discipline that helps determine the forces undergone by the elements of a mechanism, and from which stresses and strains can be obtained by means of the "Elasticity and Strength of Materials". In this way a proper design ensuring system integrity can be obtained.
The knowledge acquired in this subject also form the basis of other mechanical-type subjects of the fourth year such as "Theory of Structures and Construction", where new methods are shown in the calculation of structures formed by prismatic bars. It is also evident the relationship with the subjects "Theory of Machines" and "Machine Elements", where it is essential to obtain stresses and strains and to apply the corresponding theories of failure. Finally, the "Elasticity and Strength of Materials" is also basic for some subjects included in several Master courses: in the "Master in Mechanical Engineering" (a continuation of the Degree in Mechanical Engineering) and in the "Master in Industrial Engineering" (a continuation of the Degree in Industrial Technology Engineering).

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The competence of the subject, for the common module of the Industrial Branch, and reflected in the memory of the degree is:
- Knowledge and use of the principles of strength of materials.
As a result of learning it is expected that the students are able to:
- Acquire the basic knowledge governing the Theory of Elasticity, fundamental for analyzing the behavior of deformable solids and therefore for the analysis of Strength of Materials.
- Establish the basic equations in the analysis of solids with linear elastic behavior and the range of application of the linear-elastic theory.
- Know the criteria for the selection and use of different failure theories in the calculation of structures.
- Become familiar with some of the experimental techniques used in the calculation of stresses and strains in structures.
- Be able to calculate the stresses and strains in lattices, both isostatic and statically indeterminate. For these latter structures special emphasis is placed on the use of the force method.
- Be able to determine the stresses and strains in isostatic structures subjected to bending.

CONTENIDOS TEÓRICO-PRÁCTICOS

THEORETICAL CONTENTS

1. INTRODUCTION
2. CONCEPT OF STRESS
3. GENERAL THEORY OF STRAIN
4. THE ELASTIC SOLID
5. THE ELASTIC PROBLEM
6. THEORIES OF FAILURE

7. INTRODUCTION TO THE STRENGTH OF MATERIALS. PRISMATIC BAR STRUCTURES
8. AXIAL FORCE IN A TRUSS STRUCTURE
9. GENERAL THEORY OF BENDING. STRESS ANALYSIS
10. GENERAL THEORY OF BENDING. STRAIN ANALYSIS

LABORATORY PRACTICES
SESSION 1. THE TENSION TEST
SESSION 2. EXTENSOMETRY

TEACHING METHODS

The contents of the subject "Elasticity and Strength of Materials" are taught through lectures, practical classes, seminars and laboratory practice.
In the lectures the contents and theoretical concepts of each topic are presented with the aid of some specific publications available to the student and by the resolution of practical exercises.
In the practical classes problems based on structures and mechanical systems are solved in order to consolidate the concepts presented in the lectures.
Throughout the semester three seminars are held, in which larger problems as well as exams of previous editions are solved. The arrangement in small seminar groups propitiates an interactive resolution of problems between the professor and the students.
Along the course two laboratory practices are performed, the first corresponding to the tension test and the second dedicated to the experimental measurement method of extensometry. The practices are carried out in the "Laboratory of Strength of Materials and Structures" of the Department of Mechanical Engineering. Previously, and depending on each practice, students individually or divided into groups initially attend a theoretical presentation and solve analytically some exercise related to the practice. During the session, students are divided into smaller groups so as to carry out experimental measurements and validate their calculations. At the end of each practice, students must submit a report with the results and final conclusions.
On the virtual platform eGela, the following material is available to the students: the Student Guide, a collection of review exercises, some problems to be solved in the seminars and other problems from the examination sessions, together with the results and exam grades. All subject groups have at their disposal the same material simultaneously.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	22,5	4,5	30					3	
Horas de Actividad No Presencial del Alumno/a	33,75	6,75	45					4,5	

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 95%
- Exercises, cases or problem sets 5%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In this subject a partial exam is proposed that allows reducing contents in the final exam. It will be assumed that by not doing or not obtaining the required grade in this partial exam the student is giving up the continuous assessment system.
The requirements for passing the course are:
1. Attend all laboratory practices.
2. Get an average rating greater than or equal to 5.0.
The laboratory practices account for 5% and the written tests for 95% of the final grade. The written tests consist of individual resolution of problems and theoretical questions. The first written test enables to pass definitively the first part of the course (for this it is necessary to obtain a rating equal to or greater than 4.0). In the second part of the course, a score equal to or greater than 3.5 should be obtained in order to be able to get a pass average. The final grade is the average of the two partial tests. Students may also make a full examination even after having passed the first of the written tests. The theoretical part of the exam is in any case one third of the mark for each exam.
According to the current regulations of the University of the Basque Country - EHU, it is sufficient for the student not to present himself to give up the corresponding call.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary examination a written exam including the full course will be performed. This will consist of individual resolution of problems and theoretical questions. The theoretical part accounts for one third of the exam. The final grade will be obtained by taking the laboratory practices into account.
As in the ordinary call, to give up this call it will be sufficient for the student not to present himself.

MANDATORY MATERIALS

- "Elasticidad y Resistencia de Materiales", José Luis Alcaraz, Rubén Ansola, Javier Canales, José A. Tárrago, Estrella Veguería. Sección de Publicaciones de la E.T.S.I. de Bilbao, 2015.
- "Elasticidad y Resistencia de Materiales: Colección de Problemas de clase", José Luis Alcaraz, Rubén Ansola, Javier Canales, José A. Tárrago, Estrella Veguería. Sección de Publicaciones de la E.T.S.I. de Bilbao, 2016.

BIBLIOGRAFÍA

Basic bibliography

- "Elastikotasuna eta Materialen Erresistentzia", Rubén Ansola. UEU, Udako Euskal Unibertsitatea, 2005.
- "Resistencia de Materiales". L. Ortiz Berrocal. McGraw-Hill, 1991.
- "Mecánica de Materiales" (2ª ed.), S.P. Timoshenko y J.M. Gere. Grupo Editorial Iberoamericana, 1986.
- "Mecánica de Materiales" (2ª ed.), F.P. Beer y E.R. Johnston. McGraw-Hill, 1993.
- "Resistencia de Materiales", V.I. Feodosiev. Mir, 1980.
- "Problemas de Resistencia de Materiales", I. Miroliúbov et al. Mir, 1978.

Detailed bibliography

- "Advanced Mechanics of Materials (6th Ed.)", A.P. Boresi y R.J. Schmidt. John Wiley & Sons, 2003.
- "Advanced Strength and Applied Elasticity", A.C. Ugural y S.K. Fenster. Prentice Hall, 1995.
- "Mechanics of Materials (2nd Ed.)", R.R. Craig Jr. John Wiley & Sons, 2000.

Journals

- Int. J. of Mechanical Sciences, Elsevier.
- Int. J. of Solids and Structures,Elsevier.
- Mechanics of Materials, Elsevier.
- Computers & Structures, Elsevier.

Web sites of interest

- https://egela.ehu.es/
- http://www.ehu.eus/es/web/ingenieria-mecanica
- es.scribd.com/doc/305851/Resistencia-de-materiales-Problemas-resueltos
- es.wikipedia.org/wiki/Resistencia_de_materiales

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GITECI30 - Bachelor`s Degree in Industrial Technology Engineering **Year** Third year

COURSE

27318 - Automation and Control **Credits, ECTS:** 6

COURSE DESCRIPTION

Control systems are very present in our daily life. Examples of its applications can be found at home (temperature control, anti-theft system or mobile phone apps), in transportation systems (such as ABS or traction control of a car, or cruise control of planes), in industry (pharmaceutical, machine tool or process industry) or in the control of the traffic over the Internet. Areas such as economics, biology or medicine have also a wide range of applications that require the use of control systems.

A synthesized automatic control system has a clear goal: to achieve a system (machine, process or device) to behave in a certain way with minimal human intervention. If the control system has "feedback", then it is able to measure the behaviour of the controlled system and correct it if it deviates from the desired one. Feedback is a feature of life, as every organism share the ability to measure their own state, and make the required changes if necessary. Feedback determines how we grow, how we respond to stress or how we regulate body temperature, blood pressure or cholesterol level. Hence, control does not only make our life easier, but it is critical to our own existence.

Automatic control systems are inherently multidisciplinary. It is typically formed by sensors (to measure), actuators (in order to make changes on the system), computers and software (to calculate and make decisions).

The analysis and design of control systems requires the following knowledge:
-Knowledge of the domain of the process to be controlled (in this case, Engineering areas)
-Knowledge of control techniques
-Knowledge of the actuator and sensor technologies
-Knowledge of Real-Time systems
-Knowledge of actuator and sensor networks

This subject focuses on how to use knowledge of processes from different disciplines (physics, chemistry, mechanical, electrical, ...) acquired in other subjects previously studied and the use of previously studied mathematical tools (differential equations and Laplace transform) in the analysis and design of control systems.

This aim is achieved by the following contents:

THEORETICAL contents to address modelling examples of real systems, their mathematical representation and their model-based dynamic behaviour analysis.
METHODOLOGY contents to address the different phases of a feedback control system design which ensures that the behaviour of a system lies always within some bounds.
EXPERIMENTAL contents to show the effect of controller design in real systems (scale models of simple industrial systems).

This subject is related with the following ones in the Bachelor studies: the controller design techniques for computer implementation are studied in the pre-intensification subject "Computer-based Control", while the more technological subject "Industrial Automation" is focused on the logic control and sequential control of Industrial Processes".

The Real-Time programming concepts, networks, robotics and advanced control techniques are studied in several subjects in the Master.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

As the verified report of "Bachelor’s Degree in Industrial Technology Engineering" states, the skills and learning outcomes to be developed in this subject are:

-M02R6 Knowledge of the basics of automatic systems and control methods.

-LO Automatic and control Systems design for machines and industrial facilities.

CONTENIDOS TEÓRICO-PRÁCTICOS

LECTURES:

Lesson 1 Introduction. Open and Closed Loop control. Automatic and Manual Control. Main variables identification. Block Diagram of a system. Feedback Loop. Elements of the control loop.
Lesson 2 Dynamic System Modelling and External Representation. System Mathematical Modelling. Linearization. Laplace transform. Differential equations and transfer function. Impulse Response. Transfer function and Impulse Response relationship.
Lesson 3 Time Domain Analysis. Test signals. Time response of first order, second order and great order systems. Experimental system identification.
Lesson 4 Feedback System Analysis. Feedback Systems. Stability of Feedback Systems. Definition and creation of the Root Locus. Steady state analysis.
Lesson 5 Control System Design. PID Control: actions and parameters. Common algorithms. PID design and tuning approaches. Model-based analytical design methods. Experiment-based design methods.
Lesson 6 Frequency Domain Analysis. Transfer function and frequency response relationship. Graphical representation of the frequency response. Identification of systems based on the frequency response. Steady state error. Relative stability of Feedback Systems.

LABORATORY SESSIONS:

The laboratory sessions are essential to acquire the knowledge on control systems and emphasize the basic concepts of Automatics and Control subject.
P1: Experimental indentification (with real scale models)
P2: Feedback systems and Root Locus (in simulation)
P3: Experimental Design of PID Controllers (in simulation)
P4-5: Analythical Design of PID Controllers (with real scale models)

TEACHING METHODS

The aim of the subject is to provide the student with the necessary tools to design a control system, applying the basic control concepts to each step of the design process: modelling, analysis and design.

The lectures are used to explain the theoretical concepts while emphasizing their importance and their application context.

The seminars are used to strengthen the theoretical concepts by means of the resolution of practical exercises. In some sessions, concepts related with the laboratory sessions will be analysed, so that the preparation work required for the Laboratory Sessions is reinforced. Moreover, students are encouraged to work in teams to discuss their design results.

The laboratory sessions are focused on the different stages of a control system design and validation. Some of these sessions are focused on using real scale processes in which students work in teams, while others are based on the use of simulation software that will be handled individually.

In order to get the most of the seminars and the laboratory sessions, a proper preparation work is mandatory. The Seminar and Laboratory Notebook is the required tool to achieve this goal.

This way, students will fill the exercises and questions proposed in this notebook prior and during these sessions. This Notebook could be required by the lecturers at any time to analyse the progression of the students and provide with feedback.

All the information related with the subject (theory, simulation software) is available in the virtual platform eGELA: https://egela.ehu.es/. Hence, students should access regularly to the web page, as it will, in addition, be used to notify students with all matters related to the subject.

NOTE: If the sanitary conditions fue to the pandemic do not allow in-person activity or evaluation, a telematic mode will be activated.

SOFTWARE USED:

-Labview based tool:Analysis, simulation and control tool for real scale models
-Virtual Platform (eGELA):Communication platform in which students will find the information related with the subject.
-Virtual Platform (GOODLE):Web-based evaluation platform

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	37,5	15		7,5					
Horas de Actividad No Presencial del Alumno/a	56,25	22,5		11,25					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Multiple choice test 20%
- Exercises, cases or problem sets 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation system used in this subject is of mixed type (being a subtype of the continous evaluation), combining continuous evaluation and final exams, as detailed in Normativa de gestión para las enseñanzas de grado y de primer y segundo ciclo.

The evaluation tools to be used are:

-Partial written exam. Test type questions, open answer questions or problems can be found. 20%. Learning outcome: LO1-4
-Practical Sessions Evaluation. By using reports, results delivery or autoevaluation tools. 10%. Learning outcome: LO1-5
-Final written exam. Test type questions, open answer questions or problems can be found. 70%. Learning outcome: LO1-6

In order to pass the subject, it is required to obtain at least 50% of the mark using the aforementioned tools. Moreover, it is mandatory to pass the written final exam, this is obtaining at least the 50% of the mark associated to this part. If 50% of the mark is not achieved in this part, the final mark of the subject will be the one of the final written exam (considering a 10 points basis).

As it is detailed in the Normativa de gestión para las enseñanzas de grado y de primer y segundo ciclo, students can resign to the continuous evaluation in the Ordinary Call. This resignation must be formalised by presenting the corresponding document (provided by the lecturer) signed by the student in the Department of Automatics and System Engineering secretary’s office. This document must be formalised in the first 9 weeks of the course (according to the official course calendar) to be valid.

A a complementary exam will be carried out for the students that have resigned to the continuous evaluation to evaluate the 30% of the mark associated to this part. This complementary exam will be carried out the day of the final written exam, and will be written and/or in the laboratory, evaluating the concepts equivalent to those covered in Seminar and Laboratory sessions. This is, the mark of these students will be obtained by the mark of a final written exam (70%) and the complementary exam (30%).

The unattendance to the official final exam, will automatically imply a resignation to the call. The resignation to the ordinary or extraordinary call will imply a "No-Show" mark.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The final mark in the extraordinary call will be calculated by several exams that will evaluate all theoretical and practical concepts covered by the subject. The structure of the exams will be similar to those of the ordinary call, this is, a final written exam (70%), and a complementary exam (30%).

Students that have not resigned to the continuous evaluation will have the right to maintain the mark associated to this concept (%30), being exempt of the complementary exam. The final mark will be calculated by combining the final written exam (70%), and the continuous evaluation mark (30%).

Students that have not resigned to the continuous evaluation can choose not to maintain the mark associated to this concept (%30). This resignation to the maintenance of the continuous evaluation mark must be formalised by presenting the corresponding document (provided by the lecturer) signed by the student in the Department of Automatics and System Engineering secretary’s office. This must be formalised at least a month before the official extraordinary call exam date. The final mark will be calculated for this students by combining the final written exam (70%), and the complementary exam (30%).

For those students that have already resigned to the continuous evaluation in the ordinary call, the final mark will be calculated by combining the final written exam (70%), and the complementary exam (30%).

In order to pass the subject, it is required to obtain at least 50% of the mark using the aforementioned tools. Moreover, it is mandatory to pass the written final exam, this is obtaining at least the 50% of the mark associated to this part. If 50% of the mark is not achieved in this part, the final mark of the subject will be the one of the final written exam (considering a 10 points basis).

The unattendance to the official final exam, will automatically imply a resignation to the call. The resignation to the ordinary or extraordinary call will imply a "No-Show" mark.

MANDATORY MATERIALS

Laboratory and Seminar Notebook. Faculty publication.

Labview-based software tool for simulation and control of real time systems.

eGELA virtual platform for subject notes, information and general issues.

Matlab software

BIBLIOGRAFÍA

Basic bibliography

Sistemas de Control Moderno, (10ª Edición). Dorf, Richard C., Bishop, Robert H. ISBN: 978-84-205-4401-4 (2005).
Ingeniería de Control Moderna, (5ª Edición). K. Ogata. Pearson Prentice Hall. ISBN: 9788483226605 (2010).
Sistemas de Control Automático, (7ª edición). Benjamín C. Kuo. Pearson Prentice Hall. ISBN: 9688807230 (2005).
Sistemas Automáticos, F.X. Blasco Ferragud. M.A. Martínez Iranzo, J.S. Senent Español, J. Sancis Sáez. Universidad Politécnica de Valencia (2000)

Detailed bibliography

The Art of Control Engineering. K. Dutton, S. Thompson, B. Barraclough. Addison Wesley (1997).

Journals

Control Engineering Practice. A Journal of IFAC, the International Federation of Automatic Control. http://www.elsevier.com/
Revista Iberoamericana de Automática e Informática Industrial. http://riai.isa.upv.es/

Web sites of interest

IFAC-International Federation of Automatic Control. http://www.ifac-control.org/
Comité Español de Automática. http://www.cea-ifac.es/

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GITECI30 - Bachelor`s Degree in Industrial Technology Engineering **Year** Third year

COURSE

27322 - Calculation of Elastic Properties of Solids **Credits, ECTS:** 6

COURSE DESCRIPTION

The content of this course assumes and complements the knowledge previously acquired in the subject "Elasticity and Strength of Materials". During the development of this course it is intended that students acquire skills in solving problems of structural design and mechanical elements formed from the union of prismatic bars as well as analysis techniques to deal with deformable solids. In addition, it helps to introduce mechanical design concepts useful in the design of structures of diverse functionality.
The first topic is devoted to complete the analysis of bending, particularly unsymmetrical bending and combined bending with axial force. In the next topic, the concept of hyperstaticity in bending and its application to solving simple statically indeterminate structures by classical methods are exposed, with special emphasis on the method of forces. In the third issue the torsion theory and its application to pieces of circular cross-section is addressed. Next, two issues of considerable interest are presented: the buckling instability and the energy theorems. The program is completed with a brief exposition of the elementary theory of impact problems. With this course the student will have the basic knowledge to successfully address problems of calculation and design of solids formed by prismatic bars.
As mentioned before, this course is a continuation of the course "Elasticity and Strength of Materials" and is part of the curricular line of Mechanical Engineering. So, like that, the subject "Solid Elastic Calculation" is based on the subjects of second course "Mechanics" and "Applied Mechanics" whose knowledge and mastery are essential to understand the behavior of structures and other mechanical parts considered as deformable solids. Obviously, the student should also have a good grasp of the fundamental concepts of "Algebra" and "Calculus" studied in the first year. Another link can also be found with another subject taught in the third year, "Theory of Mechanisms and Mechanical Vibrations", a discipline that helps determine the forces undergone by the elements of a mechanism, and from which stresses and strains can be obtained by means of the "Solid Elastic Calculation". In this way a proper design ensuring system integrity can be obtained.
The knowledge acquired in this subject also form the basis of other mechanical-type subjects of the fourth year such as "Theory of Structures and Construction", where new methods are shown in the calculation of structures formed by prismatic bars. It is also evident the relationship with the subjects "Theory of Machines" and "Machine Elements", where it is essential to obtain stresses and strains and to apply the corresponding theories of failure. Finally, the "Solid Elastic Calculation" is also basic for some subjects included in several Master courses: in the "Master in Mechanical Engineering" (a continuation of the Degree in Mechanical Engineering) and in the "Master in Industrial Engineering" (a continuation of the Degree in Industrial Technology Engineering).

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The competence of the subject corresponding to the module Specific Technologies, and reflected in the memory of the degree is:
- Knowledge and ability to apply the fundamentals of elasticity and strength of materials to the behavior of real solids.
As a result of learning it is expected that the students are able to:
- Understand the fundamentals of calculation of statically indeterminate structures with particular emphasis on the method of forces and master the resolution of simple structures composed of prismatic bars.
- Complete calculation of stresses and strains in structures subjected to different types of forces including torsion effects in circular prismatic bars.
- Acquire the skills to carry out the advanced analysis of bars under biaxial or unsymmetrical bending.
- Know the procedures for calculating heterogeneous sections subjected to pure bending and be able to apply the transformed section method and the static method.
- Master the analysis of elements subjected to eccentric compression, both in materials with similar behavior in tension and compression, and those that do not support tensile stresses.
- Acquire theoretical analysis methods for calculating supports against buckling under compression and become familiar with the standards-based calculation (Technical Standards for Building).
- Be able to use as an alternative energy methods to calculate both isostatic and statically indeterminate structures, understanding the meaning of the fundamental energy theorems.
- Know the method of the equivalent static load to solve impact loads on structures with both linear and nonlinear behavior.

CONTENIDOS TEÓRICO-PRÁCTICOS

THEORETICAL CONTENTS
ITEM 1. UNSYMMETRICAL BENDING. COMBINED BENDING AND AXIAL FORCE. HETEROGENOUS SECTIONS
ITEM 2. ANALYSIS OF BENDING IN HYPERSTATIC STRUCTURES
ITEM 3. THEORY OF TORSION

ITEM 4. INSTABILITY: BUCKLING THEORY
ITEM 5. ENERGY THEOREMS
ITEM 6. IMPACT ELEMENTAL THEORY

LABORATORY PRACTICES
PRACTICE SESSION 1. PHOTOELASTICITY
PRACTICE SESSION 2. BENDING OF BEAMS

TEACHING METHODS

The contents of the subject "Solid Elastic Calculation" are taught through lectures, practical classes, seminars and laboratory practice.
In the lectures the contents and theoretical concepts of each topic are presented with the aid of some specific publications available to the student and by the resolution of practical exercises.
In the practical classes problems based on structures and mechanical systems are solved in order to consolidate the concepts presented in the lectures.
Throughout the semester three seminars are held, in which larger problems as well as exams of previous editions are solved. The arrangement in small seminar groups propitiates an interactive resolution of problems between the professor and the students.
Along the course two laboratory practices are performed, the first corresponding to a photoelasticity test and the second consisting of the measurement of reactions and deformations in beams subjected to bending. The practices are carried out in the "Laboratory of Strength of Materials and Structures" of the Department of Mechanical Engineering. Previously, and depending on each practice, students individually or divided into groups initially attend a theoretical presentation and solve analytically some exercise related to the practice prior year. During the session, students are divided into smaller groups so as to carry out experimental measurements and validate their calculations. At the end of each practice, students must submit a report with the results and final conclusions.
On the virtual platform eGela, the following material is available to the students: the Student Guide, a collection of review exercises, some problems to be solved in the seminars and other problems from the examination sessions, together with the results and exam grades. All subject groups have at their disposal the same material simultaneously.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	4,5	22,5					3	
Horas de Actividad No Presencial del Alumno/a	45	6,75	33,75					4,5	

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 95%
- Exercises, cases or problem sets 5%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In this subject a partial exam is proposed that allows reducing contents in the final exam. It will be assumed that by not doing or not obtaining the required grade in this partial exam the student is giving up the continuous assessment system.
The requirements for passing the course are:
1. Attend all laboratory practices.
2. Get an average rating greater than or equal to 5.0.
The laboratory practices account for 5% and the written tests for 95% of the final grade. The written tests consist of individual resolution of problems and theoretical questions. The first written test enables to pass definitively the first part of the course (for this it is necessary to obtain a rating equal to or greater than 4.0). In the second part of the course, a score equal to or greater than 3.5 should be obtained in order to be able to get a pass average. The final grade is the average of the two partial tests. Students may also make a full examination even after having passed the first of the written tests. The theoretical part of the exam is in any case one third of the mark for each exam.
According to the current regulations of the University of the Basque Country - EHU, it is sufficient for the student not to present himself to give up the corresponding call.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary examination a written exam including the full course will be performed. This will consist of individual

resolution of problems and theoretical questions. The theoretical part accounts for one third of the exam. The final grade will be obtained by taking the laboratory practices into account.
As in the ordinary call, to give up this call it will be sufficient for the student not to present himself.

MANDATORY MATERIALS

- "Cálculo Elástico de Sólidos", José Luis Alcaraz, Rubén Ansola, Javier Canales, José A. Tárrago, Estrella Veguería. Sección de Publicaciones de la E.T.S.I. de Bilbao, 2015.
- "Cálculo Elástico de Sólidos: Colección de Problemas de clase", José Luis Alcaraz, Rubén Ansola, Javier Canales, José A. Tárrago, Estrella Veguería. Sección de Publicaciones de la E.T.S.I. de Bilbao, 2016.

BIBLIOGRAFÍA

Basic bibliography

- "Elastikotasuna eta Materialen Erresistentzia", Rubén Ansola. UEU, Udako Euskal Unibertsitatea, 2005.
- "Resistencia de Materiales". L. Ortiz Berrocal. McGraw-Hill, 1991.
- "Mecánica de Materiales" (2ª ed.), S.P. Timoshenko y J.M. Gere. Grupo Editorial Iberoamericana, 1986.
- "Mecánica de Materiales" (2ª ed.), F.P. Beer y E.R. Johnston. McGraw-Hill, 1993.
- "Resistencia de Materiales", V.I. Feodosiev. Mir, 1980.
- "Problemas de Resistencia de Materiales", I. Miroliúbov et al. Mir, 1978.

Detailed bibliography

- "Advanced Mechanics of Materials (6th Ed.)", A.P. Boresi y R.J. Schmidt. John Wiley & Sons, 2003.
- "Advanced Strength and Applied Elasticity", A.C. Ugural y S.K. Fenster. Prentice Hall, 1995.
- "Mechanics of Materials (2nd Ed.)", R.R. Craig Jr. John Wiley & Sons, 2000.

Journals

- Int. J. of Mechanical Sciences, Elsevier.
- Int. J. of Solids and Structures,Elsevier.
- Mechanics of Materials, Elsevier.
- Computers & Structures, Elsevier.

Web sites of interest

- https://egela.ehu.es/
- http://www.ehu.eus/es/web/ingenieria-mecanica
- es.scribd.com/doc/305851/Resistencia-de-materiales-Problemas-resueltos
- es.wikipedia.org/wiki/Resistencia_de_materiales

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GITECI30 - Bachelor`s Degree in Industrial Technology Engineering **Year** Fourth year

COURSE

27323 - Engineering Projects **Credits, ECTS:** 6

COURSE DESCRIPTION

The subject "Engineering Projects" is a common subject that is given in the Degree of Engineering in Industrial Technology. The subject develops the capacity of the student to combine knowledge and attitudes acquired along the career to apply them in the develops of projects of engineering, having in counts especially the cost limitations, time, resources, organizational aspects, quality, risks and respect to the environment. Equally it develops the capacity of search of information. The topics of the theoretical part consist of exposing questions related to the managing and timing of projects of Engineering in its different phases. The practical part is about the application of the theoretical topics doing several individual and in group practices.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

M02R11.- Applied knowledge of business organisation.
M02R12.- Knowledge and skills to organize and manage projects. To know the organizational structure and functions of a project office.

Learning outcomes:
•Inclusion of environmental and sustainability considerations in the design of machines, processes and industrial installations
•Inclusion of economic and organisational considerations in the design of machines, structures, installations and industrial processes.
•Planning and drafting of projects for machines, structures, constructions, plants, processes and industrial installations.

CONTENIDOS TEÓRICO-PRÁCTICOS

1.- THE PROJECT DEFINITION
2.-.PHASES AND DOCUMENTS OF THE PROJECT
3.- PROJECT ASSESSMENT
4. BASIC AND DETAILED ENGINEERING
5. PROJECT ORGANIZATION AND MANAGEMENT
6. PROJECT TIMING
7. TECHNICAL REPORTS
8. TECHNICAL PROCEDURES AND INDUSTRIAL LEGISLATION
9. METHODOLOGY OF PRODUCT DESIGN
10. ERGONOMICS
11. ECODESIGN
12. EVALUATION OF ENVIRONMENTAL IMPACT
13. ENVIRONMENTAL MANAGEMENT OF THE COMPANIES
14. QUALITY MANAGEMENT. THE QUALITY IN THE PROJECT
15. QUALIT COSTS. TOOLS FOR PROBLEM SOLVING
16. STANDARDISATION, ACCREDITATION AND CERTIFICATION
17.LABOR RISKS PREVENTION
18. SAFETY in THE PROJECT

TEACHING METHODS

The theoretical part will be given in the first quarter and it consists of master classes and the resolution of individual exercises to help the comprehension of the given matters. The practical part will be during the whole course: the students will work with different tools in the area of the Engineering Projects, and after will develop individual and in group works, where the adquired knowledge will be put into practice.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30			30					
Horas de Actividad No Presencial del Alumno/a	45			45					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 40%
- Exercises, cases or problem sets 60%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

THE STUDENT ASSESSMENT WILL BE DONE WITH NEXT WEIGHTING PROCEDURE: FINAL THEORY EXAM 40 %, PRACTICES 60 %. IT IS NECESSARY TO OBTAIN POSITIVE ASSESSMENT IN BOTH ASPECTS SEPARATELY. THE WITHDRAWAL TO CALL IS REALIZED NOT APPEARING TO THE EXAM, AND IT WILL CONSIST of "NOT PRESENTED". THE Final THEORY EXAM OF THE ORDINARY CALL WILL BE REALIZED IN JANUARY.
The practices will be evaluated by the ongoing evaluation method. The student is able to renounce to this method, by asking for a final exam, according to the current normative rules.
"In the event that health conditions prevent the realization of a face-to-face teaching activity and/or evaluation, a non-face-to-face modality will be activated of which the students will be promptly informed."

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

THE STUDENT ASSESSMENT WILL BE DONE WITH NEXT WEIGHTING PROCEDURE: FINAL THEORY EXAM 40 %, PRACTICES 60 %. IT IS NECESSARY TO OBTAIN POSITIVE ASSESSMENT IN BOTH ASPECTS SEPARATELY. THE WITHDRAWAL TO CALL IS REALIZED NOT APPEARING TO THE EXAM, AND IT WILL CONSIST of "NOT PRESENTED".
In the case that the student does not have done the practices by the method of on-going evaluation, he or she is able to ask, previous communication, for a final exam including both theory and practices, according to the current normative rules.
"In the event that health conditions prevent the realization of a face-to-face teaching activity and/or evaluation, a non-face-to-face modality will be activated of which the students will be promptly informed."

MANDATORY MATERIALS

The management of the subject will be necessarily across the platform egela.ehu

BIBLIOGRAFÍA

Basic bibliography

- Otegi JR.,Toledo N.,Etxaniz O.,Zuazo I., Aretzaga J.: "De la idea al plan de proyectos en 10 pasos" Open Course Ware 2014 Disponible en: http://ocw.ehu.es/course/view.php?id=336
- J. Caamaño, "Elementos básicos de Ingeniería de Proyectos", Publicaciones de la ETSIB UPV/EHU, 2004
- H. Kerzner, "Project Management. A Systems Approach to Planning Scheduling and Controlling", Wiley, 2009
- PMI, "A guide to the Project Management Body of Knowledge (PMBoK) 6th edition", 2017
- A. González Marcos et. Al, "Ingeniería de Proyectos", Dextra Editorial, 2014 - Capítulo 7
- UNE 157001:2014 Criterios generales para la elaboración formal de los documentos que constituyen un proyecto técnico, 2014

Detailed bibliography

Journals

Web sites of interest

- PMI, https://www.pmi.org/
- IPMA http://www.ipma.world/
- AEIPRO https://www.aeipro.com/es/

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GITECI30 - Bachelor`s Degree in Industrial Technology Engineering **Year** Fourth year

COURSE

27325 - Structural Materials: Behaviour in Service and Mechanics of Fracture **Credits, ECTS:** 6

COURSE DESCRIPTION

Based on the fundamental knowledge of Materials Science acquired in the second year, this course contributes to the development of knowledge of the properties and behavior of structural materials in relation to the mechanical elements, mechanical structures and manufacturing machines that use materials like constructive elements. This course will be of general interest for some engineering specialty and to carry out final degree projects on Industrial Engineering.
This course explores the nature, properties and processing of structural, metallic, polymeric, composite and ceramic materials with special emphasis on the microstructure and mechanical properties. The study of fracture, fatigue and corrosion behavior in service is also analyzed.
The mechanisms that ensure horizontal coordination within the course are based on the coordination of programs of this subject with others that introduce and employ similar concepts and principles, such as machine elements, machinery calculations and structures theory.
Vertical coordination is associated with the structure of the study programme, so that the subjects necessary for the proper tracking of the present subject are already given in previous courses of degree.

Los mecanismos que garanticen la coordinación horizontal, dentro del curso, se basan en la coordinación de los programas de esta asignatura con otras que introducen y emplean conceptos y principios similares, como son Estática-Mecánica y Termodinámica.
Los mecanismos que garanticen la coordinación vertical están asociados a la estructuración del propio Plan de Estudios completo, de modo que las asignaturas precisas para el seguimiento de la presente estén ya impartidas (Física y Química), y las asignaturas que precisan de ésta para su impartición estén en cursos posteriores, como efectivamente lo están.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Capacity to address developments, projects and advanced studies in the field of materials engineering with a high degree of autonomy.
Find and select information, written and oral communication skills, writing report and projects, documentation management.

CONTENIDOS TEÓRICO-PRÁCTICOS

Lesson 1. Presentation and Introduction. Types of materials against mechanical behavior. Crystal structure. Elastic deformation and theoretical resistance. Non-crystalline structure. No elastic deformation.
Lesson 2. Structural Materials. Introduction to Physical Metallurgy. Hardening mechanisms metal alloys. Alloying and shaping materials.
Lesson 3. Iron-Carbide alloys . Diagrams, microstructures and thermal treatments.
Lesson 4. Steels and cast irons. Structural steels. Alloyed steels for strength, carburizing, nitriding. High-strength steels. Cast irons. Aluminum and titanium alloys. Non-ferrous metals.
Lesson 5. Polymeric and composite materials. Thermoplastics. Thermosets. Elastomers. Combining and modifying polymers.
Lesson 6. Ceramics and glasses. Ceramic materials. Concretes. Glasses. Refractories. Tribology.
Lesson 7. Fracture mechanics. Energy approach. Tensional approach and linear elastic fracture. Plane stress and plane strain. Anisotropic materials. Dimensional stress states. Fracture against plastification.
Lesson 8. Toughness tests. macro and microscopic aspects of fracture in materials. Mechanics of elastic-plastic fracture. CTOD. J integral. HRRFields.
Lesson 9. Fatigue of materials. Effects of cyclic loading. Fatigue tests. physical nature of fatigue damage. S-N curves. Design fatigue. Fatigue crack growth. Paris’ law.
Lesson 10. Creep and dissipation in materials. Creep tests. Physical mechanisms of creep. Creep crack growth. Estimate component life. Stress-strain-time curves. Energy dissipation in materials.
Lesson 11. Corrosion and corrosion resistant materials. Corrosion. Stress corrosion. Fatigue corrosion. Crack growth. Corrosion resistant materials.

TEACHING METHODS

In the theoretical classes, teachers give extensive explanations with the help of presentations. The book with all presentations will be available to students in the reprographic service of the university.
In the seminars, teaching will focus on specific topics that require additional exercises to encourage teamwork and participation of students with possible occasional debates. Thus, the theoretical knowledge of the subject is deepened in a more practical and applied manner.
In practical laboratory experimental work will be developed to acquire knowledge and skills of the experimental techniques

used in materials science. Students must carry a laboratory notebook (available in reprographic service center). The notebook includes the description of the practice and some short questions for self-assessment.
In the case of minimum distances are established between students for health security, the practices will be organized in a delegated mode.
Supossing that it is not possible to carry out a face-to-face evaluation of the subject, the pertinent changes will be made to carry out an online evaluation using the existing IT tools at the UPV / EHU. The characteristics of this online evaluation will be published on eGela.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	37,5	7,5	7,5	7,5					
Horas de Actividad No Presencial del Alumno/a	56,25	11,25	11,25	11,25					

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 55%
- Exercises, cases or problem sets 10%
- Teamwork assignments (problem solving, Project design) 35%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

- Written exam of the theory and exercises: 55% of the final mark.
Degree of use of the lessons practical exercises develop during lectures. Evaluation of the students autonomy ability.
-Preparation, written report and oral defense: 35% of the final mark
Evaluation of comprehensive ability to use theoretical and practical knowledge for solving open problems on materials.
Evaluation of the ability to work in teams making proposals, analyzing contributions of others, discussing ideas and implementing appropriate action. Interpersonal skills.
-Laboratory practice report: 10% of the final mark
Evaluation of knowledge communication skills both by written and oral. Evaluation of the laboratory practices use.
If the student is not presented to the exam, by default it will be consider that the student express its resignation.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

- Written exam of the theory and exercises: 55% of the final mark.
Degree of use of the lessons practical exercises develop during lectures. Evaluation of the students autonomy ability.
-Preparation, written report and oral defense: 35% of the final mark
Evaluation of comprehensive ability to use theoretical and practical knowledge for solving open problems on materials.
Evaluation of the ability to work in teams making proposals, analyzing contributions of others, discussing ideas and implementing appropriate action. Interpersonal skills.
-Laboratory practice report: 10% of the final mark
Evaluation of knowledge communication skills both by written and oral. Evaluation of the laboratory practices use.
If the student is not presented to the exam, by default it will be consider that the student express its resignation.

MANDATORY MATERIALS

Power point of the lessons.
Problem and exercises book.

BIBLIOGRAFÍA

Basic bibliography

- Arana, J.L., González, J.J., Mecánica de la fractura, Ediciones UPV-EHU (2001)
- Deformation and Fracture Mechanics of engineering Materials, John Wiley & Sons, Inc. (2013)
- Dowling N.E., Mechanical Behaviour of Materials. Prentice-Hall (1999)
- Ashby Michael F., Jones David R.H., Engineering Materials 2 Butterworth-Heinemann (2004)
- R.W.K. Honeycombe and H.K.D.H. Bhadeshia, Steels: Microestructure and Properties, 2nd edition, Arnold, 1995.
- Meyers M.A., Chawla K.K. (1984), Mechanical Metallurgy, Principles and Applications. Prentice-Hall
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- J. Polmear, Light Alloys: Metallurgy of the Light Metals, 3rd edition, Arnold, 1995
- C. Leyens and M.Peters,Titanium and Titanium Alloys, Fundamentals and Applications, Wiley-VCH GmbH and Co. (2003)
- Dieter, G.E. (1991) "Engineering Design, A Materials and Processing Approach", 2nd edition, McGraw-Hill, New York, USA. ISBN 0-07-100829-2.

Detailed bibliography

-Anderson, T.L., Fracture Mechanics, Fundamentals and Applications. CRC press (1995)
- Barson, J.M., Rolfe, S.T., Fracture and Fatigue Control in Structures, Applications of Fracture Mechanics, Buttterworth-Heinemann (1999)
- Broek D. The Practical Use of Fracture Mechanics. Kluber Academic Publishers (1989)
- Kinloch A.J., Young R.J. Fracture Behaviour of Polymers. Elsevier (1990)
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- M.J. Donachie, Superalloys: a Technical Guide, 2nd edittion, ASM International, (2002)
- M.Avedesian and H. Baker, Magnesium and Magnesium Alloys, ASM International, (1999)

Journals

- International Journal of Plasticity
- Scripta Materialia
- Materials and Design

Web sites of interest

http://products.asminternational.org/hbk/index.jsp
http://www.sciencedirect.com/

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GITECI30 - Bachelor`s Degree in Industrial Technology Engineering **Year** Fourth year

COURSE

27328 - Machine Calculation **Credits, ECTS:** 6

COURSE DESCRIPTION

In this course, main methods of machines design are presented. Also, the integration of these methods into the production scheme of a company in order to increase the quality and profitability of their products is studied.

The mechanical design and analysis is a classic mechanical engineering task. It involves obtaining a component, assembly, machine or structure based on the required technical specifications, using generally qualitative and subjective criteria, based on experience and company. Calculations in this phase, if any, such as kinematic and dynamic resistant, thermal, etc., are usually relatively simple and merely indicative, without going into detail. The working tool is a program of computer-aided design, CAD (Computer Aided Design).

In design tasks, apart from experience, the engineers mainly use their knowledge of subjects such as technical drawing, geometry, applied mechanics, machine parts, construction elements, manufacturing technologies, different standards and engineering projects.

Once a component, assembly, machine or structure has been designed, analysis techniques try to simulate its mechanical behaviour in service. Today, in the analysis phase, the computer is widely used, with programs mainly based on finite element techniques, FEA (Finite Element Analysis) and others similar.

In this phase, the engineer uses his expertise on kinematics and dynamics, elasticity and mechanics of materials, thermodynamics, fluid mechanics, fatigue, methods of computational analysis, theory of structures and specific knowledge of the type of machine or structure that he is designing and corresponding calculation standards and protocol of the company in its case.

If necessary, later, prototypes are built and are tested. The results of these tests can be used, at least in part, to improve analysis. Machine Design classes, the knowledge that the student has on materials, elasticity, mechanics of materials and other current and calculation methods are expanded. And actual calculation methods to be able to carry out the analysis of complex mechanical resistant components are presented.

Also in this matter, aspects of specimens and prototypes tests, especially in the field of fatigue problems are studied.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Competences of the subject:

- Knowledge and ability for calculation, design and testing machines.

- Ability to deal developments, projects and advanced studies in the field of mechanical engineering, with a high degree of autonomy.

Learning outcomes:

- Design by finite element method.

- Fatigue failure design.

- Search and select information, communicate orally or in writing, writing reports.

CONTENIDOS TEÓRICO-PRÁCTICOS

Presentation of the subject
1. Scope of the subject Machine Design
2. Relationship with other subjects in the curriculum; background
3. Subject program
4. Organization of the course; lectures, tutorials, labs, exams

Chapter 1

A first description of the MEF and its use in mechanical design
1. Product Development Cycle
2. Brief historical description and MEF bases
3. Functions of interpolation, natural coordinates and approximate solution.
4. Basic relations in an element
5. Calculation of the stiffness matrix of an element
6. Stiffness matrix model, boundary conditions, properties

Chapter 2
Analysis of two-dimensional models

1. Types and applications of two dimensional analysis in machine design
2. Properties and applications truss and beam elements
3. Triangular and quadrilateral linear element
4. Other elements; higher order and transition

Chapter 3
Analysis of three-dimensional models
1. Overview of three-dimensional analysis
2. Elements bar and beam
3. General considerations on the solid elements
4. Finite element models of plates and shells

Chapter 4
Mechanical properties and material selection

1. Selection of materials
2. Qualitative Properties
3. Quantitative Properties
4. Local effects; stress concentration
5. Stress concentration coefficients
6. Factors that contribute brittle failure in ductile materials

Chapter 5
Safety factor and failure theories in machine design

1. Necessity of the safety factor
2. Influence of material and method of analysis
3. Selection of safety factors
4. Theories of static failure in machine design

Chapter 6
Introduction to material fatigue

1. Analysis with variable solicitations: quasi-static and dynamic cases
2. Background and current status
3. Qualitative aspects of fatigue
4. Fatigue tests

Chapter 7
Material fatigue with uniaxial alternating stresses
1. Theories for fatigue analysis
2. Resistance to fatigue and fatigue limit
3. Modifying factors of fatigue limit
4. Stresses concentration and notch sensitivity
5. Modifying factors for finite life; Basquin equation

Chapter 8
Fatigue analysis with nonzero mean stress

1. Fatigue with mean stresses; Haigh diagram
2. Criteria for the Haigh diagram in ductile materials

3. Criteria for the Haigh diagram in brittle materials
4. Safety factor; equivalence stresses
5. Safety margin; equivalence duration
6. Treatment of stress concentration

Chapter 9
Cumulative damage

1. Cumulative Damage: Palmgren-Miner method
2. Cumulative Damage: modification of Manson
3. Procedures for cycle counting

Chapter 10
Fatigue analysis with multiaxial stress

1. General considerations on multiaxial fatigue
2. Multiaxial simple state with alternating stresses
3. Multiaxial simple state with nonzero mean stresses
4. Classic treatment of complex multiaxial states
5. Methods for global approach and critical plane

Chapter 11
Linear Fracture Mechanics for Fatigue
1. Basic concepts of fracture mechanics
2. Fatigue crack propagation; applying Paris equation
3. Delay effects caused by overload
4. Prediction of crack growth

Computer practices (PO)

Chapter PO1
Practical considerations about finite element programs
1. Organization of a Finite Element program
2. Outline of use of computer program
3. A basic example of modeling

Chapter PO2
Analysis of two-dimensional models
1. Examples with truss and beam elements
2. Examples with two-dimensional elements: plane stress, plane strain, axisymmetric
3. Examples with combination of different types of 2D elements

Chapter PO3
Analysis of three-dimensional models
1. Examples with truss and beam elements
2. Examples with solid elements
3. Examples shell elements
4. Examples with combination of different types of 3D elements

Chapter PO 4
Test and fatigue design practice
1. Computer programs for fatigue analysis
2. Fatigue design using finite element method
3. Comparison and practical considerations

TEACHING METHODS

The course consists of lectures, classroom practices and computer practices.

1. Lectures

It is the fundamental part of the subject, teachers expose classroom lessons interacting with students. For the successful use of these classes, students will have previously basic information corresponding to the lesson taught. Classes are primarily based on developments made on the board with computer presentations.

2. Classroom practices
Troubleshooting and practical approach to learning to select the most appropriate design method to each case and apply the methods and calculation procedures outlined in the theory classes and practical method of computer cases.

3. Individual and group tutorials
The tutorial classes serve to elucidate and reinforce those aspects of the subject that need the student, after attending class and done prior study work. The teachers of the subject will be available in the hours devoted to tutoring published in the GAUR application of the UPV / EHU. The place for tutoring will be the office of each professor in the Department of Mechanical Engineering of Bilbao ETSI

4. Virtual Teaching Platform
On the platform egela-EHU is available to the students notes and miscellaneous information to facilitate monitoring of the course. Specifically, the Student Guide, scripts computer practices, exams of previous years are published. Likewise, the establishment of forums will be promoted to encourage student participation and facilitate cooperative learning

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30		7,5		22,5				
Horas de Actividad No Presencial del Alumno/a	45		11,25		33,75				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 75%
- Teamwork assignments (problem solving, Project design) 25%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Students will have the opportunity to be evaluated through a single exam, according to the official call. A minimum mark of 5 points out of 10 will be required to pass the subject. In no case will the final exam be held out the official published date. The exam may include the contents taught both in the theoretical and computer classes.
In the ordinary call, students will also have the opportunity to choose a continuous evaluation according to the next criterion:
- Mid-term exam:
· Weight over the final mark: %30.
· Content: first part of the subject.
· Minimum grade: 3,5 out of 10.
- Final exam:
* If more than 3,5 in the mid-term exam:
· Weight over the final mark: %45.
· Content: second part of the subject.
· Minimum grade: 3,5 out of 10. The average with the mid-term exam must be greater than 5 out of 10 to pass the subject.
* If less than 3,5 in the mid-term exam or to improve previously obtained mark (the mark of the mid-term exam would not be considered in this case):
· Weight over the final mark: %75.
· Content: the whole subject.
· Minimum grade: 5 out of 10.
- Team work:
· Weight over the final mark: %25.
· Content: a design or analysis study of a component using the Finite Element Method. Fatigue analysis methods can also be used.
· Minimum attendance: %80 of the computer classes.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary call, students will be evaluated through a single exam, according to the official call. A minimum mark of 5 points out of 10 will be required to pass the subject. In no case will the final exam be held out the official published date. The exam may include the contents taught both in the theoretical and computer classes.

MANDATORY MATERIALS

Regarding the support material for the theoretical content, in the Library of the Engineering School, the student has a very extensive bibliography of consultation on the topics covered in this subject; those students who wish, have available in the Publications Service of the Engineering School the books entitled: " MÉTODOS DE ANÁLISIS PARA DISEÑO MECÁNICO: Vol. II." and " MÉTODOS DE CÁLCULO DE FATIGA PARA INGENIERÍA" Paraninfo publisher. For class problems there are notes in the Publications Department of the School: " CUADERNO DE EJERCICIOS DE CLASE: TECNOLOGÍA DE MATERIALES Y DISEÑO DE MÁQUINAS ". Also, on the website, http://egela.ehu.es, computer practices about finite element method, some figures, previous exam, photographs of interest, links to other pages and content of computer practices are linked.

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Basic bibliography

MÉTODOS DE ANÁLISIS PARA DISEÑO MECÁNICO: Vol. II. R. Avilés. Servicio Publicaciones ETSI Bilbao
MÉTODOS DE CÁLCULO DE FATIGA PARA INGENIERÍA. R. Aviles. Ed. Paraninfo. ISBN 9788428335188
CUADERNO DE EJERCICIOS DE CLASE: TECNOLOGÍA DE MATERIALES Y DISEÑO DE MÁQUINAS. Servicio Publicaciones ETSI Bilbao

Detailed bibliography

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Deutschmann, A.D.; Michels, W.J.; Wilson, C.E.; Machine design: theory and practice. Macmillan Publishing Co., Inc., 1975.
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Shigley, J.E.; Mischke, C.R.; Budynas, R.G.; Mechanical engineering design (7th Edition). McGraw Hill, 2004.
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Juvinall, R.C.; Marshek, K.M.; Fundamentals of machine component design (3rd Edition). Ed. Wiley, 2000.
Pilkey, W.D.; Peterson's Stress Concentration Factors, 2nd Ed. Wiley Interscience, 1997.
Dowling, N.E.; Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture, and Fatigue, 2nd Ed. Prentice-Hall, 1999.
Broek, D.; Elementary engineering fracture mechanics. Martinus Nijhoff Publishers, Kluwer Academic Publishers Group, 1984.
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Anderson, T.L.;Fracture mechanics; fundamentals and applications. CRC Press (USA), 1995.
Stephens, R.; Fatemi, A.; Stephens, R.R.; Fuchs, H.O.; Metal Fatigue in Engineering, 2nd edition. Wiley, 2001.
Zienckiewicz, O.C.; The finite element method (3' Ed.). Mc Graw-Hill, 1985.
Hughes, T.J.R.; The Finite Element Method; Linear Static and Dynamic Finite Element Analysis. Prentice-Hall International Editions, 1987.
Rao, S.S.; The Finite Element Method in Engineering. Pergamon International Library, 1982.
Avilés, R.; Métodos de Análisis para Diseño Mecánico, Vol. III: Elementos Finitos en Dinámica. Departamento de Publicaciones de la ETSI de Bilbao, 2002.

Journals

International Journal of Fatigue

Finite Elements in Analysis and Design

Web sites of interest

www.ingenierosbilbao.com
www.biblioteka.ehu.es
http://www.efatigue.com/
http://www.journals.elsevier.com/international-journal-of-fatigue/

OBSERVATIONS

In the event that the sanitary conditions prevent the face-to-face teaching activity and/or evaluation, a non-face-to-face modality will be activated. In this case, the students will be informed promptly.

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Fourth year

COURSE

27347 - Optics Applied to Telecommunications **Credits, ECTS:** 6

COURSE DESCRIPTION

a) In this course the basic theory of both physical optics and geometrical optics is developed with a clear projection to the development of optical systems typical of telecommunication engineering. Starting from electromagnetic waves, classical themes of wave optics (interference, coherence, diffraction, polarization ...) and geometrical optics are analyzed. The course also includes more applied topics, such as imaging, optical modulation, and radiation detection.

b) Knowledge in optics is essential nowadays, where the new information and communication technologies incorporate a very high percentage of advanced optical technologies.

c) There will be a course coordinator and will coordinate with other courses coordinators.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The course covers the competence related to Optics included in the optional subjects module: comprehension of advanced concepts of Optics and their application in the development and management of optical systems typical of telecommunication engineering .

The learning outcomes that students are expected to achieve at the end of the semester are:

- To demonstrate detailed understanding of the basic concepts related to the laws of Optics as well as their application for the reasoned solving of problems of Telecommunication Engineering.

- Mastery of optical instrumentation, acquiring sufficient autonomy for its use and the realization of measurements.

- Management of basic techniques for the measurement and treatment of data and evaluation of experimental errors related to optical phenomena as well as the preparation of a report of a laboratory practice.

CONTENIDOS TEÓRICO-PRÁCTICOS

CONTENTS

CHAPTER 1: ELECTROMEGNETIC WAVES
CHAPTER 2: INTERFERENCE
CHAPTER 3: COHERENCE
CHAPTER 4: DIFFRACTION
CHAPTER 5: POLARIZATION
CHAPTER 6: GEOMETRICAL OPTICS
CHAPTER 7: OPTICAL INSTRUMENTS
CHAPTER 8: IMAGING
CHAPTER 9: OPTICAL MODULATION
CHAPTER 10: DETECTION OF OPTICAL RADIATION

TEACHING METHODS

In order to achieve the proposed objectives in this course, as they are described in the competences that the student must acquire, some of the teaching methodologies established by university regulations will be combined: lectures, classroom practices and laboratory practices.

Theoretical developments, solving exercises, teaching experiences including computer demonstrations and laboratory practices are carried out.

In the event that sanitary conditions prevent the realization of a teaching activity and / or face-to-face evaluation, a non-face-to-face modality will be activated of which the students will be informed promptly.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30		15	15					
Horas de Actividad No Presencial del Alumno/a	45		22,5	22,5					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 80%
- Exercises, cases or problem sets 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

A) The following tools will be used for continuous evaluation:

- A final exam that will include the resolution of exercises and the development of a theoretical topic:
The following will be valued: the degree of knowledge of the basic principles of Optics, the precision in the arguments, the obtaining of exact numerical values, the appropriate use of units, the completeness of the solutions, the correct use of verbal, mathematical and / or language. or graphic. Serious conceptual errors will be penalized in the correction.

- Evaluation of laboratory practices through monitoring and reporting. Attendance to laboratory practices is mandatory. Students will deliver a complete report for each practice carried out, which will be assessed with a grade from 0 to 10. These reports will assess the application of knowledge to practical applications as well as the calculation of errors and their interpretation. The practice mark will be the average of the marks obtained in the practices carried out.

The final mark will be calculated according to the following percentages:
Practice mark (20%)
Final exam mark (80%)

To pass the course, it will be a necessary condition to have passed the practices, have a minimum mark of 4.0 in the final exam and have obtained an overall mark equal to or greater than 5.

In the case of continuous assessment, students may waive the call within a period that, at least, will be up to one month before the end of the teaching period for the subject. This resignation must be submitted in writing to the teaching staff responsible for the subject.

B) The students who want to be evaluated through the final evaluation system must present in writing to the coordinator responsible for the subject the waiver of continuous evaluation, for which they will have a period of 9 weeks, counting from the beginning of the semester, according to the academic calendar of the center. In this case, the learning results will be evaluated through a test, consisting of:

-A final exam that will include the resolution of exercises and the development of a theoretical topic:
The following will be valued: the degree of knowledge of the basic principles of Optics, the precision in the arguments, the obtaining of exact numerical values, the appropriate use of units, the completeness of the solutions, the correct use of verbal, mathematical and / or language. or graphic. Serious conceptual errors will be penalized in the correction.

- A practical exam that will be carried out in the laboratory and will last three hours. In this exam, they must make a report of a practice that must contain: obtaining and mathematical treatment and graphing of experimental data, calculation of errors, discussion of results and conclusions of the work.

The final mark will be calculated according to the following percentages:
Practice exam mark (20%)
Final exam mark (80%)

To pass the course, it will be a necessary condition to pass the practical exam and have obtained an overall mark equal to or greater than 5.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The following evaluation tools will be used:

- A final exam that will include the resolution of exercises and the development of a theoretical topic. The following will be valued: the degree of knowledge of the basic principles of Optics, the precision in the arguments, the obtaining of exact numerical values, the appropriate use of units, the completeness of the solutions, the correct use of verbal, mathematical and / or language. or graphic. Serious conceptual errors will be penalized in the correction.

- A practical exam to be carried out in the laboratory. Those students who have not passed the practices during the course must take a practice exam that will be carried out in the laboratory and will last three hours. In this exam, they must make a report of a practice that must contain: obtaining and mathematical treatment and graphing of experimental data, calculation of errors, discussion of results and conclusions of the work.

The final mark will be calculated according to the following percentages:
Practice exam mark (20%)
Final exam mark (80%)

To pass the course, it will be a necessary condition to have passed the practices, have a minimum mark of 4.0 in the final exam and have obtained an overall mark equal to or greater than 5.

MANDATORY MATERIALS

BIBLIOGRAFÍA

Basic bibliography

Optics, E. Hecht, Ed. Addison Wesley, 2001.
Light, R.W. Ditchburn, Ed. Dover, New York, 1991
Fundamentals of Optics, F.A. Jenkins and H.E. White, McGraw-Hill, 1981.

Detailed bibliography

Principles of Optics, M. Born and E. Wolf. 7th edition, Cambridge University Press, Cambridge, 1999.
Modern Optics, R. Guenther, Ed. Wiley & Sons, 1990

Journals

Journals:
Physics Education
The Physics Teacher
European Journal of Physics
American Journal of Physics

Web sites of interest

http://www.enciga.org/taylor/lv.htm
http://www-optics.unine.ch/education/optics_tutorials/optics_tutorials.html
http://www.ub.es/javaoptics/index-en.html
http://www.cordonline.net/laserapplets/

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Fourth year

COURSE

27352 - Industrial Automation & Communications **Credits, ECTS:** 4,5

COURSE DESCRIPTION

The aim of the course is to provide an overview of the most common technologies used in automation and industrial process control, and hierarchical organization of the usual devices that the industry employs.

The course looks for a balance between theoretical, methodological, technological and practical subjects.
- Theoretical regarding basics on industrial automation and the required elements. It will build upon the subject of computers, acquired in the first course taught concerning the information coding and programming.
- Methodological regarding on the design of systems for automated production systems.
- Technological regarding on the study of instrumentation components, industrial communications and monitoring systems.
- Practical regarding on to laboratory sessions that will be held on programmable logic controllers (PLCs) and industrial communications networks, trying to solve real automation issues.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

This subject is within the optional module covering specific competence "Ability to design control systems and industrial automation" (M07OP3). It is developed within the degree specific competence "Knowledge of basic materials and technologies, enabling to learn new methods and technologies and that will provide versatility to adapt to new situations" (G003).

At the same time, it involves basic competences like:
- MEC1: Students have demonstrated knowledge and understanding in a field of study that starts of the basis of general secondary education, and is typically at a level which, although it is supported by advanced textbooks, includes some aspects that involve knowledge of the forefront of their field of study.
- MEC5: Students have developed those skills needed to undertake further studies with a high degree of autonomy.

Once the course is completed, students will know what methodology followed in the development of an automation project, they can choose the technologies and equipment suitable for such a solution, and know how to integrate all elements within industrial production systems.

CONTENIDOS TEÓRICO-PRÁCTICOS

THEORETICAL SUBJECTS:

1st Lesson. Introduction to the Industrial Automation Systems.
2nd Lesson. Programmable Logic Controllers. Hardware and Software Architecture
3rd Lesson. Combinational Systems.
4th Lesson. Sequential Systems.
5th Lesson. Data Processing.
6th Lesson. Functions and Function Blocks.
7th Lesson. Introduction to the Industrial Communications.
8th Lesson. Industrial communications Device Oriented.
9th Lesson. Industrial communications Control Oriented.

TEORICAL SUBJECTS DEVELOPMENT:

1st BLOCK - INDUSTRIAL AUTOMATION

1st Lesson. Introduction to the Industrial Automation Systems
Blocks of an automation system. Targets in the automation. Industrial automation system components. Control system functions. Automation technologies. Industry automation systems: history, development, programming languages, applications.

2nd Lesson. Programmable Logic Controllers Architecture
Functional blocks. PLC operations. PLC hardware components. Processing. PLC families. Addressing. Inputs and outputs.

3rd Lesson. Logic Controllers Programming
3.1 Lesson. Introduction to the IEC61131 Standard: parts of the standard, programming languages, program design.
3.2 Lesson. Programming Basics - STEP7: Program structure, Module types, Processing types, Cycle and response

times.

2nd BLOCK - INDUSTRIAL SYSTEMS INTEGRATION

4th Lesson. Industrial Communications
Historical vision, communications in manufacturing environments, technologies, manufacturer architectures, basic protocols for industrial communications, field buses.
5th Lesson. PROFIBUS
Definition and standards, general features, technical features, PROFIBUS architecture, physical level - PHY (topology, transmission method), link level - FDL (transmission protocol, token passing, times, FDL services) FMA1/2 services.
6th Lesson. Industrial Ethernet
Industrial Ethernet solutions, Ethernet communications, technical features.
7th Lesson. PROFINET
Fundamentals, transmission systems in real time, decentralized field devices, decentralized automation.
8th Lesson. OPC
Purpose, location, architecture, databases, OPC, objects and interfaces, OPC applications, general architecture and components, local and remote servers, OPC standards.

SEMINAR SUBJECTS:DEVELOPMENT:

- 1st Seminar: Description of the industrial automation systems
- 2nd Seminar: Building blocks
- 3rd Seminar: SFC design (GRAFCET)
- 4th Seminar: Process data access communications
- 5th Seminar: Control communications
- 6th Seminar: High level communications
- 7td Seminar: Final Project

PRACTICAL SUBJECTS:DEVELOPMENT:

- 1st Practice: Development environment
- 2nd Practice: Combinational Systems
- 3rd Practice: Sequential Systems 1/2
- 4th Practice: Decentralized peripherals communications
- 5th Practice: Control communications
- 6th Practice: High level communications
- 7th Practice: Final Project

TEACHING METHODS

In this course several methodologies are used, depending on the type of education:
- Master Lecture: Offering brief presentations of theoretical content will be taught by the teacher, carrying out various individual activities by the student.
- Seminary Mode: Brief theoretical/practical exhibitions will be taught by the teacher, devoting part of the on-site time to the realization of individual and group activities.
- Laboratory Model: Different works about case of concept in which implement the contents in lectures and seminar in order to strengthen both autonomous and group work .

A final group work will be is performed for the resolution of a case study that will bring together the different methodologies and technologies developed in the different modes.

In the event that the sanitary conditions prevent the realization of a teaching activity and / or face-to-face evaluation, a non-face-to-face modality will be activated of which the students will be informed promptly.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15	15		15					
Horas de Actividad No Presencial del Alumno/a	22,5	22,5		22,5					

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

Evaluation methods

- Continuous evaluation

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Multiple choice test 30%
- Exercises, cases or problem sets 10%
- Individual assignments 30%
- Teamwork assignments (problem solving, Project design) 30%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Written Test: 30% (Pass score 40%)
Seminar/Laboratory: 70% (Continuous Assessment)
Disposition for Seminar Sessions: 10% (Independent work - Pass score 50%)
Laboratory Practices: 30% (Independent work - Pass score 50%)
Final work: 30% (Group work - Pass score 50%)

The renounce to the ordinary call or to the continuous assessment will be notified personally and in the format agreed at the start of the course, to the coordinator or teacher of the course, 2 weeks before the end of the quarter in which the subject is taught.

In case of renounce to the continuous assessment, a seminar/laboratory test will be made.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Written Test: 30% (Pass score 50%)
Laboratory Test: 70% (Pass score 50%)

The renounce to the extraordinary call will be notified personally and in the format agreed at the start of the course, to the coordinator or teacher of the course, 2 weeks before the date of the resist exam of the subject.

MANDATORY MATERIALS

Students will be equipped with the informatics (software) needed for the development of the different works:
- Tools for hardware devices configuration
- Programming tools for the devices
- Programming tools for communications

BIBLIOGRAFÍA

Basic bibliography

Title: Autómatas Programables. Entorno y Aplicaciones
Authors: E. Mandado Pérez, J. Marcos Acevedo, C. Fernández Silva, J.I. Armesto Quiroga, S. Pérez López
Publisher: Thomson
Year of Publication: 2005

Title: IEC 61131-3: Programming Industrial Automation Systems (2nd edition)
Authors: Karl Heinz John, Michael Tiegelkamp
Publisher: Springer
Year of Publication: 2010

Title: Automating with SIMATIC S7-1500: Configuring, Programming and Testing with STEP 7 Professional
Authors: Hans Berger
Publisher: Wiley
Year of Publication: 2014

Title: Comunicaciones Industriales. Guía Práctica
Authors: Aquilino Rodríguez Penín
Publisher: Marcombo, Ediciones Técnicas
Year of Publication: 2008

Title: Profibus. The Fieldbus for Industrial Automation
Authors: K. Bender. Carl Hanser Verlag
Publisher: Prentice
Year of Publication: 1993

Title: Automating with PROFINET (2nd edition)
Authors: R. Pigan, M. Metter
Publisher: Wiley

Year of Publication: 2008

Title: OPC - From Data Access to Unified Architecture
Authors: J. Lange, F. Iwanitz, T.J. Burke
Publisher: Vde Verlag Gmbh, 4ªEdición
Year of Publication: 2010

Detailed bibliography

Title: Autómatas Programables (2ª Edición)
Authors: J. Balcells y J.L. Romeral
Publisher: Marcombo
Year of Publication: 1997

Title: Autómatas Programables Industriales. Arquitectura y Aplicaciones
Authors: G. Michel
Publisher: Marcombo
Year of Publication: 1990

Title: Automatización de Maniobras Industriales Mediante Autómatas Programables
Authors: J. Pérez Cruz, M. Pineda Sánchez
Publisher: Universidad Politécnica de Valencia
Year of Publication: 2006

Title: Programming Industrial Control Systems Using IEC 1131-3 (2nd Revised edition)
Authors: Robert W. Lewis
Publisher: Institution of Engineering and Technology
Year of Publication: 1998

Title: The Industrial Communication Technology Handbook
Authors: R. Zurawski
Publisher: CRC Press
Year of Publication: 2005

Title: Communication Networks for Manufacturing
Authors: J.R. Pimentel
Publisher: Prentice - Hall International
Year of Publication: 1990

Title: Decentralization with Profibus-DP. Architecture and Fundamentals
Authors: J. Weigmann, G. Kilian
Publisher: Siemens
Year of Publication: 2000

Title: Sistemas de Supervisión (2ª Edición)
Authors: J. Colomer, J. Meléndez, J. Ayza.
Publisher: Cuadernos CEA-IFAC. Cetisa / Boixareu Editores
Year of Publication: 2001

Title: Sistemas SCADA (2ª Edición)
Authors: A. Rodríguez
Publisher: Marcombo, Ediciones Técnicas
Year of Publication: 2007

Journals

Automática e Instrumentación http://www.tecnipublicaciones.com/automatica/
Control Engineering Practice. A Journal of IFAC, the International Federation of Automatic Control. http://www.elsevier.com/

Web sites of interest

IFAC-International Federation of Automatic Control. http://www.ifac-control.org/
Comité Español de Automática. http://www.cea-ifac.es/
PI - PROFIBUS & PROFINET International http://www.profibus.com/
OPC Foundation http://www.opcfoundation.org/

OBSERVATIONS

In the event that the sanitary conditions prevent the realization of a teaching activity and / or face-to-face evaluation, a non-face-to-face modality will be activated of which the students will be informed promptly.

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Second year

COURSE

27359 - Telecommunication Services & Network Architecture **Credits, ECTS:** 9

COURSE DESCRIPTION

Starting from the origins of Telematics, the course presents the fundamentals of the components of a communications system. It presents the need to establish communication architectures models stratified in layers and analyzes the concepts associated with these architectures as well as the interaction between layers and their application.

To that end, the most relevant applications and protocols are analyzed layer by layer so that the student acquires the necessary skills to analyze and diagnose the state of a network, identify connections and interpret the operation of the applications and the application, transport, network and link layer protocols from the information contained in a network trace obtained through a network protocol analyzer/packet sniffer software.

Likewise, contents that allow successfully designing network architectures and addressing schemes adapted to customer specifications are developed by selecting alternatives that optimize the number of addresses, networks, equipments, etc.

To successfully performe in this course students must become familiar with the tools and basic applications in telematics as well as with their usage such that they are able to further understand and apply the theoretical concepts of the course.

Contextualization in the curriculum:

In this course, which takes place during semesters S3 and S4, a global view of the architecture of telecommunication networks and services is provided. Therefore, the competences acquired through it are essential for access to jobs related to Telematics.

The contents of this course are related to other courses taught within the Bachelor of Science Degree in Telecommunication Technologies. Specifically, it provides the necessary foundations for other courses in the curricular lines of Telecommunication Networks and Telecommunication Services, being the axis from which they are structured: Network Planning and Modeling (common to the branch of Telecommunications during S5) and Networks Access, Transport Networks (backbone to the branch of Telematics Engineering during S6), Information Systems Architecture (common to the branch of Telecommunications during S6) and Advanced Telematic Services (backbone to the branch of Telematics Engineering during S6).

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The approach of the course is oriented so that the student can acquire the following competences:

BASIC SKILLS That the students:
-Know how to apply their knowledge to their work or vocation in a professional way and have the skills that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study
-Can transmit information, ideas, problems and solutions to a specialized and non-specialized public
-Have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

COMPETENCES OF THE DEGREE:
- Knowledge of foundations and technologies, which enables him to learn new methods and technologies, as well as giving him great versatility to adapt to new situations.
- Ability to solve problems with initiative, decision making, creativity, and to communicate and transmit knowledge, skills and abilities, understanding the ethical and professional responsibility of the Telecommunication Technical Engineer activity.
- Ability to work in a multidisciplinary group and in a multilingual environment and to communicate, both in writing and orally, knowledge, procedures, results and ideas related to telecommunications and electronics.

COMPETENCES OF THE COMMON MODULE TO THE TELECOMMUNICATION BRANCH
- Ability to learn independently new knowledge and techniques suitable for the conception, development or operation of telecommunication systems and services.
- Knowledge and use of network architecture concepts, protocols and communication interfaces.
- Ability to differentiate the concepts of access and transport networks, circuit and packet switching networks, fixed and mobile networks, as well as distributed network applications and systems, voice, data, audio, video and interactive services and services. multimedia.
- Knowledge of the methods of network interconnection and routing, as well as the basics of planning, dimensioning of networks according to traffic parameters.

CONTENIDOS TEÓRICO-PRÁCTICOS

1.-Basic concepts and foundations of telecommunication networks and services
What is a telecommunication network, elements, topologies, services, applications ...
Architecture of a telecommunications network:
- Terminal systems
- Access network: technologies, dedicated / shared link ...
- Network core:
Switching functions (circuits / packets, connection oriented / non-connection oriented), multiplexing (FDM / TDM / statistics)
Internet backbones, ISPs
Protocol layers / Service models

2.-Application layer
Principles of network applications
Basic applications: web browsing, file transfer, email, name resolution, p2p applications

3.-Transport Layer
The transport layer and its services
Unreliable transport: UDP
Reliable transport: TCP, flow control, congestion control
Session capture and analysis of them.

4.-Network layer
Network functions, types of services
Service oriented connection (generic).
Non-connection oriented service: IP. Addressing, datagrams, basic procedures and associated procedures (ARP, ICMP, DHCP, NAT ...)

5.-Link layer
Link functions.
Point-point links: Simplified HDLC, PPP.
Multipoint links-LAN: Ethernet

6.-Network interconnection
Interconnection functions.
Interconnection at the physical level (repeaters, hubs), link (bridges, switches), network (routers), superior (gateway)

7.-Global vision of the course
Vision of telecommunication networks and services integrating all levels of communication

PROFUNDIZACIÓN

REVISTAS

DIRECCIONES INTERNET

EVALUACIÓN DE LA ASIGNATURA (INDICAR METODOLOGÍA DE EVALUACIÓN Y % SOBRE LA NOTA FINAL. P. EJ. EXAMEN ESCRITO 60%, INFORMES 10%,.....).

TEACHING METHODS

Teaching-Learning Methodology

The course consists of Lectures (M), Seminars (S) and Labs (PL) based on which the theoretical and practical contents are articulated according to the instructions M / S / PL for each one of them.

Regarding the organization/distribution throughout the course of the different modalities of classes, since it is an annual (fall+spring semester) course, the bulk of the lecturing hours are concentrated during the first semester so that the students have all the necessary theoretical background to make the most out of the lab sessions and seminars as soon as

possible.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	21	7,5	31,5					
Horas de Actividad No Presencial del Alumno/a	45	31,5	11,25	47,25					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Exercises, cases or problem sets 5%
- Lab sessions with computers and other communication network equipments 25%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The final grade for this course is computed as the sum of 4 aspects:
A. Continuous evaluation of the seminars: 5% of the grade
B. Labs: 25% of the grade
C. Minimum skills assesment: 20% of the grade
D. Theory/Assignment-practical exams (written): 50% of the grade
*In addition, in order to promote active learning, voluntary participation in tasks to be carried out in relation to master/lecture classes will be rewarded. This can mean up to an additional 5% (for practical purposes, a score of 10,5) in the final grade.

In order to pass the course, the following conditions must be met (BOTH):
-In section C, score a minimum of 7 points (out of 10).
-In the weighted sum (A * 0.05 + B * 0.25 + C * 0.20 + D * 0.5) score 5 points (out of 10) or above.

Not fulfilling any of the above two conditions will meant that the course will be graded as "Not passed".

Below is a breakdown of each of the 4 parts of the grade:

5% Continuous Evaluation Performance:
This part of the grade includes the evaluation of the individual and group-assignments to be solved during seminar sessions, as well as the attitude, involvement and evolution of the students during these sessions.

25% Labs Evaluation. To choose:
1) With compulsory attendance and continuous performance assesment (default):
-Evaluation of weekly activities related to labs performance and written lab-reports, both at individual and team (couple) level (50%).
- Individual hands-on skills assessment tests, scheduled after the end of each block of lab practices (50%).

2) Without compulsory attendance and without continuous assessment:
-A single individual lab-skills assessment test to be carried out during the Spring semester. The specific date of completion of this test will be notified at the beginning of the Fall semester (100% of the labs grade).

Students are requested to communicate their choice of one or another form of assessment before Labs practices have begun i.e, before the 4th academic week of the Fall semester.

20% Minimum skills assesment
Mastery of basic/fundamental concepts covered in this course.

50% Written Exams
December / January: written exam on Theory related aspects covered in lectures during the Fall semester (20%)
May: written exam on exercises and practical questions related to contents covered in the course assignments during the Fall and Spring semester (30%)

DISCLAIMERS OF FOLLOW-UP/CONTINUOUS ASSESSMENT EVALUATION:
Those students who wish to avail themselves of the right to renounce the continuous (or mixed) assessment system and

opt for the final evaluation, may communicate the aforementioned decision, preferably via email, to the teachers responsible for the course at any time during the first 18 academic weeks of the current academic year.

DISCLAIMERS TO THE CALL:
The resignation to the call will mean the qualification of "Not Presented". In the case of continuous assessment evaluation, students may waive the call by simply not signing in for the final evaluation test.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Evaluation of the Extraordinary Call
The evaluation of the extraordinary call will be made based on the results of an exam that constitutes the 100% of the final grade.
The exam will consist of 2 separate parts:

Y. Minimum skills assesment: 20% of the grade
Z. Written Exam to cover all theoretical and practical aspects treated in the course (lectures, seminars and labs): 80% of the grade

In order to pass the course, the following conditions must be met (BOTH):
-In section Y, score no less than 7 points (out of 10).
-Score above 5 points (out of 10) in the weighted sum (Y * 0.2 + Z * 0.8).

Among the students that either did not take the exam or did not pass the course in the ordinary call, those who scored less than 7 points (out of 10) in section C , but
achieved 5 points (out of 10) or above in the weighted sum A * 0.05 + B * 0.25 + D * 0.50 will be able to released of sitting for Part Z of the exam.
And their final grade will be computed in the extraordinary call as the weighted sum of Aord * 0.05 + Bord * 0.25 + Yextra * 0.20 + Dord * 0.50.

MANDATORY MATERIALS

-Slide bundles with material for lecture classes (available eGela).
-Self-assessment questionnaires for knowledge assimilation (available in eGela in online format and / or pdf)
-Wiki and final report on expected minimum knowledge required for each of the theoretical topics (available in eGela)
-Assigments (exhibitions and resolution of exercises individually, or through different group dynamics) for seminar classes.
-Guides for the realization of labs (includes questionnaires prior to practice, script of the proposed practice for its development in the laboratory, questionnaire to be completed for the preparation of the final report of the practice based on the skills acquired during the realization Of the same).

BIBLIOGRAFÍA

Basic bibliography

*) Kurose, J.F., and Ross, K.W. "Computer Networking: A top-down Approach", (7th Edition) Pearson, 2016.
*) Knuth, D. "Fundamentals of Computer Networking", 2018.
*) White, M.B. "Computer Networking The Complete Guide to Understanding Wireless Technology, Network Security, Computer Architecture and Communications Systems", Newstone 2018.

Detailed bibliography

*) Bernstein, J. "Networking Made Easy: Get Yourself Connected (Computers Made Easy)" 2018
*) Stallings, W. "Data and Computer Communications" (10th Edition) Pearson, 2013.

Journals

Web sites of interest

- Kurose, on-line resources: http://wps.aw.com/aw_kurose_network_5/
- Stallings, on-line resources: http://williamstallings.com/DataComm/
http://www.librosite.net/20/20a.asp?l=63

OBSERVATIONS

In the event that the sanitary conditions prevent the realization of a teaching activity and / or face-to-face evaluation, a non-face-to-face modality will be activated of which the students will be informed promptly.

COURSE GUIDE 2022/23

Faculty	345 - Faculty of Engineering - Bilbao	**Cycle**	Not Applicable
Degree	GTELEC30 - Bachelor's Degree in Telecommunications Engineering	**Year**	Third year

COURSE

27360 - Circuit Electronics | **Credits, ECTS:** 6

COURSE DESCRIPTION

Circuit Electronics is a four-month, compulsory course in the Telecommunications Technology Engineering Degree. The course is taught in the first four-month period of the third year of the degree. The aim of the course is to master the analysis and design of analog electronic circuits, especially linear circuits (amplifiers).

The course includes laboratory training in which, despite the low credit load, students work in a well-structure project that helps for the mastering of complex electronic circuits design (between 50 and 100 components), for the most suitable component selection, for circuit specifications, characterization, hardware implementation and detection and correction of failures and errors.
The course is based on previous knowledge acquired in the first year of the degree, in "Basic Electronics" and "Electronic Devices and Circuits", at least in what corresponds to the basic knowledge of some of the components. However, several concepts are also used, such as cuadripoles, input/output impedances, complex domain in s, Bode plots… which are basic telecommunication-concepts partially acquired in other courses of the degree.

Regarding the scope of the course, it goes as far as the compensation in frequency of feedback circuits, a topic not covered in much depth. A more rigorous analysis of this last topic and others will be made in "Telecommunication Circuits". The same happens to non linear analog circuits (timers, multipliers, phase-locked circuits, power supplies, etc).

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The sequence of main technological steps for the fabrication of analog circuits based on CMOS technology is introduced, as well as the design rules that influence their geometry.
Multi-stage amplifiers are worked on the basis of transistors and analyzing basic analog subsystems (the differential pair, current-sources, active-loads, power stages).
Frequency response and bandwidth will be studied, as well as the characterization of limiting conditions for operation.

The concept of feedback is introduced, starting from the existing topologies and solving methodology and finishing with the concept of stability and stability compensation techniques.
The amplifier will be considered as a non-ideal electronic circuit, and after describing its constraints, criteria for the suitable OpAmp selection are given. Its internal configuration is studied and the student is trained to the analysis of these amplifiers, the obtaining of their main characteristics, as well as the analysis and the design.

The course is completed with about 40 hours of practical work. Within the 40 hours, 15 are fulfilled in the laboratories of the UPV/EHU and directly monitored by the teacher. In this assignment, a design of relative complexity -from 50 to 100 components- is supervised. The functionality and specifications of the assignment are marked at the beginning of the course. The design is made based on groups of two students and the collaboration among different groups. The aim of this task is to fulfill a design and its hardware implementation, verifying its behavior, correcting failures and errors, and optimizing the design so that it is functionally adjusted to the initial specifications (or improves them). The circuit will be characterized and a brief report will be drawn up. Afterwards, the circuit will be defended individually in a laboratory work-station, where meanwhile, each student will demonstrate their ability for characterization. The circuit will not be exclusively restricted to the corresponding theoretical topics of the course. Discrete or integrated components can be included in the circuit, as well as analog and digital components. As an example, an audio power amplifier could be implemented, with its acoustic level light indicator and circuits that make it possible to increase the output power or decrease the noise level. As another example, the circuit could be based on communication systems, usually at low frequency (1 MHz) or electronic instrumentation subsystems or combinations thereof.

CONTENIDOS TEÓRICO-PRÁCTICOS

1. Active devices.
1.1. The basis of the diodes
1.2. Bipolar transistors
1.3. MOS-FET transistors
2. Basic amplifying steps
2.1. Single stage basic circuits
  2.1.1. Common-emitter and common-source amplifiers
  2.1.2. Current mirror
  2.1.3. Current mirror as active load
  2.1.4. Common-collector and common-drain circuits
2.2. Single stage amplifier circuits
  2.2.1. Parallel transistors

2.2.2. Darlington transistors and super-follower transistors
2.2.3. Cascode
2.2.4. Differential
2.2.5. Class B and AB outputs
3. Analysis of amplifiers
3.1. Cascode amplifiers
3.1.1. Classification
3.1.2. Analysis in DC
3.1.3. Gain
3.1.4. Dynamic range
3.2. Frequency response
3.2.1. Bode plots
3.2.2. Low frequency response
3.2.3. High frequency response
4. Feedback
4.1. Negative feedback concept
4.2. Topologies
4.3. Analysis method
4.4. Input and output impedances
4.5. Frequency response
4.6. Stability
4.6.1. Nyquist criterion
4.6.2. Bode criterion
4.7. Compensation methods
5. Processing of analog circuits based on CMOS
5.1. CMOS circuit fabrication
5.2. Design rules
5.3. Component design examples
6. CMOS Operational Amplifier
6.1. Ideal operational amplifiers
6.2. Internal structure of operational amplifiers, CMOS technology
6.2.1. 2-stage and 3-stage OpAmp
6.2.2. Stability in CMOS OpAmp
6.2.3. Improving current mirrors
6.2.4. Folded cascode OpAmp
6.2.5. Current mirror OpAmp
6.2.6. Fully differential OpAmp
7. Bipolar operational amplifiers
7.1. Real operational amplifiers, non-ideal effects
7.2. Thermal dissipation
7.2.1. A class stages
7.2.2. AB class stages
7.2.3. Other subcircuits for bipolar operationals.
7.3. Internal structure of operational amplifiers, bipolar technology
7.3.1. 741-type OpAmp
7.3.2. 741-type OpAmp with JFET inputs
7.3.3. Precision OpAmp

TEACHING METHODS

Theory lessons are supported by both master classes and problem-solving classes.
At the beginning of the course, and in a class dedicated to it, the laboratory training project to be carried out during the course will be exposed, as well as the requirements to fulfill and some aspects to be taken into account in the assessment. Achieving the requirements of the project is a necessary but not a sufficient condition to overcome the laboratory part. Furthermore, it will be necessary to demonstrate, answering to questions in an individually oral exam, a sufficient skill in the characterization of the circuits performed.

Laboratory attendance is voluntary, as well as master classes attendance. In the implementation of the project, each student must provide the consumables components that are needed, which will also be of their choice. It is also recommended for them, to have basic tools to help in the hardware assembly, such as welders, scissors, etc. By extension, it is also helpful to have some basic instruments for the characterization of the circuits, such as a multimeter and the possibility to use an oscilloscope. Basic equipment for circuit characterization is available at the laboratory's opening hours: power supply, multimeter, signal generator, and oscilloscope. As a courtesy, working-stations will be set up for the recommended modifications or failure correction of the circuits, but not for their assembly itself, as this is supposed to be done outside the established practice hours. The evaluation of the work of the laboratory will be done in one of the work-stations, individually, based on the characterization of the assembled circuit, which must be operative at

the moment of the assessment, and the written report.

In the case that the health conditions do not allow the realization of a teaching activity and / or evaluation in person, it will activate a modality of non-presence of which students will be informed promtly.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	45			15					
Horas de Actividad No Presencial del Alumno/a	67,5			22,5					

Legend:

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 75%
- Exercises, cases or problem sets 25%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The final mark is composed of 75% corresponding to the theoretical part, which is assessed mainly by means of a final written examination, and 25% corresponding to the laboratory.

Part of the subject of the theoretical part could be liberated by passing a partial exam, which could be done around the middle of the term.

In any case, students must pass both the theoretical and the laboratory part in order to obtain a pass grade in the subject overall. The theoretical part implies the written exam for problem solving and theoretical concepts, as long as the student decides to fulfill it/them. The laboratory part usually includes a design, an assembly, a characterization, a written report and an oral individual exam.

In the case of not attending the evaluation of the laboratory part, the student may attempt to a final evaluation of this part which will be done within the written final exam or in a separate session in the lab. If wanting to make use of this evaluation method, the student will inform to the teacher beforehand. This evaluation will also be considered as an exceptional condition, since it is not possible to evaluate the evolution of the student throughout the laboratory. This fact implies that the level of the tests must be such that can exempt the student from the performance in the laboratory.

In any case, it will always be more advisable to attend the laboratory on an ordinary basis.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Concerning the extraordinary session this will be based on a written exam of the master classes. The mark of this exam will be worth 75% of the final qualification.

The remaining 25% will correspond to the qualification of the laboratory. The laboratory mark will be saved for the two sessions (regular and extraordinary). If the laboratory part of the regular session has been failed, the student may agree with the teacher on an individual performance of the considered laboratory test; for that reason, prior the data of the extraordinary session, and sufficiently in advance, the student should contact the teacher to fix the evaluation of the practical test. The EHU/UPV is not obliged to provide laboratories for this purpose.

As in the ordinary session and in the case of not having followed the procedure before indicated, the student could attempt to a final evaluation of the part of the laboratory that would also be carried out in a writing test within the final exam or in an independent session in the laboratory. In that case, the student should inform beforehand to decide which the most convenient procedure is, or at least not to contravene any regulations, regarding the final evaluation of the courses. This evaluation will also be considered as an exceptional condition, since it is not possible to evaluate the evolution of the student throughout the laboratory, which implies that the level of the tests must be such that can exempt the student from the performance in the laboratory.

MANDATORY MATERIALS

Course content (slides) are available on eGela.

Basic tool for the personal realization of the laboratory activities.

BIBLIOGRAFÍA

Basic bibliography

Basic bibliography

- T. C. Carusone, D. A. Johns & K. W. Martin, 'ANALOG INTEGRATED CIRCUIT DESIGN'. 2nd edition, John Wiley & Sons, 2012
- P. R. Gray y R. G. Meyer. 'Análisis y diseño de circuitos integrados analógicos', 3rd edition. Prentice Hall-Hispanoamericana, 1995.
- A. S. Sedra y K. C. Smith. 'Circuitos microelectrónicos'. 5th edition. McGraw-Hill, 2006.
- J. Millman y A. Grabel. 'Microelectrónica'. Editorial Hispano Europea.
- PSPICE handouts.
- Catalogs / Application notes for components.

Detailed bibliography

- P.R. Gray, P.J. Hurst, S.H. Lewis y R.G. Meyer. 'Analysis and design of Analog Integrated Circuits', 5th edition. John Wiley & Sons, 2009.
- Sergio Franco. "Design with operational amplifiers and analog integrated circuits". 2nd edition. McGraw-Hill, 2002.

Journals

Web sites of interest

http://es.farnell.com/
http://es.rs-online.com
http://www.digikey.es

All addresses as links for component searching and datasheets.

OBSERVATIONS

There will be no restrictions on the use of calculating instruments in the examinations.

From the experience of past editions of this course, as well as from other equivalent courses from previous study plans, the existence of students whose laboratory skills are exceptional, but not on the theoretical part or vice versa has been observed. The current system of a single subject with a single weighting prevents these students from achieving the brilliance in their results as they deserve. It is for this reason that the teaching staff of this course will pay attention to these students and, if so, they will be able to qualify the student regardless of the general formula.

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Fourth year

COURSE

27362 - Deployment & Management of Networks & Services **Credits, ECTS:** 4,5

COURSE DESCRIPTION

The course aims at applying the network architecture and interconnection principles in the telematics modules in order the students to be able to deploy a whole end-to-end system including all nodes and services required.
They will therefore design and configure in a lab environment the addressing/routing mechanisms and internetworking protocols from link up to application layer to support the information exchange among all the elements in the telecommunication service supply chain (that would include both describing, programming and validating routing and signalling elements throughout the architecture).
On the other hand the infrastructure designed should be able to deliver required QoS levels and guarantee proper performance of deployed services. Optimization mechanisms and enhancements will be also considered in order to face possible degradation situations.
In the scope of the telematics module the course aims at combining the views from "Access Networks" and "Transport Networks" courses in a holistic/e2e manner.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The course aims at applying the network architecture and interconnection principles in the telematics modules in order the students to be able to deploy a whole end-to-end system including all nodes and services required.
* Design and configure in a lab environment the addressing/routing mechanisms and internetworking protocols from link up to application layer to support the information exchange among all the elements in the telecommunication service supply chain (Competence TE2 -routing, signaling- and TE4 -description and validation of protocols and interfaces- from the Telematics Module)
* Design a infrastructure as to deliver required QoS levels and guarantee proper performance of deployed services (TE5 -enhancements of networks and services via technological- and TE6 -designg of architecture-)
* Empiricallly evaluate the obtained performance and propose posible enhancements/optimization mechanisms to face degradation conditions (TE3 -ability to compose services by using planning and analysis tools-).

CONTENIDOS TEÓRICO-PRÁCTICOS

It is basically a lab course so that most lab tasks will be group-tasks following this structure::
1. Introduction to the simulated company networking and services requirements/problems.
2. HW and SW installation and maintenance.
3. Basic services and link level.
4. Isolated company network.
5. Interconnection.
6. Network management and modeling.
7. Advanced services and enhancement.

TEACHING METHODS

After setting 2-3 people group the problem of designing and deploying network and services for the simulated company will be addressed following a "problem based learning" approach. That would include not only pure technical aspects but also cost and suitability for the company.
Every group will be in fact responsible for defining its objetives and ambition.
As a pre-requisite all student will follow a personal basic network/services administration initial instruction.
In both cases autonomous online learning will be heavily promoted, keeping any master class to a minimum.
In order to ensure the feedbacking process the simulated company definition process will be comprehensively supported by the teacher and will also involve two oral defences.

In the event that sanitary conditions prevent the face-to-face teaching activity and / or assessment, online modalities will be made active and the students will be promtly informed.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching				45					
Horas de Actividad No Presencial del Alumno/a				67,5					

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Oral defence 23%
- Teamwork assignments (problem solving, Project design) 69%
- Oral presentation of assigned tasks, Reading¿ 8%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

This is a 100% lab course, Project based.
Therefore, the initial server admin task will be individually evaluated but all the rest will be presented as group tasks (including task reports, public defenses, etc..)
Final mark will be the weighted sum of the partial ones following the distribution in this guide.
The students are entitled to dismiss the continuous evaluation and apply for a single final probe by carrying out the procedures (and according to the deadlines) in the official UPV/EHU BSC student rules.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Considering that all the practical skills must be evaluated the student will present his working company project in an oral defence and show it actually working according to the specification.

MANDATORY MATERIALS

Provided it is a project based course students' capability to face on their own the problems is particularly encouraged. Therefore, at the beginning of each lab some initial guidance will be provided but the groups will later search for information online.

BIBLIOGRAFÍA

Basic bibliography

Basic bibliography is associated with every single tool/software to be used for the deployment of the simulated company's network. In fact, the course itself demands students to be responsible for the research phases either via online browsing of by using manufacturers' handbooks/tutorials (even those available in previous courses).

Detailed bibliography

LIFS (various authors, available online www.tldp.org)
The Linux System Administrator's Guide (various authors available online www.tldp.org)
Linux Advanced Routing & Traffic Control (various authors, available online http://www.lartc.org/)

Journals

Being a practical engineering lab no research journal is foreseen as useful.

Web sites of interest

Manuals
http://www.tldp.org/
http://www.lartc.org
http://www.cisco.com
Software
https://sourceforge.net/
https://github.com/
https://www.kernel.org
stackoverflow.com/
News
www.reddit.com
www.slashdot.org
www.barrapunto.com

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao
Cycle Not Applicable
Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering
Year Fourth year

COURSE

27364 - Laboratory of Communications Electronics
Credits, ECTS: 4,5

COURSE DESCRIPTION

This subject is the framework where the knowledge acquired in electronics in the previous courses is developed through practical implementations. It complements the subject of Circuits of Telecommunication of the same specialty. It focuses, but not exclusively, on those circuits, systems and measurement instruments used in communications electronics systems and circuits.

Subjects require to acquire module competences:

COURSE 1st: Basic Electronics, Devices and Electronic Circuits
COURSE 2: Theory of Communication. Electromagnetic fields.
COURSE 3º: Circuit Electronics, Telecommunication Systems, Radiocommunication Systems. High Frequency Systems. Electronic Instrumentation. Electronic power systems.
COURSE 4: Telecommunication Circuits, Electronic Systems Technology.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Goals:
- Analyze and deepen the operation of electronic systems for the transmission of signals generated by telecommunication systems.
- Assess, determine and specify the reliability and accuracy of electronic telecommunication systems.
- Design and solve electronic systems of telecommunication systems through individual and cooperative work.
- Detect, assess and solve problems affecting telecommunications systems due to different types of sources of disturbance.

Competencies:

Professional or specific
- Identification and resolution of communication engineering problems using electronic systems.
- Design capability oriented to the electronic product.

Transversal or general
- General reasoning, applied and critical.
- Autonomous Learning.
- Search for information.

Specific competences of the MO5 module - Electronic Systems:
-M05SE1: Ability to build, exploit and manage systems of capture, transport, representation, processing, storage, management and presentation of multimedia information, from the point of view of electronic systems.
-M05SE3: Ability to perform the specification, implementation, documentation and set-up of equipment and systems, electronic, instrumentation and control, considering both the technical aspects and the corresponding regulatory regulations.
-M05SE5: Ability to design circuits of analog and digital electronics, analog-digital and digital-analog conversion, radiofrequency, power and electric power conversion for telecommunication and computer applications.
-M05SE6: Ability to understand and use feedback theory and electronic control systems.
-M05S58: Ability to specify and use electronic instrumentation and measurement systems.
-M05S59: Ability to analyze and solve problems of interference and electromagnetic compatibility.

CONTENIDOS TEÓRICO-PRÁCTICOS

Design and assembly of basic electronic subsystems in telecommunications systems
- Electronic components and selection criteria
- Oscillators
- Modulators and Demodulators
- Small Signal Amplifiers
- Power Stages

Instrumentation and measurement techniques
- Synthesized signal and function generator
- Spectrum analyzer
- Network Analyzer

- Vector Modulator Analyzer

TEACHING METHODS

Methodology of teaching based on laboratory work, which consists of designing and constructing, through a series of guided practices, electronic subsystems for the implementation of basic functions in telecommunications.
The student must design, assemble, measure, improve the designs until they meet the required starting specifications, and finally characterize the built circuits.
The subject will be managed through a virtual platform that will allow the immediate sharing of messages and information, access to documentation and electronic specification sheets, consultations, discussion groups, etc.
The non-presence part will be dedicated to the search of information, reading of documentation, specification sheets and application notes, and the preparation of designs and even electronic assembly of prototypes, as well as electronic simulation of subsystems which may be relevant. It will also be dedicated to the completion of the final reports of the practices carried out.
To prepare the laboratory practices there will be brief lectures and a previous job of searching information on the web. In laboratory practices, the proposed electronic systems should be designed, simulated and physically realized. Finally, the electronic system should be characterized with a report.
In the event that the sanitary conditions prevent the realization of a teaching activity and / or face-to-face evaluation, a on-line modality will be activated of which the students will be informed promptly.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching				40	5				
Horas de Actividad No Presencial del Alumno/a				60	7,5				

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Oral defence 20%
- Exercises, cases or problem sets 40%
- Teamwork assignments (problem solving, Project design) 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The scores will be based on the evaluation of the work performed in class, the prototypes to be designed and assembled, and the final report of the prototype assemble and, which should include the design process and the characterization of the implemented circuits.
Evaluation instruments:
- Attendance control sheet through ICTs and presence.
- Written report of the theoretical realization by means of simulation of the proposed practices.
- Resolution in the laboratory of the proposed practices.
- Written report of laboratory practices.

The resignation procedure is the one included in the corresponding regulations. The evaluation of those students that accept the resignation is done by a test for the 100% of the subject.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation in second call consists of a test, for the 100% of the subject, to be carried out in the laboratory.

MANDATORY MATERIALS

Orcad, PSpice, LTspice, Agilent ADS or equivalent CAD/CAE tool.

BIBLIOGRAFÍA

Basic bibliography

Peter Wizmuller, RF Design Guide: Systems, Circuits and Equations, Artech House, Inc, 1995
H. L. Krauss, C. W. Bostian, F. H. Raab. Solid State radio Engineering. John Wiley & Sons 1980
Clarke-Hess. Communication Circuits: Analysis an Design. Addison Wesley 1978
Steve C. Cripps. RF Power Amplifiers for wireless Communications. Artech House 1999
RF Circuit Design, Christopher Bowick, 2nd Edition, Newnes-Elsevier 2008

Detailed bibliography

Pieter L.D. Abrie. Design of RF and Microwave Ampliers and Oscilators. Artech House, Inc. 1999
RF Power Transistor Manual. RCA Corporation 1971.
Sven-Olof Öhvrick, Radio School. Transmitter Technology RT1C. Ericcson Radio System AB 2000.
David M. Pozar. Microwave Engineering. Addison-Wesley
Chris Bowick. RF Circuit Design. SAMS
Irving M Gottlieb. Practical RF Power Design Techniques. TAB books McGraw-Hill 1993
Inder Bahl, Prakash Bhartia, Microwave Solid State Circuit Design, John Wiley & Sons, Inc. 1988

Journals

RF Design
Microwaves & RF
Microwave Engineering
Microwave Journal

Web sites of interest

http://www.radioelectronicschool.net/
http://www.mwjournal.com
http://www.mwee.com/
http://www.mwrf.com/
http://rfdesign.com/

OBSERVATIONS

The subject has a MOODLE server (eGela).

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Second year

COURSE

27365 - Theory of Communication **Credits, ECTS:** 7,5

COURSE DESCRIPTION

This subject is integrated into the common module of telecommunication (Module 02), and as such, it studies the basic principles of telecommunications. The subject describes, both from a formal and a mathematical point of view, the basic mechanisms that allow the transmission of information in modern telecommunication systems (radio and digital television, data transmission, telephone communications etc.). To this end, both the digital information to be transmitted (with stochastic characteristics), and the limitations of the channel through which the transmission is performed, are modeled considering two main cases: the transmission through bandwidth-limited channels and AWGN channels. Both, base-band and pass-band systems are studied. The mathematical models learned in the lectures are reinforced by means of laboratory sessions.
The subject is taught during the second semester of the second year of the degree. Thus, it uses the background acquired in the subjects 'Circuit Analysis' and 'Signal Processing' (first course) related to the tools used for signal analysis and signal processing (convolution and Fourier transform). It is also assumed that the students have the skills and abilities related to the basic techniques of statistical analysis (subject of 'Statistics', first course) and other basic tools of algebra and calculus ('Algebra',' Calculus I and II' and 'Advanced Mathematics'), such as graphical representation of functions, basic integrals, operations with complex numbers, trigonometric functions, vector representation and basic operations with vectors. In addition, it is important for the students to understand the concepts of energy and power, acquired in the subject 'Extension of Physics'.
On the other hand, as a subject of basic fundamentals of communications, it prepares the students for future subjects in the field of communications (subjects of Module 03), such as 'Telecommunication Systems', 'Radiocommunication Systems' and 'Mobile Communications', where the concepts studied in Communication Theory are used as a background for a more elaborate description of the techniques used for the transmission of information in communication systems.
Coordination is ensured through the general mechanisms of coordination: course, module and degree.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Upon successful completion of this course students will be able to:
- List and describe the basic components of a communication system and interpret its fundamental parameters.
- Operate formally with the usual stochastic processes in communication systems and analyze their spectral characteristics.
-Describe formally the basic techniques to modulate information in digital form.
- Identify the basic types of digital and analog modulations and be able to interpret the associated graphical representations (power spectral density, IQ constellation, eye diagram).
- Design an optimal receiver for basic digital modulation techniques based on elementary specifications.
- Program with computer tools oriented to the analysis, design and implementation of the modulation and demodulation subsystems from the point of view of the detection and generation of the signals.
- Manage instrumentation for the generation and detection of digital and analog modulated signals.

CONTENIDOS TEÓRICO-PRÁCTICOS

Classroom teaching:
Lesson 1 Introduction to communication systems
Lesson 2 Signals and random processes
Lesson 3 Transmission of signals with noise
Lesson 4 Bandpass signals and systems
Lesson 5 Baseband digital communications
Lesson 6 Digital modulations
Lesson 7 Noise in digital communications

Seminars

Analog modulations and resolution of complex problems in group

Laboratories

Practice 1 Analog Modulations. AM.
Practice 2 Analog modulations. FM.
Practice 3 Digital modulations

TEACHING METHODS

PRESENTIAL TEACHING:
- Classroom lectures:
*exposition of fundamentals and theory
*problem resolution.

It will be necessary for the students to perform the required personal work (non-contact teaching) to follow the classes.

- Laboratory practices: simulation of analog and digital communication systems in the Matlab / Octave environment and analysis of digital communication systems using real equipment.
- Seminars: explanation of analog modulations and discussion, resolution and oral presentation, both individually and as a group of complex problems.

NON-PRESENTIAL TEACHING:
- Classroom lectures:
* Study of the theory proposed for the week. Preparation of lists of questions for discussion in the classes face-to-face
* Resolution of proposed problems and preparation of exercises.
- Laboratory practices: preparation of the proposed practices and relate results to the theory.
- Seminars: individual and team preparation of the proposed problems.
Problem resolution.
It will be necessary for the students to perform the required personal work (non-contact teaching) to follow the classes with use.
- Laboratory practices: simulation of analog communication systems in the Matlab / Octave environment and analysis of digital communication systems using real equipment.
- Seminars: discussion, resolution and oral presentation, both individually and as a group of complex problems.
NON-PRESENTIAL TEACHING:
- Master and classroom practices:
- Study of the theory proposed for the week. Preparation of lists of questions for discussion in the classes face-to-face Resolution of proposed problems and preparation of exercises.
- Laboratory practices: preparation of the proposed practices and relate results to the theory.
- Seminars: individual and team preparation of the proposed problems.

If the health conditions do not allow a presential teaching and evaluation, a non-presential mode will be activated and the students will be informed from time to time.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	7,5	22,5	15					
Horas de Actividad No Presencial del Alumno/a	45	11,25	33,75	22,5					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 65%
- Exercises, cases or problem sets 25%
- Teamwork assignments (problem solving, Project design) 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Two assessment systems are considered in ordinary call: on the one hand, the continuous evaluation system, which requires regular attendance at the classes and a regular follow-up of the subject, surpassing the partial exams that are carried out; on the other hand, the final evaluation system, basically consisting of a single final exam of the subject. Both systems are exclusive, so the student must expressly waive the continuous evaluation to be able to take the final evaluation test.

A) CONTINUOUS EVALUATION SYSTEM
A continuous evaluation will be carried out throughout the course through three individual partial evaluation tests (PEP) along with the evaluation of work done in the Seminars. In each of the PEP they will evaluate the competences acquired

in solving problems (lectures, classroom practices and seminars) and in laboratories (laboratory classes):
- PEP1:
* Lessons 1 and 2 (PEP1-M)
*Laboratory Practice 1 (PEP1-L)
- PEP2:
* Lessons 3 and 4 (PEP2-M)
* Laboratory practice 2 (PEP2-L)
- PEP3:
* Lessons 5, 6 and 7 (PEP3-M)
* Laboratory Practice 3 (PEP3-L)

- Seminars: Teamwork evaluation: oral and written presentation of complex problems during the seminar sessions.
- A questionnaire will be performed in each laboratory session, with questions about the work to be done during non-presential teaching.
CALCULATION OF THE FINAL NOTE

The final grade of the subject will be calculated with the following formula:

NF= 0,65*(N(PEP1-M)*0,3+ N(PEP2-M)*0,3+ N(PEP3-M)*0,4)+
0,25*(N(PEP1-L)*0,25+ N(PEP2-L)*0,35+ N(PEP3-L)*0,40)+
0,1*N(Seminars)
To pass the subject it will be necessary to fulfill the following conditions:
- Obtain an NF equal to or greater than 5 points out of 10 (5/10).
- Having obtained an average score in the part of Classroom (M) higher than 3 points out of 10, an average score in the part of Laboratories higher than 3 points out of 10, and an average score in the part of Seminars greater than 3 points out of 10. That is to say:
* N(PEP1-M)*0,3+ N(PEP2-M)*0,3+ N(PEP3-M)*0,4 must be equal or greater than 3 out of 10
* N(PEP1-L)*0,25+ N(PEP2-L)*0,35+ N(PEP3-L)*0,40 must be equal or greater than 3 out of 10
* N(Seminars) must be equal or greater than 3 out of 10

- Have a minimum attendance of 75% to face-to-face classes of laboratory and seminars.
- The questionnaires performed in each laboratory session will have to be passed.
In case you have not obtained a minimum of 3 points out of 10 in any of the sections and the final grade obtained through the formula was greater than 4.5 the final grade that will be reflected in the minutes will be 4.5 / 10.

ASSISTANCE TO THE PRESENTIAL TEACHING

To be able to follow the continuous evaluation system, a minimum attendance of 75% is required for face-to-face classes classes of laboratory and seminars.
This criterion will be applied throughout the course, so that in order to be evaluated in the partial evaluation tests (PEPs), this requirement must be met on the date of completion of each test.
The rejection of the continuous evaluation must be made through written communication to the teacher of the subject until April 30. The rejection of the continuous evaluation supposes the loss of the results of the evaluations previously carried out. The rejection of the continuous evaluation can be done separately for the laboratories, on the one hand, and for the set of classroom lectures -seminars, on the other. If the continuous assessment of the part of classroom lectures is waived, the seminars will automatically be renounced and the part of classroom lectures will have a weight of 75% of the grade.
B) FINAL EVALUATION SYSTEM
It will consist in the realization of an exam on the day of the ordinary call. The exam will have two parts, one written test consisting of problem solving of the subject and a test of laboratory practices.
The Final Note will be calculated by applying the following formula:
NF = 0.75 * N (M + PA) + 0.25 * N (Lab)
It will be necessary to obtain a minimum score of 3 out of 10 in each of the sections. That is to say:
- N (M + PA) must be equal to or greater than 3 points out of 10
- N (Lab) must be equal to or greater than 3 points out of 10
In case you have not obtained a minimum of 3 points out of 10 in any of the sections and the final grade obtained by the formula was higher than 4.5 the final grade that will be reflected in the minutes will be 4.5 / 10.
If you do not assist to the exam in the ordinary call, the rejection of it will be assumed in any case.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation in the extraordinary call will be made with respect to the same contents taught during the course (classroom lessons (M+PA), Laboratory practices (Lab) and Seminars).
It will consist of an examination on the day of the extraordinary call. The exam will have two parts, one written test consisting of problem solving on the subject and a test of laboratory practices.

The Final Note will be calculated by applying the following formula:
NF = 0.75 * N (M + PA) + 0.25 * N (Lab)
It will be necessary to obtain a minimum score of 5 out of 10. Additionally, it will be necessary to obtain a minimum score of 3 out of 10 (3/10) in each of the sections. That is to say:
- N (M + PA) must be equal to or greater than 3 points out of 10 (3/10)
- N (Lab) must be equal to or greater than 3 points out of 10 (3/10)
In case you have not obtained a minimum of 3 points out of 10 in any of the sections and the final grade obtained by the formula was higher than 4.5 the final grade that will be reflected in the minutes will be 4.5 / 10.
If a grade equal to or greater than 5/10 has been obtained in the ordinary call at the Classroom lectures modalities (M+PA) , it will be possible to keep this note for the extraordinary call. The same applies to the Laboratory Practices modality.
No grade obtained during the course in the different sections is maintained for later courses.

MANDATORY MATERIALS

Tool to support teaching: egela.ehu.eus

Theory and exercises in egela.ehu.eus

BIBLIOGRAFÍA

Basic bibliography

A. Bruce Carlson
Communications Systems: An Introduction to Signals and Noise in Electrical Communications
McGraw-Hill, 2010 (5ª Edición)

Ferrel G. Stremler
Introduction to Communications Systems
Addison-Wesley 3ª Ed. 1990

Symon Haykin
Communication Systems
John Wiley & Sons, 2ª Ed. 1994

Jesus López, Eduardo Martos
Señales aleatorias. Teoría y ejercicios resueltos.
Ed. Marcombo

Detailed bibliography

Stochastic processes:
A. Papoulis
Probability, random variables, and stochastic processes
(4aEd.), McGraw-Hill, 1994

Digital communications tutorials:
http://www.complextoreal.com/tutorial.htm

Digital communications course:
Principles of Digital Communications: Zheng, Lizhong, and Robert Gallager. 6.450 Principles of Digital Communications I, Fall 2006. (Massachusetts Institute of Technology: MIT OpenCourseWare), http://ocw.mit.edu (Accessed 21 Jan, 2013).
License: Creative Commons BY-NC-SA

Journals

Web sites of interest

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Fourth year

COURSE

27373 - Optic Communications **Credits, ECTS:** 4,5

COURSE DESCRIPTION

Optical communications is an elective subject given on the first four-month period of the 4th year in the Faculty of Engineering in Bilbao, and it is linked to the module Telecommunication Systems.

The subject is devoted to the fiber-optic communications employed in information technology. Optical communications are taking on a more important role in the field of telecommunications engineering. Therefore, this is a key subject to learn, analyze, evaluate and design the elements, devices, systems and networks that make use of such a technology.

The subject will not be difficult to follow provided that the student is able to solve problems with skill in calculus and statistics (subjects 'Calculus I', 'Algebra' and 'Statistics' of the 1st year). Likewise, it is required a working knowledge both in solving problems related to the propagation of electromagnetic fields (subject 'Electromagnetic Fields' of the 2nd year) and in handling circuits, components and subsystems used with high frequency signals (subject 'High frequency systems' of the 4th year).

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Competencies are the correct combination of knowledge, skills and abilities, attitude and values; all of them are necessary to perform correctly a job. The specific competencies are acquired and developed in the module Telecommunication Systems, whereas the general and transversal competencies are developed during the whole degree of Telecommunications Engineering (Grado en Ingeniería en Tecnología de Telecomunicación).

Students of this subject will acquire the following competencies:

Specific competencies:
- Ability to select circuits, subsystems and systems for radio-frequency, microwave, broadcasting, radio link and radiodetermination (M03S4).
- Ability to select antennas, pieces of equipment and systems for transmission and guided and non-guided wave propagation by electromagnetic, radio-frequency related or optical means, as well as to manage the corresponding radio spectrum and frequency assignment (M03S5).

General and transversal competencies:
- Knowledge of the fundamental topics and technologies that allow students both to learn new methods and technologies and to adapt themselves to any new situation (G003).
- Ability to solve problems with initiative, decision making, creativity, and to communicate and transfer knowledge, skills and abilities, understanding the ethical and professional responsibility in the performance of the Technical Telecommunications Engineering (G004).

CONTENIDOS TEÓRICO-PRÁCTICOS

The subject is divided into two sections:
- On one hand, in the lectures + practical classroom work, contents are worked individually by students, and they consist of five lessons.
- On the other, in the seminars + practical laboratory work, students work in groups of three or four, and they have to complete six practical tasks. Previously, training lessons are given so that students carry out correctly their tasks.

Lectures + practical classroom work:
- Lesson 1: Introduction to optical fibers.
Critical angle and evanescent field. Optical fiber: structure, types, applications, refractive index profiles, numerical aperture and transmission capacity. Historical view.
- Lesson 2: Propagation in optical fibers.
Attenuation: intrinsic and extrinsic mechanisms, transmission windows and maximum distance limited by attenuation. Dispersion: concept and effects, types of dispersion and maximum distance limited by dispersion. Cables and fibers: structure and types of cables. Connectors and splices: intrinsic and extrinsic losses, connector and splice losses.
- Lesson 3: Optical emitters.
LEDs: working principle, SLEDs, ELEDs and efficiencies. Lasers: working principle, Fabry-Perot laser, efficiencies, emission modes and lasers based on distributed mirrors. External modulators.
- Lesson 4: Optical detectors and network design.
Photodiodes: working principle, efficiencies and responsivity, spectral features and avalanche photodiodes vs PIN photodiodes. Design of an optical link taking into account the times of response of the laser, of the optical fiber and of the receiver.

- Lesson 5: Optical amplifiers and non-linear effects.
Optical amplifiers: working principle, EDFA, SOA and Raman. Non-linear effects: classification and description.

Seminars + practical laboratory work:
- Training lessons: Introduction and safety. Metrology. Introduction to the study of uncertainties.
- Practical task 1: Measurement of passive devices in monomode fibers.
Measurement of bending losses. Couplers.
- Practical task 2: Measurement of the numerical aperture and other parameters of interest in multimode fibers.
Misalignment losses in fibers. Attenuation in optical fibers with connectors using different LEDs.
- Practical task 3: Measurement of active devices and WDM transmission systems.
Measurement of a semiconductor laser. Power-current curve. Transmission with wavelength division multiplexing.
Measurement of the attenuation in demux filters.
- Practical task 4: Measurement of an optical fiber communications link.
Learning to use an optical time-domain reflectometer (OTDR). Measurement of the attenuation and insertion losses in fiber links.
- Practical task 5: Investigation of the dispersion and bit error rate in an optical link.
Measurement of the dispersion. Investigation of the quality factor and bit error rate as a function of the link length.
- Practical task 6: Design and simulation of a digital transmission network.
Design, simulation and optimization of a digital transmission system in medium-range distances using monomode fibers.

TEACHING METHODS

Students of this subject work individually (lectures + practical classroom work) or in groups (seminars + practical laboratory work). The methodology is explained in more detail below:

- Masterclasses (lectures):
The theoretical basics and concepts are explained by the lecturer. In order to encourage students to participate, theoretical lectures are alternated with mathematical tasks performed in groups of two or three students. Furthermore, the lecturer assists students with the study and the reading of recommended bibliography in the hours of student work outside the classroom. Learning results: RA1 and RA2.

- Problem-solving activities and problem-solving task-based learning (practical classroom work):
Problem-solving activities are carried out by the lecturer on the blackboard; these problems are related to the theory explained in the lectures (they are marked with an asterisk). Students are also encouraged to participate and discuss in class, involving question-answer type interactions, as well as problem-solving activities of a certain subsection on the blackboard by one or two students. In such an interaction, mistakes in problem-solving activities can be as valuable as correct answers, since they make it possible to identify items that were not clear enough and correct common mistakes. Students can also solve additional problems (not marked with an asterisk) in the hours of student work outside the classroom. Learning results: RA3, RA7 and RA8.

- Practical task-based learning (seminars + practical laboratory work):
Students perform experimental measurements in groups of three or four (there are six practical tasks, they are independent, and they are not necessarily conducted sequentially). Previously, students can read the manuals thoroughly and prepare each practical task in the hours of student work outside the classroom. Afterwards, there are two sessions to complete each practical task: in the first session, in the practical laboratory work, each group performs the experimental measurements and records the results; in the second session, in the seminars, the results from the previous session are processed by each group and documented in standard reports. The lecturer assists each group both with their experimental measuring and with the development of the standard report in order to improve successive practical tasks and reports. Assistance from lecturer takes place in the hours of face-to-face teaching of seminars + practical laboratory work, as well as in office hours. Learning results: RA2, RA4, RA5 and RA6.

Note: should the health conditions prevent any face-to-face teaching and/or assessment, such activity will move online, and students will be kept informed in a timely manner.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	7,5	15	7,5	15					
Horas de Actividad No Presencial del Alumno/a	11,25	22,5	11,25	22,5					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 28%
- Multiple choice test 7%
- Teamwork assignments (problem solving, Project design) 65%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

To pass the subject it is required to get at least a 50% pass mark on:
- the lectures + practical classroom work
and on
- the seminars + practical laboratory work.

Assessment of the lectures + practical classroom work (individual mark):
- For continuous assessment:
  * Two questionnaires in the eGela virtual platform (7% of the total grade).
  * A written exam in the official examination date of the final assessment test (28% of the total grade).
- For final assessment (for students that requested to be graded by final assessment):
  * A questionnaire and a written exam in the official examination date of the final assessment test (35% of the total grade).

Assessment of the seminars + practical laboratory work (individual or group mark):
- For continuous assessment:
  * 6 standard reports of the experimental measurements processed correctly (65% of the total grade, group mark).
- For final assessment (for students that requested to be graded by final assessment):
  * A practical exam after the written exam in the official examination date of the final assessment test (65% of the total grade, individual mark).

Withdrawal from continuous assessment:
- Students have the right to be graded by final assessment: they must present a written request to do this, within 9 weeks, starting from the beginning of the four-month period.

Withdrawal from a call:
- For continuous assessment: students may withdraw from the ordinary exam call one month before the end of the teaching period. To do this, they must present a written request to this end. Otherwise, non-attendance at the exam call in the official examination date of the final assessment test will result in a failing grade (NOT PASS will be applied).
- For final assessment (for students that requested to be graded by final assessment): non-attendance at the exam call in the official examination date of the final assessment test will result in a withdrawal (NOT PRESENTED will be applied).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

To pass the subject it is required to get at least a 50% pass mark on:
- the lectures + practical classroom work
and on
- the seminars + practical laboratory work.

Assessment of the lectures + practical classroom work and seminars + practical laboratory work (individual mark):
- A questionnaire and a written exam (35% of the total grade) + a practical exam (65% of the total grade) in the official examination date of the final assessment test.

Students who achieved at least a 50% pass mark in the assessment of the lectures + practical classroom work or in the assessment of the seminars + practical laboratory work of a previous call: it is possible to keep the mark of the corresponding assessment.

Withdrawal from a call:
- Non-attendance at the exam call in the official examination date of the final assessment test will result in a withdrawal (NOT PRESENTED will be applied).

MANDATORY MATERIALS

Lecture materials and notes are available in the eGela virtual platform:
- PowerPoint slides used in the lectures.
- Questions from the exercises worked on in the practical classroom work.
- Manuals and standard reports of the seminars + practical laboratory work.

Information about the use of materials, media and resources:
- During teaching activities (continuous assessment):
  * Students are permitted to use books or course notes as well as electronic or computer systems or devices. Should these systems or devices have access to the Internet, any search for other than instructional materials will be prohibited. In any case, no telephone systems, devices or any other type of help are permitted.

- In the final assessment test (both continuous assessment and final assessment):
  * Students are only permitted to use calculators. Neither books or course notes nor telephone, electronic or computer systems or devices nor any other type of help are permitted.

BIBLIOGRAFÍA

Basic bibliography

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M. G. Kuzyk, Polymer fiber optics: materials, physics, and applications. Taylor and Francis, 2007.
J. Powers, An introduction to fiber optic systems. McGraw-Hill, 2002.
B. E. A. Saleh, M. C. Teich, Fundamentals of photonics. John Wiley and Sons, 2007.

Journals

Revista Española de Física: http://www.revistadefisica.es/index.php/ref/index

Web sites of interest

RP photonics encyclopedia: http://www.rp-photonics.com/encyclopedia.html
EXFO glossary: http://www.exfo.com/support/services/instrument-services/be-expert-training-program/animated-optical-glossary
International Telecommunication Union (G Series Recommendations): http://www.itu.int/ITU-T/recommendations/index.aspx?ser=G
Bureau International des Poids et Measures: www.bipm.org
Centro español de metrología: www.cem.es
Revista española de metrología: www.e-medida.es
Asociación Española de Normalización y Certificación (AENOR): www.aenor.es
Entidad nacional de acreditación: www.enac.es

OBSERVATIONS

- Students will be subjected to the 'Academic ethics policy and prevention of dishonest and fraudulent activities of the University of the Basque Country (UPV/EHU)'.
- Attendance of the lectures + practical classroom work is optional. Nevertheless, students who do not attend and do not show any doctor's note will have to get up to date with the lecture material.
- Attendance of the seminars + practical laboratory is compulsory for students accepting the conditions of continuous assessment of those types of teaching. Students who do not attend and do not show any doctor's note will receive no marks in the corresponding standard report.

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Not Applicable

COURSE

27374 - Access Networks **Credits, ECTS:** 6

COURSE DESCRIPTION

The ``Access Networks`` course is one of the subjects of the Telematics specialization in the third year of the degree in Engineering in Telecommunication Technology. It belongs to the area of ``Networks`` of this specialty together with ``Transport Networks`` and ``Mobile Service Networks`` within this branch.

This subject presents and explains the main characteristics of the access network, which is the part of the network that connects the end user of the service to the first node in the network that supports this service. This course, together with Mobile Networks and Services and Transport Networks make up a set to have a complete vision of the current networks. Mobile Networks and Services deals with aspects of access networks that include mobility. Transport Networks completes the study of communications networks to describe the functioning of the different service nodes, their interconnection and techniques that allow the services to be provided.

The subject is divided into two main parts. In the first part, the features and technologies of Public Access Networks, which are those available to the general public, are presented. In the second part, Corporate Access Networks are analysed. These help provide access to a particular closed group of users. The architecture and operation of both types of networks are very different and that is the reason for this division.

For the study of Public Access Networks technologies, they will be classified and described according to the transmission medium used: wired (ADSL, HFC, FFTX...) or wireless (WiMAX...). In the case of Corporate Access Networks technologies, different technologies are analyzed and some complex scenarios are also introduced, such as logical segmentation of a LAN, remote access to a private network and loop resolution in LANs.

One of the main aims of this subject is that the student should develop the ability to manage specifications, regulations and mandatory standards as well as analyze and evaluate the social and environmental impact of technical solutions. To meet these goals, legislation or the main regulations related to the access network infrastructure (CTI and structured cabling systems) necessary for the design and installation of these networks in a timely manner are also introduced.

Prerequisite to take this course is, at least, having acquired the basic concepts related to communications networks introduced in the Telecommunication Networks and Services Architecture course, which is compulsory one-year course in the second year of the degree.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

This subject contributes to the following telematics competency related to the design and deployment of networks:

Ability to apply the fundamental techniques of networks, services and data communication applications such as signalling, switching and management systems, routing, security (cryptographic protocols, tunnelling, firewall, charging mechanisms, authentication and content protection), traffic engineering (graph theory, queuing theory and teletraffic) charging and reliability and quality of service, either in fixed, mobile, personal, local or long distance environments, with different bandwidths, including telephony and data.

CONTENIDOS TEÓRICO-PRÁCTICOS

THEORETICAL CONTENT
---
1 Introduction
2 Public Network Access Technologies
3 Corporate Network Access Technologies

PRACTICAL CONTENT

Seminar 1: Getting knowledge about my access network
Seminar 2: QoS and network neutrality

Practice 1: Access network performance
Practice 2: Structured cabling and CTIs
Practice 3: VLAN

TEACHING METHODS

As regards the methodology, the course is divided into two parts: 1) the theoretical knowledge is taught in lectures and in

classroom practice (30 hours) and 2) the subject has a practical component based on laboratory practice (27 hours) and two seminars (3 hours).

In lectures, the teacher's explanation will be supported by material that will be available in eGela. Debate with students will be encouraged, together with activities that may help the understanding of the topics discussed in the context of the classroom.

In laboratory practical work, both autonomous (based on individual questionnaires) and group work will be required. The practices and reports will be developed in pairs and groups.

Finally, in seminars debate and oral presentation of current issues related to access networks will be encouraged.

In the event that sanitary conditions prevent the face-to-face teaching activity and / or assessment, online modalities will be made active and the students will be promtly informed.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	22,5	3	7,5	27					
Horas de Actividad No Presencial del Alumno/a	33,75	4,5	11,25	40,5					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 50%
- Exercises, cases or problem sets 25%
- Individual assignments 5%
- Teamwork assignments (problem solving, Project design) 15%
- Oral presentation of assigned tasks, Reading¿ 5%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the ordinary evaluation modality, the mark will be the sum of 2 parts:
A. Final exam: 50% of the mark
B. Continuous Evaluation: 50% of the mark, of which
25% - reports of practical work and explanation of it
5% - handing in of individual questionnaires
15% - attitude and progress shown in class (all kinds of class)
5% - presentation of work done (seminars)

In order to pass the course, the students must fulfil ALL the following conditions:
- To have attended all the compulsory attendance classes (laboratory classes and seminars).
- To pass both parts of the subject, A and B. In that case, the final grade will be the sum of the two parts. In case of failure to pass any of the two parts, the final grade will be that of the failed part.

If a student wants to opt out of continuous evaluation or of ordinary evaluation, he/she must proceed according to the procedure and deadlines established in the Student Evaluation Rules, in articles 8 and 12 respectively.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary exam call, the note will be the result of a final exam that will comprise the 100% of the subject.

To decline to sit in the extraordinary call of the course, it will be enough not to attend the final written test of the extraordinary call.

MANDATORY MATERIALS

Documentation available in the official virtual classroom of the course (egela):
https://egela.ehu.es/

BIBLIOGRAFÍA

Basic bibliography

* ``Tecnologías de Banda Ancha y convergencia de redes``. Manuel Álvarez-Campana, Julio Berrocal Colmenarejo, Francisco González Vidal, Raquel Pérez Leal, Isabel Román Martínez, Enrique Vázquez Gallo. Ministerio de Industria, Turismo y Comercio. Disponible en: http://oa.upm.es/2697/
* ``Servicios avanzados de telecomunicación``, María Carmen España Boquera. Ed. Díaz de Santos, 2003.
* ``Comunicaciones y Redes de Computadores``, Stallings, Williams, 7ª ed, Ed. Pearson Educación, 2004.
* ITU-T Recommendations. http://www.itu.int/pub/T-REC
* ``The All-New Switch Book: The Complete Guide to LAN Switching Technology``, Rich Seifert, James Edwards, 2ª ed, Ed. Wiley, 2008.

Detailed bibliography

* ``Local access network technologies``. Paul France. IEE telecommunications series 47.
* ``ADSL standards, implementation and architecture``. Charles K. Summers. CRC Press. Advanced and emerging communications technologies series.

Journals

Web sites of interest

http://oa.upm.es/2697/ Libro ``Tecnologías de Banda Ancha y convergencia de redes`` Álvarez-Campana et al
http://www.bandaancha.es/Informacion/Tecnologias/Paginas/Tecnologias.aspx Information about WideBand technologies by the Spanish Ministry of Energy, Tourism and Digital Agenda
http://www.itu.int/pub/T-REC ITU-T Recommendations

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Not Applicable

COURSE

27375 - Transport Networks **Credits, ECTS:** 6

COURSE DESCRIPTION

SHORT DESCRIPTION
This course provides essential knowledge about telecommunication transport networks.
The most significant technologies for data transport over long distances will be analyzed as well as the information transport techniques for every technology, regardless of the nature of them (data, PSTN, mobile services), and with reliability and quality of service guarantee.
In addition the most significant signaling techniques and systems for the management, operation and maintenance of these networks will be described. And different mechanisms and protocols for the routing information will also be analyzed.
To sum up, the main goal of this course is to develop in students the ability to understand the global operation of transport networks, their main components and the functionality and role of each of them.

CONTEXTUALISATION
This subject fits in the part of the Telecommunication degree related to Telecommunication Networks and Services.
The aim of this subject is to study in detail the most relevant transport networks technologies, such as those related to transmission, switching, routing and signaling. In this context some of the concepts introduced in the subjects "Architecture of Telecommunication Networks and Services" (2nd year of the degree) and Telecommunication Systems (5th semester of the degree) are used.
In addition, this subject is complementary with the subject "Access Networks", taught in the same four-month period, and whose contents are closely related.
"Transport Network" is also related to other courses given in subsequent four-month periods of the Telecommunication degree such as "Network and Services Deployment and Management" "Mobile Networks and Services" and "Multimedia Services".

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

From the point of view of competencies, this subject contributes to the telematics competencies related to the design and deployment of networks and services. The competencies of the correspondent module and transverse competencies this subject contributes to are detailed next.

COMPETENCIES OF THE TELEMATICS SPECIALITY

Ability to build, operate and manage telecom networks, services, processes and applications, considering all of these concepts as systems for acquisition, transportation, representation, processing, storage, management and presentation of multimedia information, from the point of view of telematics services.

Ability to apply learnt techniques in networks, services and telematics applications, such as management systems, signaling and switching, routing, security (cryptographic protocols, tunneling, firewall, billing mechanisms, content authentication and protection strategies), traffic engineering (graph theory, queuing theory and teletraffic) billing, reliability and quality of service, both in fixed, mobile, personal, local or long distance environments and with different bandwidths, including telephony and data.

TRANSVERSE COMPETENCY

Communicate and transmit knowledge, skills and abilities. Communicate in writing knowledge, procedures, results and ideas related to telecommunications and electronics, in a multilingual environment.

CONTENIDOS TEÓRICO-PRÁCTICOS

0. INTRODUCTION
0.1. Introduction to this subject
0.2. Introduction to main concepts related to transport networks: routing, transmission, switching and signalling.

1. ROUTING
1.1. What is routing? What is it for? Context and operation. Types of routing strategies.
1.2 Routing in data networks
1.2.1 Static routing (ARP-IP, RIBs and FIBs)
1.2.2 Dynamic routing: RIP, OSPF, BGP
[Some of the routing concepts are studied and worked by means of laboratory sessions]

2. TRANSMISSION
2.1 Introduction
2.1.1 Introduction to transmission networks
2.1.2 Contextualization, evolution and operation
2.2 Technologies in transmission networks
2.2.1 Introduction to optical transport networks
2.2.2 Digital Multiplexing Hierarchies TDM
2.2.2.1 PDH (just introduction: obsolete in RT)
2.2.2.2 SDH / SONET
2.2.3 Optical Multiplexing Hierarchies (emergent networks)
2.2.3.1 OTN / WDM
2.2.3.2 MPLS-TP
2.3 Convergence of networks and services: NGN

3. SWITCHING
3.1 Switching
3.1.1 Introduction
3.1.2 Types of switching: circuit, packet, connectionless and connection oriented
3.2 Circuit Switches
3.2.1 Spatial / Temporal / Two-dimensional switching
3.2.2 Single-stage / multi-stage switches
3.3 Packet Switches
3.3.1 Elements: input interface, output interface, switching framework, processor.
3.3.2 Queue management, sending planning, discard criteria
3.3.3 Switching frameworks in routers: 3 generations
3.3.4 Evolution of connection-oriented networks: X.25, FR, ATM
3.4 Integrated Switching
3.4.1 Hybrid Switching
3.4.2 Based on circuit switching
3.4.3 Based on packet switching

4. SIGNALLING
4.1 Signalling
4.1.1 What is it? Functions (in circuits and packets based networks)
4.1.2 Classification (in circuits and packets based networks)
4.2 SS7 Signalling
4.2.1 SS7 Signaling
4.2.1.1 Common channel network signaling
4.2.1.2. Architecture of SS7 signaling network
4.2.1.3 SS7 protocols
4.2.2 ISUP
4.2.2.1 Supported services by ISUP. ISUP vs ISDN
4.2.2.2 ISUP Messages Formats
4.2.2.3 Call control procedures and messages
4.2.3 MTP
4.2.3.1 MTP3
4.2.3.2 MTP2
4.2.3.3 MTP1

TEACHING METHODS

The subject consists of lectures (M), Seminars (S), and Laboratory Sessions (PL).
It will be necessary to deliver a practice report for every practical exercise proposed by the teacher. The exercises in the lab and their corresponding reports can be made in pairs. Students must submit reports one week after the final session of every exercise.

In the event that the sanitary conditions prevent the realization of any teaching activity and/or face-to-face evaluation, a non-face-to-face modality will be activated of which the students will be informed promptly.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	22,5	15	7,5	15					
Horas de Actividad No Presencial del Alumno/a	33,75	22,5	11,25	22,5					

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Exercises, cases or problem sets 30%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

A. Written exam (70 % of the total score)
This exam consists of two parts:
a. First part exam.
- When: 11/03/2022.
- Score: 20% of the total score.
- Content: First lesson of the subject (routing).
b. Second part exam.
- When: Public date of the ordinary exam call
- Score: 50% of the total score.
- Content: Second, third, and fourth lessons of the subject (transmission, switching and signalling).

B. Seminars continuous assessment: 10% of the total score.

C. Labs continuous assessment: 20% of the total score.
Reports, attendance and active participation at lab session.
20% of this score is assigned to the quality of the written reports.

To pass the subject it is required to pass the exam and the practical part of the subject.

Attendance at all seminars and lab sessions is required for continuous assessment.

The students that do not want to take the continuous assessment and want to be assessed by means of a final exam, must present to the lecturer responsible for the subject (marivi.higuero@ehu.eus) a written resignation to the continuous assessment, as it is detailed in the Students Evaluation Rules of the UPV/EHU.

Likewise, for ordinary exam call resignations, the ordinary regulations of the university will be applied

In the event that the sanitary conditions prevent the realization of any teaching activity and/or face-to-face evaluation, a non-face-to-face modality will be activated of which the students will be informed promptly.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

- Final assessment system: 100% of the total score.
To pass the subject it is required:
- To get a score equal to or greater than 5 points out of 10 on the final written exam.

MANDATORY MATERIALS

Web page of the subject in egela site:
http://egela.ehu.eus

BIBLIOGRAFÍA

Basic bibliography

- Behrouz A. Forouzan, "Transmisión de datos y redes de comunicaciones", 4ª ed., 2007. Ed. McGraw-Hill
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- Stamatios V. Kartalopoulos, "Next Generation Intelligent Optical Networks", Springer, 2008 (disponible versión electrónica en la biblioteca http://dx.doi.org/10.1007/978-0-387-71756-2
- John Bellamy, "Digital Telephony". Wiley Series in telecommunications, 2nd.Ed, 1990
- Handbook of UIT-T:"Redes ópticas de transporte", UIT-T 2012 (disponible en CD en la biblioteca)
- UIT-T Recommendations: http://www.itu.int/en/publications/ITU-T/Pages/default.aspx

Detailed bibliography

Journals

Web sites of interest

http://www.informit.com/library/library.aspx?b=Signaling_System_No_7
http://www.itu.int/en/publications/ITU-T/Pages/default.aspx

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Third year

COURSE

27376 - Radio Communication Systems **Credits, ECTS:** 6

COURSE DESCRIPTION

The subject "Sistemas de Radiocomunicación" is the last mandatory subject of Radiocommunications area for all the students. It is a continuation of Electromagnetic Fields (Campos Electromagnéticos, 2nd year) and Telecommunication Systems (Sistemas de Telecomunicación, 3rd year, 1st quadrimester). Therefore, good knowledge of concepts and techniques taught in these subjects is recommendable to study "Sistemas de Radiocomunicación" subject.
In this subject, basic and general concepts applicable to every radiocommunication systems are studied. Later, the main four types of systems are analyzed: radio links, broadcasting, satellite communications and mobile communications. In the laboratory, students use equipment and software for the analysis and simulation of radiocommunication systems.
The concepts and capabilities acquired by the students will allow them to get into the job market under favorable conditions in the radiocommunication área.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

- Ability to construct, operate and manage networks, services, processes and telecom applications, understood these as systems of acquisition, transportation, representation, processing, storage, management and presentation of multimedia information, from the point of view of transmission systems.
- Ability to apply the techniques in networks, services and telecommunications applications in both fixed and mobile environments, personal, local or long distance, with different bandwidths, including telephony, radio, television and data, from the standpoint of transmission systems.
- Capacity for the selection of antennas, transmission equipment and systems, propagation of guided and unguided waves by electromagnetic means, RF or optical and related management and allocation of radio frequency space.

CONTENIDOS TEÓRICO-PRÁCTICOS

Chapter 1.- Spectrum engineering
Chapter 2.- Radio Basics
Chapter 3.- Propagation
Chapter 4.- Fixed Service Systems
Chapter 5.- Terrestrial Broadcasting
Chapter 6.- Satellite Communications
Chapter 7.- Mobile Communications

Laboratory:

Practice 1: Spectrum Analyzer and Antenna Characterization
Practice 2: Radio Services Planning using software

TEACHING METHODS

In the master classes, the lecturer will give lectures using audiovisual means and materials previously available for the students.
Questions and problems will be solved in the class in a participatory way. Most problems and exercises will be provided together with the solutions. Hence, students could go in depth in the theoretical knowledge and real applications of the subject and the addressed concepts.
In the laboratory experimental works will be carried out in order to acquire knowledge and skills on the experimental techniques used in radiocommunications.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	22,5		22,5	15					
Horas de Actividad No Presencial del Alumno/a	33,75		33,75	22,5					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 80%
- Exercises, cases or problem sets 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The subject is evaluated following the ongoing assessment ("evaluación continua") typology that is composed of two parts: a theoretical part (composed of a mid-term exam and a final exam) and a laboratory part.

Final mark:

- 80% of the mark from the theoretical part plus 20% from the mark of the laboratory part
- Minimum: 4 points out of 10 in each part.

1) The mark of the theoretical part (written exam corresponding to master and practical classes) is calculated as follows:
- Mid-term exam: 50% of the mark. Chapter 1, 2 and 3.
- Final exam: 2 parts, each one is 50% of the mark
• 1st part. Chapters 4, 5, 6 and 7
• 2nd part. Chapters 1, 2 and 3. If the student does this exam, the new mark will replace the mark of the mid-term exam.

2) The mark of the laboratory part corresponds to the deliverables presented by the student.

Attending to the laboratory is mandatory to be evaluated following the "evaluacion continua" system.

The students refusing the ongoing assessment system, following the procedure and the deadlines stated in Normativa de Evaluación del Alumnado, will have a final evaluation in the form of a written exam consisting of a part corresponding to lectures (80%) and a part corresponding to the laboratory (20%).

Waiving the ordinary call: students not sitting for the final exam will be considered as students waiving the ordinary call.

When the condition of "Minimum of 4 points out of 10 in each of the two parts (theory and laboratory)" is not met, and the value of Final_Note calculated according to the next formula

Nota_final=0,8*nota_teoría+0,2*nota_laboratorio

is greater than 4, the final mark will be 4.

In all other cases, the final mark will be the result of applying the formula.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Written exam consisting of a part corresponding to lectures (80%) and a part corresponding to the laboratory (20%), requiring a minimum of 4 points out of 10 in each of the two parts.

If a student request to maintain the mark of the laboratory part from the ongoing assessment, the student will have only a written exam corresponding to lectures. The final mark will be calculated from the laboratory part (20%) and from the written exam (80%).

When the condition of "Minimum of 4 points out of 10 in each of the two parts (theory and laboratory)" is not met, and the value of Final_Note calculated according to the next formula

Nota_final=0,8*nota_teoría+0,2*nota_laboratorio

is greater than 4, the final mark will be 4.

In all other cases, the final mark will be the result of applying the formula.

MANDATORY MATERIALS

- Lecture slides
- Practical cases and problems
- Guides for laboratory

BIBLIOGRAFÍA

Basic bibliography

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- J. A. Romo "Radiocomunicaciones-Ingeniería de Telecomunicaciones." Publicaciones-Escuela Técnica Superior de Ingeniería de Bilbao, 2008.
- José María Hernando. "Transmisión por Radio" séptima edición. Editorial Universitaria Ramón Areces, 2013.
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- J. A. Romo. "Comunicaciones por satélite" Publicaciones-Escuela Técnica Superior de Ingeniería de Bilbao, 2009.
- Robert K. Crane. "Propagation handbook for wireless communication system design" CRC Press LLC, 2003.
- Louis J. Ippolito, Jr. "Satellite Communications Systems Engineering" Ed. John Wiley & Sons Ltd, 2008

Journals

IEEE Antennas and Wireless Propagation Letters
IEEE Transactions on Antennas and Propagation
IEEE Transactions on Communications
IEEE Transactions on Vehicular Technology

Web sites of interest

ITU-R: https://www.itu.int/en/Pages/default.aspx

IEEE: http://ieeexplore.ieee.org/Xplore/home.jsp

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Fourth year

COURSE

27377 - Mobile Networks and Services **Credits, ECTS:** 4,5

COURSE DESCRIPTION

In this course the particularities of the wireless mobile environment regarding the provision of telecommunications services are identified and the necessary adjustments at different levels compared to the non-mobile environment are analysed. Different technological solutions to provide mobility are studied and compared, analysing the specific problems solved by each of them, their application environment, network architecture, protocols, types of services they can offer...
The course seeks a specialization in the telematics aspects of mobile networks and services, fostering the acquisition of the skills to apply the techniques required by both telephony and data networks to the ever-growing mobile environments.
The course is based on the general networking concepts presented in the course "Architecture of Telecommunication Networks and Services" which are particularized in this course for mobile networks. In addition, "Mobile Networks and Services" forms a block with two other courses: "Access Networks" and "Transport Networks". In the first one, the different technologies that allow the users to access the data networks are covered. Wireless and mobile networks are a subset of these technologies that in "Mobile Networks and Services" is studied in depth. In the second backhaul and interconnection networks are analysed.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

BASIC COMPETENCIES
. Students have demonstrated knowledge and understanding in a field of study that has its foundations on the general secondary education, and it is typically at a level which, although it is based on advanced textbooks, includes some aspects that involve knowledge of the forefront of their field of study.
. Students can apply their knowledge to their work or vocation in a professional manner and have skills typically demonstrated through devising and defending arguments and solving problems within their field of study.
. Students have the ability to gather and analyse relevant data (usually within their field of study) to make judgments that include reflection on relevant social, scientific or ethical aspects.
. Students can communicate information, ideas, problems and solutions to both specialised and non-specialised audiences.
. Students have developed those skills needed to undertake further studies with a high degree of autonomy.

COMPETENCIES OF THE GRADE
. Knowledge of basic subjects and technologies that enable the student to learn new methods and technologies and that will give him or her the versatility to adapt to new situations.
. Ability to solve problems with initiative, decision making, creativity, and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the activity of a Technical Telecommunications Engineer.
. Ability to work in a multidisciplinary group and in a multilingual environment and communicate, both in writing and orally, knowledge, procedures, results and ideas related to telecommunications and electronics.

SPECIALTY COMPETENCIES OF THE TELEMATICS MODULE
. Ability to apply the fundamental techniques of the networks, services and data communication applications, such as management systems, signaling and switching, routing, security (cryptographic protocols, tunneling, firewall, tarification mechanisms, authentication and contents protection), traffic engineering (graph theory, queuing theory and teletraffic) pricing and reliability and quality of service, either in fixed, mobile, personal, local or long distance environments with different bandwidths, including telephony and data.

LEARNING RESULTS.
. The students will be able to describe the problems and the particular needs that arise in the provision of telecommunication services due to the wireless mobile environment, and will also be able to analyse comprehensively and compare alternative solutions to address these problems.
. The students will be able to search and analyse information on a mobile technology, working in a team. They will be able to analyse and understand in depth and, in most cases, experimentally test this technology as a prerequisite to achieve the following learning outcomes.
. The students will be able to prepare an oral presentation on the technology that has been analysed, present it to the class and satisfactorily answer questions about it.
. The students will be able to discuss the characteristics, advantages and disadvantages of mobile technologies, and compare them reasonably.

CONTENIDOS TEÓRICO-PRÁCTICOS

1. Mobile networks and services: Introduction and context.

2. Technological requirements of the mobile environment.
3. Mobile network technologies.

TEACHING METHODS

Regarding the teaching methodology, the course is divided into two parts. In the first 6 weeks of the course lectures are used to present the first two units. In the second part of the course (9 weeks) the class is organised in work groups to analyse different mobile technologies and present them to the class. Seminar classes and classroom practices are used in this stage to accomplish these tasks.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	17,5	15	12,5						
Horas de Actividad No Presencial del Alumno/a	26,25	22,5	18,75						

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Teamwork assignments (problem solving, Project design) 30%
- Oral presentation of assigned tasks, Reading¿ 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the ordinary exam call, the mark will be the sum of 3 parts:
A. Partial examination: 10% of the mark
B. Analysis of technologies: 40% of the mark
C. Final examination: 50% of the mark

In order to pass the course, the students must meet the following conditions (all of them):
- Have participated actively in one of the working groups on technology.
- In the weighted sum (A + B * 0.1 * 0.4 * 0.5 + C), get at least 5 points (out of 10).
- In the weighted sum (A + C * 0.1 * 0.5), obtain at least 4 points (out of 10).

To decline to sit in the ordinary call of the course will be enough not to attend the final written test of the ordinary call.

If a student wants to decline the ongoing assessment, he/she must proceed according to the procedure and deadlines established in the Article 8.3 of the Student Assessment Rules of the UPV/EHU.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary exam call, the qualification will be determined by a final written test that will comprise the 100% of the subject.

To decline to sit in this call it will be enough not to attend the final written examination.

MANDATORY MATERIALS

Documentation available in the virtual classroom of the course in eGela.

BIBLIOGRAFÍA

Basic bibliography

- "IP in Wireless Networks". Basavaraj Patil et al. Ed. Prentice Hall, 2003.
- "The Wireless Mobile Internet: Architectures, Protocols and Services". Abbas Jamalipour. Ed. John Wiley and Sons, 2003.
– "Mobile IP: Present State and Future". Abdul Sakib Mondal. Ed.Springer, 2003.
– "An Introduction to Wireless Technology". DeCain. IBM RedBooks (http://www.redbooks.ibm.com), 1995.

Detailed bibliography

– "UMTS Networks: Architecture, Mobility and Services". Heikki Kaaranen et al. John Wiley and Sons, 2001.

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– "General Packet Radio Service". Bates. McGraw-Hill, 2002.
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– "802.11 Wireless Networks: The definitive Guide". Gast. O’Reilly, 2002.
– "Wireless LANs: implementing interoperable networks". J. Geier, McMillan Technical Publishing, 1999.
– "Bluetooth: Implementation and Use". Morrow. McGraw-Hill, 2002.
– "Mobile IP, the Internet unplugged". Solomon. Prentice Hall, 1998.
– "LTE: Nuevas tendencias en comunicaciones móviles". R. Agusti et al. Ed. Fundación Vodafone España, 2010.https://proyectolte.files.wordpress.com/2012/09/lte-nuevas-tendencias.pdf

Journals

Web sites of interest

http://www.palowireless.com/gsm/tutorials.asp
http://www.3gpp.org
http://www.ieee802.org/11/
http://standards.ieee.org/about/get/802/802.11.html
http://www.wi-fi.org/
http://www.ieee802.org/15/
http://www.bluetooth.com/Pages/Bluetooth-Home.aspx
http://www.coit.es/foro/?op=cronologia&idcategoria=317 (Cronología de España)

OBSERVATIONS

En el caso de que las condiciones sanitarias impidan la realización de una actividad docente y/o evaluación presencial, se activará una modalidad no presencial de la que los/las estudiantes serán informados puntualmente

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Not Applicable

COURSE

27380 - Advanced Remote Services **Credits, ECTS:** 6

COURSE DESCRIPTION

The main objective of this subject is that the student achieves the ability to develop advanced remote services and applications. Java EE is used as the base technology, although other alternatives are presented. The student will also deploy the services in his/her own server, so basic server administration is also covered.

This subject depends on the Java programming capability developed in the Programing in Distributed Environments subject, and the concepts of database design of the Basic Programing subject.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

M01CM02: Basic knowledge in computer programming, operating systems, databases and software used in engineering.
M02R7: Knowledge and usage of programming skills in telecommunication networks, systems and services.
M04TE7: Ability to program remote services and applications.

CONTENIDOS TEÓRICO-PRÁCTICOS

Lesson 1 - Server Administration
Lesson 2 - Static Web Pages
Lesson 3 - Dynamic Web Pages
Lesson 4 - Data Representation
Lesson 5 - Service Oriented Architecture
Lesson 6 - Presentation Layer
Lesson 7 - Business Layer
Lesson 8 - Data Layer
Lesson 9 - Web Applications Hosting

TEACHING METHODS

All classes will be given in the form of lectures, and most of them also in classroom exercises and computer practices. As part of the lectures, small assessment tests will be prepared to help the student gauge his/her progress in the subject; this will also be part of the continuous assessment. Computer practical work is done individually and focuses on the application of the concepts developed in the lectures, so they will not be a repetition of these. During the classroom exercises the students will present their development of the corresponding computer practices, which will also lead to a discussion with the rest of the students and will be part of the continuous assessment.

In the event that sanitary conditions prevent the face-to-face teaching activity and/or assessment, new online modalities will be made active and students will be promtly informed.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	22,5		15	22,5					
Horas de Actividad No Presencial del Alumno/a	33,75		22,5	33,75					

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Multiple choice test 20%
- Exercises, cases or problem sets 5%
- Oral presentation of assigned tasks, Reading¿ 5%
- COMPUTER PROGRAM EXAM 70%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

A continuous assessment system is followed consisting of:
* Examinations during the course (30%): attendance at lectures will be monitored by tests carried out in class, according to teaching needs. Computer practical work will be evaluated by public presentation and discussion in class, and by participation in computer and classroom practical work. If the oral presentation is not made or if attendance at any of the lecture tests, computer or classroom practical work sessions is below 80%, then the total mark for the examinations during

the course will be 0. Not preparing practical computer work in advance will count as an attendance fault.
* Final examination on the official exam date (70%): this will consist of the development of a computer program.

In order to pass it is necessary to achieve at least 4.0 in the final examination and an average 5.0 in this and the rest of the examinations.

In order to withdraw from this ordinary call it is sufficient not to attend the final exam.

In order to renounce to the continuous assessment Article 8 of the Regulations on Assessment of Students is applicable. In this case, the assessment will be carried out following the same system as the one followed in the extraordinary call.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The assessment consists of a final exam constituting 100% of the grade. This exam contains a written part and another practical one carried out in the computer. Both parts must be passed in order to pass the subject.

Those students with a grade of at least 6.0 over 10 in the lecture tests (continuous assessment) under the ordinary call can keep that grade for the written part of the extraordinary call in the same academic year.

MANDATORY MATERIALS

This subject makes use of a virtual classroom in the e-Gela platform where the student can access the following compulsory material for each type of class:
* Lectures: outlines to help in following the lectures that must be filled in by the student.
* Practical work: protocols for the different computer work, which must be read in advance to help with the preparation of sessions.

BIBLIOGRAFÍA

Basic bibliography

The Java EE 7 Tutorial
http://docs.oracle.com/javaee/7/tutorial/

EJB 3 Developer Guide: A Practical Guide for developers and architects to the Enterprise Java Beans Standard.
http://www.amazon.com/EJB-Developer-Guide-developers-architects/dp/1847195601

Core JavaServer Faces.
http://www.amazon.com/Core-JavaServer-Faces-David-Geary/dp/0131463055

Detailed bibliography

SCJP Sun Certified Programmer for Java 6 Exam 310-065
http://www.amazon.com/SCJP-Certified-Programmer-Java-310-065/dp/0071591060

Sun Certified Developer for Java Web Services Study Guide (Exam 310-220)
http://www.amazon.com/Certified-Developer-Services-310-220-Certification/dp/0072259523

Service-Oriented Architecture (SOA): Concepts, Technology, and Design
http://www.amazon.com/Service-Oriented-Architecture-SOA-Concepts-Technology/dp/0131858580

Cloud Computing Bible
http://www.amazon.es/Cloud-Computing-Bible-Barrie-Sosinsky/dp/0470903562

Journals

Web sites of interest

Indicadas en la bibliografía básica

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Fourth year

COURSE

27383 - Laboratory of Digital Systems **Credits, ECTS:** 4,5

COURSE DESCRIPTION

The subject Digital Systems Laboratory is a compulsory subject of the Electronic Systems specialty in the fourth year of the Degree in Engineering in Telecommunication Technology.

The objective of this subject is to equip students with the ability to design and develop digital systems with hardware and software processing units integrated in an FPGA. These tailor-made mixed circuits offer a high degree of flexibility and high throughput. The incorporation of this type of devices in the products of the companies of the industrial sector is very interesting and the demand of professionals with capacity to work with this type of technologies is high.

In this subject, from a practical approach, students deal with high speed hardware design oriented to reconfigurable devices, the detailed study of a simple soft processor embedded in the reconfigurable device and the design methodology necessary to face the complete development of a mixed system.

The subjects Digital Electronics and Digital Systems converge in this subject. The concepts and capacities acquired in them must be applied intensively, extensively and in combination. In this way, the bases are established to be able to face the design of complex systems based on platforms.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

In this subject the competences M05SE4 and M05SE5 of the module M05 Electronic Systems are worked:
M05SE4: Ability to apply electronics as support technology in other fields and activities, and not only in the field of Information Technology and Communications.
M05SE5: Ability to design circuits of analog and digital electronics, analog-digital and digital-analog conversion, radiofrequency, power and electric power conversion for telecommunication and computer applications.

The following are the most important learning outcomes that students should acquire through this subject:
- Identify the internal architecture of the FPGAS.
- Properly describe the fundamental circuits for the synchronous digital design at high speed.
- To know the process of synthesis and implementation of complex designs based on FPGAs.
- Describe mixed circuits composed of a small processor to which custom circuits are added and the program that runs on it.
- Perform the co-simulation of mixed circuits and the test using embedded logic analysis.
- Document complex designs realized in FPGAs using a specification document and a reference design.

CONTENIDOS TEÓRICO-PRÁCTICOS

Topic 1: Advanced electronic design with FPGAS
VHDL design optimized for FPGA architecture
Synchronous design
Advanced management techniques of global clocks
Management of design constraints

Topic 2: Design with soft mini-processors
Mixed-core architecture
8-bit soft microprocessor
Code generation

Topic 3: Hardware-software integration in an FPGA
Integration of software in FPGA design flow
Cosimulation

TEACHING METHODS

The subject is taught in a clearly practical orientation.

In the laboratory students work individually and also in groups. Several projects are developed, some highly guided and others with a free part for students to use their imagination and autonomous work. It stimulates the planning and organization of work, study inside and outside the classroom, positive attitude towards peers, oral and written expression, discussion of answers, bibliographic search and use of English.

The master classes explain the fundamental concepts. The students must deepen these concepts through the study of theoretical contents and the realization of practical exercises.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	7,5			12,5	25				
Horas de Actividad No Presencial del Alumno/a	11,25			18,75	37,5				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Multiple choice test 10%
- Individual assignments 15%
- Teamwork assignments (problem solving, Project design) 75%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation of the subject is done through the continuous assessment system.
The weight of the different activities in the final note is as follows:

Test (10%)

Individual basic practices (15%)

Final practice in team (75%)

The relinquishment must be requested as indicated by current regulations.

The student who does not carry out the continuous evaluation or who, having renounced it, does not attend the final ordinary call, will have a grade of Not Presented.

In the event that the sanitary conditions prevent the realization of a teaching activity and / or face-to-face evaluation, a non-face-to-face modality will be activated of which the students will be informed promptly.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation in the extraordinary call will be carried out based on some works.

The student who does not carry out those works will have a grade of Not Presented.

MANDATORY MATERIALS

Documents in the egela platform of this subject.

BIBLIOGRAFÍA

Basic bibliography

Floyd, T.L., Fundamentos de sistemas digitales, 7a edición, Prentice Hall, 2001
Wakerly, J. F., Digital Design. Principles and Practices, Prentice Hall, 2000
Uyemura, J. P., Diseño de sistemas digitales. Un enfoque integrado; Thomson Learning, 2000
Xilinx Inc, Xilinx ISE In-Depth Tutorial (UG695), http://www.xilinx.com
Xilinx Inc, Xilinx UG129 PicoBlaze 8-bit Embeded Microcontroller User Guide, http://www.xilinx.com

Detailed bibliography

Ashenden, Peter J, "The designer's guide to VHDL".

Journals

Xcell online, https://www.xilinx.com/about/xcell-publications/xcell-journal.html

Web sites of interest

http://www.xilinx.com
http://www.opencores.org

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** First year

COURSE

27384 - Analysis of Circuits **Credits, ECTS:** 6

COURSE DESCRIPTION

"Circuit analysis" is one of the basic subjects of the first year of the degree in Telecommunications Technology Engineering. It is placed in the module called Basic Training. The students will acquire basic knowledge on circuit theory, and will be able to solve simple circuits, reduce circuit complexity, and analyze circuit behaviour. Special attention will be placed on aspects related to telecommunication circuits. The subject is practice oriented, and comprises laboratory sessions to demonstrate applications and work with practical signals and systems related to telecommunications engineering.

Since the subject is both basic and practice oriented, it helps understanding other subjects like basic electronics, electronic devices and circuits, and circuit electronics. The subject is closely related to signal processing, a subject in which some of the tools and concepts introduced in circuit analysis are mathematically formulated.

To successfully complete Circuit Analysis, it is convenient to master basic complex-number algebra, linear algebra, and the basic concepts of electromagnetism. All these topics are covered in the mathematics and physics courses of the second high school year.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The transversal competences of the degree developed in this subject are:
CT1: Ability to solve problems resourcefully, to take decisions, to be creative, to communicate and transmit knowledge, skills, and abilities, to understand the ethical and professional responsibility of Telecommunications Technical Engineers while developing their activity.
CT2: Ability to work in multidisciplinary teams and multilingual environments and to communicate knowledge both in writing and orally.

This subject's competences are framed within the following competences of the Basic Training of the study plan:
CM4: Understanding and mastery of the basic concepts of linear systems and of the related functions and transforms, theory of electric circuits, electronic circuits, physical principle of semiconductors and logic families, electronic and photonic devices, technology of materials and its application to solve engineering problems of engineering.

CONTENIDOS TEÓRICO-PRÁCTICOS

1 Circuit Elements and Basic Laws
- 1.1 Introduction
- 1.2 Electric Circuit
- 1.3 Circuit Elements
- 1.4 Circuit Topology
- 1.5 Kirchhoff's Laws
- 1.6 Tellegen's Theorem
- 1.7 DC Power and Energy
- 1.8 Linearity

2 Simplification of Circuits
- 2.1 Introduction
- 2.2 Association of Resistances in Series and in Parallel
- 2.3 Association of Ideal Sources
- 2.4 Association of Passive Elements
- 2.5 Real GeneratorsSources Circuit Topology
- 2.6 Association of Real GeneratorsSources
- 2.7 Thevenin and Norton Equivalents
- 2.8 Simplification and Elimination of Branches

3 Dynamic Circuits
- 3.1 Introduction
- 3.2 Transient Response
- 3.3 DC Steady State
- 3.4 Sinusoidal Steady State

3.5 Power and Energy in Sinusoidal Steady State

4 Power Transmission
4.1 Maximum Transfer of Power
4.2 Everitt's Theorem
4.3 Design of a Matching Network
4.4 Insertion and Transmission Losses

5 Analysis of Circuits in the Frequency Domain
5.1 Frequency Response
5.2 Filters: Types and Characteristics
5.3 Signal Filtering

TEACHING METHODS

The contents of this subject are, essentially, worked on individually. The methodology for each mode of learning activity is described in this section, both for face-to-face teaching and for private study.

FACE-TO-FACE TEACHING (60h):
Master lectures (MAG): oral explanations of the fundamentals and theoretical concepts. These explanations are based on a set of slides for each topic, which can also be employed as documentation by students. (15h)

Classroom practices (PA): the teacher resolves ten problems per topic on the blackboard. Students know what problems will be done in advance, so that they can work on them prior to the face-to-face session. (15h)
Laboratory classes (LAB): simulation of circuits employing informatic computer tools (OrCAD/PSPICE). Some concepts worked in MAG or PA sessions are interrelated. At the same time, new theoretical concepts are learned. In addition, the fifth topic of the subject is entirely developed at the end of the course in laboratory classes. Sessions are based on exercise scriptsguides, in such a way that students know beforehand what they should prepare at home for the next session, which consists in a deliverable short task (pre-lab). (18h)
Seminars (SEM): question-solving sessions about things that have not been fully understood during the private study and resolution of problems. (12h)

PRIVATE STUDY (90h):

Magisterial classesster lectures: home assignments should be done every week, and some effort is also dedicated to the preparation for individual basic knowledge exams of basic knowledge (CB).
Classroom practices: students have to do 15 problems per topic individually. Questions that arise are solved in the seminars.
Laboratory classes: a deliverable short task (pre-lab) per session has to be done, and some effort is also dedicated to the preparation for questionnaires and for the final exam.
Seminars: there are individual assessments that should be prepared.

If the case of being under inadequate health conditions for a normal development of the classes and the exams, it would be necessary to proceed with online education, about which all students would be informed in a timely manner.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15	12	15	18					
Horas de Actividad No Presencial del Alumno/a	22,5	18	22,5	27					

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 65%
- Exercises, cases or problem sets 35%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

ORDINARY CALL: GUIDELINES AND RESIGNATION
In this subject, a continuous-evaluation method is employed, which is arranged into the following sections:

1. Section corresponding to magisterial classes and to classroom exercises. The grade obtained in this section is the weighted average of the scores in two written exams:

1.1) Partial exam on the themes 1 and 2: 40% (26% of the final grade in the subject).
Those students who pass this exam (>=5) are exempted from having to be examined on this part in the final ordinary exam. All other students will have to sit the part corresponding to these themes in the final ordinary exam (1.2.a).

1.2) Final exam corresponding to the ordinary call. It consists of two parts:
a) Part on the themes 1 and 2: 40% (26% of the final grade in the subject).
Only students who have not been able to pass the partial exam mentioned in Section 1.1 have to sit this part of the exam. However, those students who have passed the partial exam are allowed to sit this part of the exam, resigning their grade in the aforementioned partial exam.

b) Part on the themes 3 and 4: 60% (39% of the final grade in the subject).
In this part, it is compulsory to pass a minimum grade (>=4) in order for the mark obtained by the student in 1.1 or in 1.2a to be counted.

The weighted average of both parts of this section has to be >=5 in order to pass this section and to be able to pass the whole subject.

2. Section corresponding to laboratory exercises. In this section, the grade is assigned from three assessment elements:

2.1) Continuous evaluation of the tasks for the completion of the laboratory exercises : 10% (3.5 % of the final grade in the subject).

2.2) Partial exam on the laboratory exercises 1-4: 30% (10.5 % of the final grade in the subject).
Those students who pass this exam (>=5) are exempted from having to be examined on this part in the final ordinary exam. All other students will have to sit the part corresponding to these themes in the final ordinary exam (2.3.a).
This partial exam is taken on the same data as that of Section 1.1.

2.3) Final exam corresponding to the ordinary call. It consists of two parts:
a) Part on the laboratory exercises 1-4: 30% (10.5% of the final grade in the subject).
Only students who have not been able to pass the partial exam mentioned in Section 2.2 have to sit this part of the exam. However, those students who have passed the partial exam are allowed to sit this part of the exam, resigning their grade in the aforementioned partial exam.
b) Part on the laboratory exercises 5-9: 60% (21% of the final grade in the subject).
In this part, it is compulsory to pass a minimum grade (>=4) in order for the mark obtained by the student in 2.2 or in 2.3a to be counted.

The weighted average of both parts of the exams of this section has to be >=5 in order to pass this section and to be able to pass the whole subject.

IMPOSSIBILITY TO FOLLOW THE CONTINUOUS EVALUATION:

Impossibility to follow the continuous evaluation.
Students unable to follow the continuous evaluation will have the opportunity to demonstrate that they have acquired the learning results in the ordinary final call through an evaluation consisting of:
- Final theory exam: 65% of the final grade.
- Final lab exam: 35% of the final grade.

Both exams have to be passed with a minimum grade of 5/10.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The extraordinary call is composed of two parts:
- Final theory exam: 65% of the final grade.
- Final lab exam: 35% of the final grade.

Both exams have to be passed with a minimum grade of 5/10.

MANDATORY MATERIALS

In eGela (http://egela.ehu.eus/), students will be provided with the following learning materials necessary for the subject:

1 Overhead transparencies with the theoretical contents of the subject, topics T1-T4.
2 A collection of 10 problems to be solved in the classroom practices (PA) and 15 more problems aimed for offsite private work, topics T1-T4.

3 A collection of 15 problems per topic on basic concepts, topics T1-T4.
4 OrCAD/PSPICE user manual and installation guide.
5 Exercise scripts for the laboratory.
6 Videos.

BIBLIOGRAFÍA

Basic bibliography

R. E.Thomas, A. J. Rosa
The analysis and design of linear circuits
Wiley, 2011 (7th edition)

R. L. Boylestad
Introductory Circuit Analysis
Pearson Education 2015 (13th edition)

F. López Ferreras
Análisis de Circuitos lineales (volúmenes I y II)
Editorial Ciencia 3. 1994

W.H. Hayt and H. Kemerly
Engineering Circuit Analysis
McGraw Hill 2006 (7th Edition)

M. E. Van Valkenburg
Network analysis
Prentice Hall 1991 (3rd edition)

Detailed bibliography

Análisis de Circuitos en ingeniería. Hayt Kemerly. McGraw Hill 1993
Análisis de Redes. Van Valkenburg. Editorial Limusa 1991

Journals

Web sites of interest

OBSERVATIONS

If the case of being under inadequate health conditions for a normal development of the classes and the exams, it would be necessary to proceed with online education, about which all students would be informed in a timely manner.

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Second year

COURSE

27385 - Electromagnetic Fields **Credits, ECTS:** 6

COURSE DESCRIPTION

In order to work on applications related to communications, antennas, radars and microwaves, it is essential to understand how electromagnetic waves are created, transmitted and received. Since integrated circuits are becoming smaller and they work on higher frequencies, it is necessary to take into account the effects of wave propagation on those chips and circuit wafers. Due to the latest discoveries in material sciences, there is no doubt that a revolution is already taking place in the control and manipulation of light. Among these discoveries, it is worth mentioning the structures based on photonic band-gaps, the omnidirectional dielectric mirrors, the negative-index metamaterials, and the control of slow and fast light. For a full understanding of these discoveries, it is essential to master the basics of electromagnetic waves that will be covered in this subject.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Students of this subject will be able to:
- Define and understand electromagnetic waves, as well as acquire knowledge of new technologies on their own for the development of telecommunications systems. (Competence R1 of the telecommunications module.)
- Use skills, tools, and applications to solve and develop solutions applied to telecommunications, by handling specifications, regulations, and compulsory rules, and understanding the ethical and professional responsibility of a technical telecommunications engineer. (Competence R2 of the telecommunications module.)
- Handle, analyse, and specify the basic parameters of electromagnetic waves for their application in communication systems, performing measurements, calculations, and reports, and understanding the propagation mechanisms, the transmission of waves on different media, and the devices used to transmit and receive those waves (Competences R4 and R8 of the telecommunications module.)
- Analyse the normal and oblique incidence of plane waves on plane surfaces, and evaluate the advantages and drawbacks of guided and non-guided propagation systems, being able to explain clearly the procedures, results, and ideas related to telecommunications. (Competence R5 of the telecommunications module.)

CONTENIDOS TEÓRICO-PRÁCTICOS

- LESSON 0. INTRODUCTION
- LESSON 1. PLANE WAVES
1. Introduction. General description. Maxwell's laws on the frequency domain
2. Propagation of plane waves on different media: lossless media, media without magnetic loss, good insulators, good conductors
3. Polarization of plane waves
4. Power flow
5. Phase velocity and group velocity
- LESSON 2. NORMAL AND OBLIQUE INCIDENCE ON FLAT SURFACES OF DISCONTINUITY
1. Normal incidence on flat surfaces of discontinuity
1.1. Normal incidence in two media. Reflection and transmission coefficients. Superposition of two waves
1.2. Normal incidence in three media. Normal incidence in media with N flat surfaces of discontinuity. How to suppress reflections on the first medium
2. Oblique incidence on flat surfaces of discontinuity
2.1. Snell's laws. Refractive index. Total reflection
2.2. Separating the components of the incident electric field on the plane of incidence. Parallel polarization and perpendicular polarization. Analysis of the reflection coefficients. Polarization angle
- LESSON 3. ELECTROMAGNETIC RADIATION
1. Radiation mechanism
2. Basic parameters of antennas: radiation pattern, directivity, and gain
3. Typical/basic antennas. Reciprocity theorem
3.1. Linear antennas
3.2. Aperture antennas
3.3. Reciprocity theorem
4. Friis formula
- LESSON 4. GUIDED WAVES
1. Waveguides
1.1. Statement of the problem and generalization
1.2. Modes and propagation parameters
2. Transmission lines
2.1. Transmission lines. Study of TEM modes
2.2. Equivalent circuit of a line

2.3. Equations and solutions of the transmission line
2.4. Impedance transformers
2.5. Reflections on transmission lines

Practical laboratory work:
P1. Measurement of RF signals with the spectrum analyzer
P2. Measurement of the frequency on waveguides
P3. Measurement of coaxial cables with the network analyzer
P4. Measurement of the standing wave ratio on waveguides
P5. Measurement of antennas

TEACHING METHODS

Students of this subject work individually or in groups. On one hand, students work individually in the lectures + practical classroom work; on the other, they work in groups of five or six in the practical laboratory work. The methodology is explained in more detail below:
- Lectures: theoretical basics and concepts are explained using PowerPoint presentations.
- Practical classroom work: problem-solving activities are carried out; these problems are related to the theory explained in the lectures.
- Practical laboratory work: experimental measurements are performed and processed, and then recorded in standard reports, in groups of five or six.

In the event that health conditions prevent the performance of a teaching activity and / or evaluation in person, will activate a mode of non-presence of which students will be informed promptly.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	37,5		15	7,5					
Horas de Actividad No Presencial del Alumno/a	56,25		22,5	11,25					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Multiple choice test 18%
- Teamwork assignments (problem solving, Project design) 12%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The total mark of the subject is divided into two sections:
- 88% of the total mark: assessment of the lectures + practical classroom work.
- 12% of the total mark: assessment of the practical laboratory work.

To pass the subject it is required:
- To get at least a 50% pass mark on the lectures + practical classroom work
and
- to get at least a 50% pass mark on the practical laboratory work.

Assessment of the lectures + practical classroom work:
- Continuous assessment:
* Questionnaires in the eGela platform (18% of the total grade).
* Set of problems and/or questions in a final written exam in the official examination date of the final assessment test (70% of the total grade).
* Students have the right to be graded by final assessment: they must present a written request to do this, within 9 weeks, starting from the beginning of the four-month period.
- Final assessment:
* Set of problems and/or questions in a final written exam in the official examination date of the final assessment test (88% of the total grade).

Assessment of the practical laboratory work:
- Continuous assessment:

* Standard reports of the measurements obtained (12% of the total grade).
* Students work in groups and each report must be submitted after each session.
* Students have the right to be graded by final assessment: they must present a written request to do this, within 9 weeks, starting from the beginning of the four-month period.
- Final assessment:
* Practical exam after the written exam in the official examination date of the final assessment test (12% of the total grade).
* Individual.

Withdrawal from a call: non-attendance at the exam call in the official examination date of the final assessment test will result in a withdrawal (NOT PRESENTED will be applied).

In case of health conditions do not allow the face-to-face teaching and/or evaluation activity, and on-line modality will be prepared and the students will be informed.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The total mark of the subject is divided into two sections:
- 88% of the total mark: assessment of the lectures + practical classroom work.
- 12% of the total mark: assessment of the practical laboratory work.

To pass the subject it is required:
- To get at least a 50% pass mark on the lectures + practical classroom work
and
- to get at least a 50% pass mark on the practical laboratory work.

Assessment of the lectures + practical classroom work:
- Students who achieved at least a 50% pass mark in the assessment of the lectures + practical classroom work of a previous call:
* It is possible to keep the mark of the assessment of the lectures + practical classroom work of the previous call without having to take the written exam again (88% of the total grade).
- Students not fulfilling the previous condition:
* They will have to take the written exam in the official examination date of the final assessment test (88% of the total grade).

Assessment of the practical laboratory work:
- Students who achieved at least a 50% pass mark in the assessment of the practical laboratory work of a previous call:
* It is possible to keep the mark of the assessment of the practical laboratory work of the previous call without having to take the practical exam (12% of the total grade).
- Students not fulfilling the previous condition:
* They will have to take the practical exam after the written exam in the official examination date of the final assessment test (12% of the total grade).

Withdrawal from a call: non-attendance at the exam call in the official examination date of the final assessment test will result in a withdrawal (NOT PRESENTED will be applied).

In case of health conditions do not allow the face-to-face teaching and/or evaluation activity, and on-line modality will be prepared and the students will be informed.

MANDATORY MATERIALS

Lecture materials and notes are available in the eGela virtual platform:
- PowerPoint slides used in the lectures.
- Questions from the exercises worked on in the practical classroom work.
- Manuals and standard reports of the practical laboratory work.

Information about the use of materials, media and resources:
- During teaching activities (continuous assessment):
* No telephone systems, devices or any other type of help are permitted, except as provided for below.
* Students are permitted to use books or course notes as well as electronic or computer systems or devices. Should these systems or devices have access to the Internet, any search for other than instructional materials will be prohibited.

- In the final assessment test (both continuous assessment and final assessment):
* Neither books or course notes nor telephone, electronic or computer systems or devices nor any other type of help are permitted, except as provided for below.
* Students are only permitted to use calculators.

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D. K. Cheng, "Fundamentos de electromagnetismo para ingeniería," Addison-Wesley Iberoamericana, 1997.
S. V. Marshall, R. E. DuBroff, G. G. Skitek, "Electromagnetismo. Conceptos y aplicaciones," 4. edición, Prentice-Hall Hispanoamericana, 1997.
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J. E. Page de la Vega, J. E. Camacho Peñalosa, "Ondas Planas," Servicio de Publicaciones ETSIT Madrid.
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W. Ramo, Van Duzer, "Fields and Waves in Communications Electronics," Wiley, 1984.
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J. Bolton, "Electromagnetic Waves," Open University, 2006.
M. Born and E. Wolf, "Principles of Optics," 6th ed., Pergamon Press, 1990.
R. E. Collin, "Antennas and Radiowave Propagation," McGraw-Hill, 1985.
S. Cogollos Borrás, H. Esteban González, C. Bachiller Martín, "Campos Electromagnéticos," Editorial Universidad Politécnica de Valencia, 2007.
E. Hecht, "Optica," Addison-Wesley, 2002.
J. D. Jackson, "Classical Electrodynamics," John Wiley and Sons, 1999.
D. M. Pozar, "Microwave Engineering," Addison Wesley, 2002.
S. J. Orfanidis, "Electromagnetic Waves and Antennas," http://www.ece.rutgers.edu/~orfanidi/ewa/
G. Befeki, A. H. Barrett, "Electromagnetic Vibrations, Waves, and Radiation," The MIT Press, 1977.

Journals

Revista Española de Física: http://www.revistadefisica.es/index.php/ref/index

Web sites of interest

http://www.amanogawa.com/waves.html
http://webpages.ursinus.edu/lriley/courses/p212/lectures/lectures.html
http://hyperphysics.phy-astr.gsu.edu/HBASE/hph.html
http://www.falstad.com/mathphysics.html
http://www.colorado.edu/physics/2000/index.pl
http://www-personal.umich.edu/~jbourj/em.htm

OBSERVATIONS

This teaching guide conforms to the "Normativa reguladora de la Evaluación del alumnado en las titulaciones oficiales de Grado" (Regulations) (BOPV nº 50 de 13-01-2017).

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Fourth year

COURSE

27386 - Antennae & Propagation **Credits, ECTS:** 4,5

COURSE DESCRIPTION

To adequately perform the functions related to radio applications inherent to telecommunications, it is necessary to master the operation and design of antennas and radiant systems, and the propagation of radioelectric waves.

The subject comparatively studies, on the one hand, the physical and technological foundations of the different types of antennas or radiating systems, and on the other, the radioelectric propagation algorithms, used in the professional deployment of the increasingly numerous information technology services that are based on wireless communications, such as mobile phone services, broadcasting, radar, radiolocation, etc.

In the part of radiant systems, three steps are followed. First of all, starting from the physical foundations of electromagnetic radiation, the operation of some elementary antennas is analytically characterized. From this analysis, the key parameters for the characterization of radiant systems are obtained, which allow the design or the comparative evaluation of different options of radiant systems for their optimal integration in a radiocommunication system. Last, the most complex radiant systems and antenna arrays are analyzed with the support of practical work carried out using simulation software packages.

In the radio propagation part, a similar progressive approach is followed: starting from the review of the characteristic phenomena of the propagation of electromagnetic waves at different frequencies, the effects that these phenomena may have on a radiocommunication signal are analyzed, and the different types of algorithms, which are used in the professional environment for the prediction of signal reception conditions, are introduced and analyzed. These types of algorithms, both analytical and statistical, for both outdoor and indoor environments, are necessary in the planning phase of radiocommunication services.

The subject of Antennas & Propagation is not limited to theoretical knowledge, but rather, by carrying out practical work in laboratory projects, it allows the acquisition of the competences and knowledge required for the comparative analysis and design of radiant systems, and for the comparative analysis and implementation of algorithms for the prediction of radio propagation.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCES
The competences of Module M03 or "Sistemas de Telecomunicación" Module that should be acquired by students are the following ones (not to be translated but copied from the official documentation of the Degree):
-S03 Capacidad de análisis de componentes y sus especificaciones para sistemas de comunicaciones guiadas y no guiadas.
-S04 Capacidad para la selección de circuitos, subsistemas y sistemas de radiofrecuencia, microondas, radiodifusión, radioenlaces y radiodeterminación.
-S05 Capacidad para la selección de antenas, equipos y sistemas de transmisión, propagación de ondas guiadas y no guiadas, por medios electromagnéticos, de radiofrecuencia u ópticos y la correspondiente gestión del espacio radioeléctrico y asignación de frecuencias.

Moreover, the general competences of the degree that are developed in the subject are the following ones (not to be translated but copied from the official documentation of the Degree):
-G003 (Específica): Conocimiento de materias básicas y tecnologías que capacite al alumnado para el aprendizaje de nuevos métodos y tecnologías, así como que le dote de una gran versatilidad para adaptarse a nuevas situaciones.
-G004 (Transversal): Capacidad de resolver problemas con iniciativa, toma de decisiones, creatividad, y de comunicar y transmitir conocimientos, habilidades y destrezas, comprendiendo la responsabilidad ética y profesional de la actividad deIngeniería Técnica de Telecomunicación.

LEARNING RESULTS
Students should acquire the following learning results in the subject (not to be translated but copied from the official documentation of the Degree):
-RA01: Identifica los parámetros fundamentales que definen las propiedades de las antenas en general y de cada una de las familias de sistemas radiantes, en particular, tanto para su análisis como para su diseño como elementos de los sistemas radioeléctricos.
-RA02: Selecciona el tipo o tipos de antena adecuados, a partir de sus especificaciones, para cumplir con los requisitos

de los distintos sistemas de comunicaciones en los que se requiere su uso.
-RA03: Certifica el rendimiento y el funcionamiento de los sistemas radiantes empleando software de simulación e instrumentos de medida; procesa y analiza de manera correcta los datos obtenidos. -RA04: Conoce y aplica los conceptos relacionados con los mecanismos de propagación radioeléctrica así como los algoritmos de predicción determinísticos y empíricos, en distintos entornos de despliegue de sistemas de radiocomunicaciones, tanto outdoor como indoor, para evaluar la disponibilidad de los servicios asociados, en su fase de planificación.
-RA05: Expresa de forma fluida, tanto escrita como oral con apoyo visual, tanto individualmente como parte de un trabajo en equipo, los procedimientos, resultados y conclusiones derivadas de los resultados de aprendizaje anteriormente descritos.

CONTENIDOS TEÓRICO-PRÁCTICOS

ANTENNAS and PROPAGATION program
Lesson 1
-Frequency bands and antenna types.
-Antenna parameters: input impedance, efficiency, radiation pattern, polarization.

Lesson 2
-Fundamentals of electromagnetic radiation. Radiation regions.
-Wire antennas: dipoles, monopoles, loop antennas, yagi antenna, log-periodic antenna.
-Antenna arrays.

Lesson 3
-Helical antennas.
-Aperture antennas.
-Slot antennas.
-Horns.
-Reflectors.

Lesson 4.
-Outdoor propagation: propagation phenomena, modes of propagation, environments, prediction methods and classification.
-Analytical propagation models: one-ray model and Friis formula, two-ray model.
-Deterministic propagation models: diffraction; attenuation by gases, hydrometeors and clutter.
-Deterministic prediction methods: Ray tracing, Ikegami and ITU-R.

Lesson 5.
-Empiric propagation models: log-distance, specific environment models.
-Indoor propagation: ITU-R, COST 231, picocells.

PRACTICAL LABORATORY WORK
1) Antenna characterization procedures. Measurements: radiation pattern, directivity, S21, S11 and impedance.

2) Several antenna types analysis and synthesis. Design and simulation.

3) Implementation of a propagation model and verification by means of comparison with measurements.

TEACHING METHODS

The lecturing hours of master classes will be devoted to explaining the theoretical background of each lesson, using slides and the blackboard for this purpose.
In the classroom-practice hours, problem-solving activities will be carried out, sometimes solely on the blackboard, sometimes with the aid of antenna-design software packages. All this will lay the groundwork of the concepts to be applied in the laboratory.
Laboratory projects will be carried out in two or three-people groups, and each group will have to deliver the required documentation regarding the results of the work. They will also have to do a presentation of them in order to be evaluated.

In the event that sanitary conditions prevent the realization of a face-to-face teaching activity and / or evaluation, a non-face-to-face modality will be set in place of which the students will be informed promptly.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15	4,5	7,5	18					
Horas de Actividad No Presencial del Alumno/a	22,5	6,75	11,25	27					

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Exercises, cases or problem sets 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The total score of the subject is divided into two sections:
- 60 % of the total score: assessment of the written exam.
- 40 % of the total score: assessment of the practical laboratory work. This evaluation process includes both the evaluation of individual and group work.

Electronic devices such as calculators, smartphones, smartwatches, etc cannot be used in order to answer quizzes. For the rest of the exam only calculators are allowed.

To pass the subject it is required:
- To get a score equal to or greater than 5 points out of 10 on the written exam
and
- to get a score equal to or greater than 5 points out of 10 on the practical laboratory work.

Should this requirement not be fulfilled, the final total grade will be the grade obtained in the failed part.

Assessment of the written exam:
- Only final assessment.
* Written exam in the official examination hour: set of problems and/or questions.

Assessment of the practical laboratory work:
- Continuous assessment:
* There will be oral presentations by the working groups of the laboratory about the work carried out in the projects. Each project will be given a 0-to-10 grade, and each grade will determine a third of the final grade of the laboratory part. After each presentation, there will be a question time in which all the other groups than the one that has made the presentation will have to pose at least one question per group. Otherwise, all the members of the defaulting group will be penalized with a negative point over 10 in the grade of that particular project. One negative point per each due question. The question time will conclude with the questions and comments of the professor regarding both the technical contents and the formal aspects of the presentation. The conclusions from these questions and comments will be the basis of the grade of this project. A previously published rubric, made available to the students prior to the evaluation, will be used for this evaluation. Furthermore, after the evaluation of each project is completed, the following will be delivered to each concerned person: the scores of the evaluation of the practice, carried out according to the rubric, both individual and group based, with the corresponding justifications, and a set of general observations and improvements for all students in the class.

* Students have the right to resign to the continuous assessment in accordance with the procedure and established deadlines in Article 8.3 of Student Assessment Regulations of the UPV/EHU. Then they would be assessed following the final assessment procedure: they must report a written statement for such a claim, with a deadline of 9 weeks, starting from the beginning of the four-month period.
- Additional final assessment:
* Test exam about the laboratory projects after the first written exam (in the official examination date).
* Individual.

Declining to sit: not attending the final exam call will be considered equivalent to a withdrawal (no examination attempt is used) and a grade of NS.

In the event that sanitary conditions prevent the realization of a face-to-face teaching activity and / or evaluation, a non-face-to-face modality will be set in place of which the students will be informed promptly.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The total score of the subject is divided into two sections:
- 60 % of the total score: assessment of the written exam.
- 40 % of the total score: assessment of the practical laboratory work. This evaluation process includes both the evaluation of individual and group work.

Electronic devices such as calculators, smartphones, smartwatches, etc cannot be used in order to answer quizzes. For the rest of the exam only calculators are allowed.

To pass the subject it is required:
- To get a score equal to or greater than 5 points out of 10 on the written exam
and
- to get a score equal to or greater than 5 points out of 10 on the practical laboratory work.

Should this requirement not be fulfilled, the final grade will be the grade obtained in the failed part.

Assessment of the written exam:
- Students that got a score equal to or greater than 5 points out of 10 on the written exam of the previous call:
* It is possible to keep the score of the written exam of the previous call without having to take the written exam again.
- Students not fulfilling the previous condition:
* Written exam in the official examination hour: set of problems and/or questions.

Assessment of the practical laboratory work:
- Students that got a score equal to or greater than 5 points out of 10 on the practical laboratory work of the previous call:
* It is possible to keep the score of the practical laboratory work of the previous call without having to take the practical exam.
- Students not fulfilling the previous condition:
* Practical test exam after the written exam (in the official examination date).

Declining to sit: not attending the final exam call will be considered equivalent to a withdrawal (no examination attempt is used) and a grade of NS.

In the event that sanitary conditions prevent the realization of a face-to-face teaching activity and / or evaluation, a non-face-to-face modality will be set in place of which the students will be informed promptly.

MANDATORY MATERIALS

All the material is available on the eGela online teaching platform:
- PowerPoint slides for the lectures.
- Exercises to be worked on during the classroom practices.
- Guide notes of the practical laboratory work.

Deliverables will be made accessible through the online platform.

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Basic bibliography

C. A. Balanis, "Antenna Theory: Analysis and Design," John Wiley & Sons, 2016

C. A. Balanis, "Modern Antenna Handbook," John Wiley & Sons, 2008

W. L. Thiele y G. A. Stutzman, "Antenna Theory and Design," John Wiley & Sons, 2013

J. D. Kraus, "Antennas for all applications," McGraw-Hill, 2003.

All of them are available in the faculty Library.

Detailed bibliography

R. E. Collin, "Antennas and Radiowave Propagation," McGraw-Hill, 1985.
S. J. Orfanidis, "Electromagnetic Waves and Antennas," http://www.ece.rutgers.edu/~orfanidi/ewa/

J. Bolton, "An introduction to Maxwell's Equations," Open University, 2006.
J. Bolton, "Electromagnetic Fields," Open University, 2006.
J. Bolton, "Electromagnetic Waves," Open University, 2006.
D. M. Pozar, "Microwave Engineering," Addison Wesley, 2002.

Journals

IEEE Transactions on Antennas & Propagation.
IEEE Antennas and Wireless Propagation Letters.
IEEE Antennas & Propagation Magazine.
Microwaves and RF.

Web sites of interest

The evaluation versions of the software packages that will be used in the course can be found on the Internet:
MMANA-GAL: https://hamsoft.ca/pages/mmana-gal.php
Antenna Magus: https://www.3ds.com/products-services/simulia/products/antenna-magus/
TICRA GRASP: https://www.ticra.com/software/grasp/

Some free online apps for the analysis of certain types of antennas are also of interest:
-Dipoles: https://www.omnicalculator.com/physics/dipole
-Antenna arrays: https://antennaarraycalculator.blogspot.com/p/calculator.html
-Horn antennas: https://hornantennacalculator.blogspot.com/p/calculator.html

OBSERVATIONS

This teaching guide conforms to the "Normativa reguladora de la Evaluación del alumnado en las titulaciones oficiales de Grado" (BOPV nº 50 de 13-01-2017).

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Fourth year

COURSE

27388 - Radar & Satellite Navigation Systems **Credits, ECTS:** 4,5

COURSE DESCRIPTION

The subject 'Radar y Sistemas de Navegación por Satélite' is in 4th course, within the intensification on 'Telecommuication systems'. It is focused on the technologies that obtain positioning and additional information from objects, by means of the electromagnetic properties of the radio signals: Radar systems and Global Navigation Satellite Systems (GNSS).

In the syllabus, concepts from previous subjects related to radiocommunication systems, antennas and propagation are applied. The students must have basic knowledge of these topics.

The approach of the subject is quite practical. Theoretical concepts are applied to operational situations and specifications of real radars are used in the examples.

It is possible to make the exam in English. Basic materials are also available in English.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The student will learn different technologies used in the radar and GNSS systems. They will apply, in a practical way, concepts learnt in previous subjects about propagation, antennas and signal processing.

The student will work with these concepts in practical situations and representative examples.

CONTENIDOS TEÓRICO-PRÁCTICOS

The basic contents of the subject are:
- Analysis of the radar signal in time and frequency domains.
- Understanding of the functionalities ans specifications of the subsystems that compose a generic radar system (antenna, transmission, reception, signal processing, anti-clutter techniques, ...)
- Main data processing techniques used in radar and GNSS
- Architecture of the GNSS
- Signals, data processing and services in GPS and Galileo

TEACHING METHODS

The core of the subject is described in the theoretical lecturers, where the main concepts and the approach of the practical exercises are described.

Additionally, practical problems describing representative situations will be faced by the students, by applying the concepts of the syllabus and technical specifications of real radars. The practical problems will be presented by the professor, both in theoretical lecturers and seminars, and solved by the students in working groups.

The lab practise will be focused in radar simulations related to selected concepts from the syllabus, with a software tool developed for that purpose. The students will write a short report for each individual practise, including the results and the analysis of the problem resolution.

Field practise will provide a close approach to real radar systems or to simulators of applications based on radar systems.

In case the sanitary conditions prevent from the planned teaching activity and/or the face-to-face evaluation, a non-face-to-face modality would be activated and the students would be informed promptly.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15	7,5	7,5	10					5
Horas de Actividad No Presencial del Alumno/a	22,5	11,25	11,25	15					7,5

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

Evaluation methods

- Continuous evaluation

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 50%
- Exercises, cases or problem sets 25%
- Individual assignments 15%
- Teamwork assignments (problem solving, Project design) 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation of the subject will be as follows:
- An individual written exam about theoretical concepts and short practical questions, after the first weeks of the triannual (15%)
- A short report with the results of a practical use case (10%)
- Periodical reports of the lab practise and a final practical exam with questions related to the simulations developed in the lab practise (25%). Periodical reports of the lab practise must be handed over on time.
- A final written exam with theoretical questions and practical problems (50%). It is required to pass this final exam to pass the subject.

It is mandatory to complete all the lab and practical problems and to deliver the required reports in order to pass the subject.

The evaluation criteria are the following:
- Proper knowledge and comprehension of the main contents and concepts of the subject.
- Adequate relation of theoretical concepts, technological requirements and technological solutions
- Adequate application of the previous items to specific representative situations
- Accuracy of the quantitative results of practical examples

Students that choose not to participate in partial exams must notice this fact to the professor at least one week before the first partial trial. Otherwise, they will be evaluated in the partial exams, even if they are not present in the trial.

Students that choose not to participate in partial exams will be evaluated in a final exam composed of:
- A written exam containing the most relevant theoretical concepts, practical questions and problems (75%)
- The development of a lab practise, similar to those developed during the course (25%)

In case that health conditions prevent from the scheduled activities and/or the on-site examination, online alternatives will be launched and students will be punctually informed.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation will consist of a final exam composed by:
- A written exam containing the most relevant theoretical concepts, practical questions and problems (75%)
- The development of a lab practise, similar to those developed during the course, and a practical exam. The grade obtained in this part within the ordinary exam will be kept in the extraordinary exam (25%)

In case that health conditions prevent from the scheduled activities and/or the on-site examination, online alternatives will be launched and students will be punctually informed.

MANDATORY MATERIALS

The resources for the students are:
- Syllabus of the subject
- Exercises, practical problems and representative examples
- Practical cases, technical specifications of radars
- User manual of the software tool for lab simulations
- Additional bibliography

These resources will be available at virtual room for the students E-Gela.

BIBLIOGRAFÍA

Basic bibliography

- Introduction to Radar Systems, M.I. Skolnik, McGraw-Hill Book Co., Singapur, 1980
- GNSS Data Processing, ESA TM-23, Vol I: Fundamentals and Algorithms (disponible en www.navipedia.net/GNSS_Book/ESA_GNSS-Book_TM-23_Vol_I.pdf)
- GNSS tutorials

Detailed bibliography

- Monopulse principles and techniques, S. M. Sherman, Artech House, 1984
- Principles of Modern Radar, J.L. Eaves et al.
- Radar Principles, N. Levanon.
- Radar System Design and Analysis, S.A. Hovanessian, Artech House Inc., USA, 1984
- Guía práctica del GPS, P. Correia, Marcombo.
- The GPS Manual. Principles and Applications, S. Dye, Baylin Publications
- Documentación sobre el sistema GPS publicada por el DoD de EEUU (disponible en E-gela)
- Documentación sobre el sistema Galileo publicado por la Agencia Espacial Europea (disponible en E-gela)

Journals

Web sites of interest

http://www.navipedia.net/
http://www.gps.gov/
http://www.esa.int/galileo
http://www.esa.int/Our_Activities/Navigation/The_present_-_EGNOS/What_is_EGNOS
http://egnos-portal.gsa.europa.eu/

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Fourth year

COURSE

27389 - Microprocessor-based Designs **Credits, ECTS:** 4,5

COURSE DESCRIPTION

The objective of this subject is to initiate the student in the analysis of the characteristics of different microprocessors to select the most suitable one, for the design that must be done.
There are some design requirements that must be fulfilled. Focusing on the microprocessor and adding the necessary elements, the design of a product (hardware and software) will be completed.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Capacity to design analog and digital electronics devices, analog-digital and digital-analogue conversion, radio frequency, power and conversion of electrical power for telecommunication and computer applications.

Capacity to carry out the specification, implementation, documentation and set-up of electronic, instrumentation and control devices and systems, considering both the technical requirements and the corresponding standard regulations.

Therefore, the student acquires the ability to select advanced microprocessors, electronic components and integrate them into a digital system based on a microprocessor, in order to create a product, that fullfill the specification. Tjey also acquires the ability to configure and program the microprocessor for the required functionality.
It uses the concepts of analogue and digital electronics of other subjects of the degree.

Modern microprocessors compete designing complex systems, with FPGA and DSP. So it is necessary to analyze points as computational speed and performance, use of memory, processor, coprocessors and peripherals performance, bus organization and compiler efficiency.

Much of the effort is dedicated to the design of the program: computer tools for editing, compiling, debugging, simulating, linking and loading in memory, configuration of peripherals, C-programming, auxiliary libraries, real time execution.

Objective: To give the students the capacity to design and develop digital circuits based on microprocessors of great computing capacity

CONTENIDOS TEÓRICO-PRÁCTICOS

1. Introduction to systems based on advanced microprocessor
2. Detailed Knowledge of microprocessors: kernel, memories, interrupts, timers, I/O ports, Peripheral.
3. Design of a product based on a microprocessor.
4. Design Flow of a complex digital system. Development and debugging Tools.
5. C Programming oriented to microprocessor.
6. Complete development of a microprocessor program to load into it.
7. The microprocessor's electronic card: physical and electrical aspects.

Practices
-Analysis and comparison of microprocessors.
-Product Design with microprocessors.
-Study of a micro of the family Kinetis.
-Knowledge of the development environment.
-Study of the evaluation card.
-Development of a program on the evaluation card:
  Debugging.
  Loading and executing on the card.
  Management of the main parts of the
-Free Work with the microprocessor

TEACHING METHODS

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	7,5			12,5	25				
Horas de Actividad No Presencial del Alumno/a	11,25			18,75	37,5				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Exercises, cases or problem sets 15%
- Teamwork assignments (problem solving, Project design) 65%
- Oral presentation of assigned tasks, Reading¿ 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Continuous Evaluation: All parts must be approved separately.
The waiver of the continuous evaluation shall be carried out as set out in the corresponding evaluation regulation.

The Final examination will count 100%, and include a theoretical and practical part in the laboratory.
The procedure for waiving a call will be the one included in the corresponding legislation.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

It will Be done by final test that and includes a theoretical and practical part in the laboratory.
The same criteria as in the ordinary call Will Be followed

MANDATORY MATERIALS

Kinetis KwikStik evaluation board

BIBLIOGRAFÍA

Basic bibliography

-Kinetics user´s and instructions manual
-Codewarrior manual

Detailed bibliography

Journals

Web sites of interest

www.freescale.com/Kinetis
www.freescale.com/codewarrior

OBSERVATIONS

The teaching material is available on the eGELA platform.

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao
Cycle Not Applicable
Degree GIAMBI30 - Bachelor's Degree in Environmental Engineering
Year Fourth year

COURSE

27440 - Environmental Management in Industry
Credits, ECTS: 4,5

COURSE DESCRIPTION

The main aim of the course is to provide knowledge of the design, implementation and evaluation of environmental management systems in industry, as well as other environmental management tools useful to reduce the impact of industrial activities and to report on their commitment to do so.
This course is taught during the last semester of the Degree. It requires previous knowledge acquired in basic and specific courses, in particular in "Environmental Science and Technology". "Environmental Management in Industry" is an optional course, but compulsory in the "Environmental Management" specialization. However, this course is useful for students of any variation of the Degree in Environmental Engineering, as well as Chemical Engineering, Civil Engineering and Industrial Engineering, among others.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The competences acquired in the course will allow students to:
-Describe and argue the benefits of implementing an environmental management system in organizations, in particular in the industrial sector.
-Detail the main features and applications of existing environmental tools in order to implement an environmental management system.
-Identify the main steps in order to plan, design, implement, assess, and improve an environmental management system.
-Describe the fundamentals and applications of other useful environmental management tools such as life cycle assessment, eco-design, environmental footprint, ecolabelling and others.

CONTENIDOS TEÓRICO-PRÁCTICOS

The main contents of the course comprises four topics:
-Topic 1. Business and Environment. Introduction to Environmental Management Systems (EMS) in an organization.
-Topic 2. Environmental Management Systems. Context. Standardised environmental management systems. Implementation of Environmental Management Systems. Integrated management systems. Environmental indicators. Communication: environmental statement.
-Topic 3. Environmental audits. Definition, scope and objectives. Types of environmental audits. Content and methodology of an environmental audit. Communication: the audit report.
-Topic 4. Other environmental management. Life Cycle Assessment. Ecodesign. Environmental footprint, carbon footprint, ecological footprint, and water footprint. Ecolabelling. Product and organisation environmental footprint. Sustainability reports.

TEACHING METHODS

The course will be delivered by means of:
-Lectures (MC), which will be used to explain core contents in order to develop students' knowledge and understanding of the aforementioned concepts.
-Seminars (S), which will be used for practical activities, discussions in groups, reviews, etc..
-Computer labs (CL), which will be used to solve practical cases and to prepare an individual report that will be presented to the group at the end of the semester.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	22,5	15			7,5				
Horas de Actividad No Presencial del Alumno/a	33,75	22,5			11,25				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Multiple choice test 40%
- Exercises, cases or problem sets 20%
- Individual assignments 35%
- Oral presentation of assigned tasks, Reading¿ 5%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Continuous assessment is used in both ordinary and extraordinary assessment sessions. The completion of activities, computer lab reports and the exposition are included in the assessment criteria (60%). Students are also required to take a final written exam in May/June (40%). It is essential to pass this final exam (minimum grade: 5.0/10.0) to average it with the grades obtained during the semester (activities, computer lab reports and oral defence:
Any student wishing to waive continuous evaluation and wishing to be marked by final assessment instead of by continuous assessment in the ordinary session should request this in a written document from the lecturer responsible for the course before the ninth week after the course starts. In this case, the student must do the following in May/June:
-Written exam: multiple choice test (40% of final grade)
-Resolution of a practical case (50% of the final grade)
-Computer lab test (10% of the final grade)

- Una prueba escrita tipo test que se realizará al final del cuatrimestre y que supondrá el 40% de la calificación final de la asignatura, y estará dividido en un 30% test y un 10% problemas. Es imprescindible aprobar esta parte (nota mínima de 5,0 sobre 10,0) para promediar la nota con la obtenida en las actividades, informes de prácticas de ordenador y trabajos individuales

El estudiante que quiera renunciar a la evaluación continua, y quiera ser evaluado mediante evaluación final, deberá presentar un escrito al profesorado responsable de la asignatura indicando su renuncia antes de la novena semana después del comienzo de la asignatura. En este caso el alumno deberá realizar:
- Prueba escrita tipo test (40% de la nota final).
- Resolución de un caso práctico (50% de la nota final).
- Prueba de práctica de ordenador (10% de la nota final).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Students who do not pass the subject in the ordinary call are required to take a written exam similar to that in the ordinary session (40% of the final mark). The remaining 60% of the mark will correspond to the activities carried out throughout the semester (practical activities, computer lab reports and oral presentation).
Any student who requested to be qualified by final assessment in the ordinary session will be marked according to the same criteria as in the ordinary session.

MANDATORY MATERIALS

Materials required to follow the sessions will be shared with the students though eGela virtual platform (https://egela.ehu.eus/):
-Lecture materials and documents,
-Instructions for practical activities and computer lab guides,
-Links to useful websites and useful reports.

BIBLIOGRAFÍA

Basic bibliography

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- AENOR. Gestión Ambiental. AENOR ediciones (2011).
- Aranda, A., Zabalza, I., Martínez, A., Valero, A., Scarpellini, S. El Análisis del Ciclo de Vida como herramienta de gestión empresarial, Ed. Fundación Confemetal (2006).
- Carretero Peña, A. Aspectos ambientales. Identificación y evaluación. Editorial AENOR (2016).
- Gómez Orea, D. Evaluación de Impacto Ambiental. 3ª Edición. Ed. Mundi Prensa (2013).
- Granero, J, y Ferrando, M., Cómo implantar un Sistema de Gestión Ambiental según la norma ISO 14001:2004. Ed. Fundación Confemetal (2011).
- Innovación y Cualificación, S. L. Target Asesores. Gestión Ambiental en la Empresa. IC Editorial (2013).
- Norma UNE-EN ISO 14064:2012. Gases de Efecto Invernadero (2012)
- Norma UNE-EN ISO 14001:2015. Sistemas de gestión ambiental. Requisitos con orientación para su uso (2015).
- Norma UNE-EN ISO 14006:2011. Sistemas de gestión ambiental. Directrices para la incorporación del ecodiseño (2011).
- Norma UNE-EN ISO 14040:2006. Gestión ambiental. Análisis del ciclo de vida. Principios y marco de referencia (2006).
- Sociedad Pública de Gestión Ambiental-IHOBE. Manual IHOBE ISO14001. Operativa de implantación. Edita: Sociedad Pública de Gestión Ambiental del Gobierno Vasco (2000). Disponible en: https://www.ihobe.eus/publicaciones/manual-ihobe-iso-14001-operativa-implantacion Último acceso: julio de 2019
- Sociedad Pública de Gestión Ambiental-IHOBE. Etiquetado ambiental de producto. La declaración ambiental de

producto. Un instrumento de información y comparación ambiental entre productos. Edita: Gobierno Vasco (2015).
- Sociedad Pública de Gestión Ambiental-IHOBE. Guía metodológica para la aplicación de la huella ambiental corporativa. Edita: Sociedad Pública de Gestión Ambiental del Gobierno Vasco (2017). Disponible en: http://www.euskadi.eus/contenidos/documentacion/huella_ambiental/es_def/adjuntos/Guia_huella_ambiental_CASTdef.pdf Último acceso: julio de 2019
- Sociedad Pública de Gestión Ambiental-IHOBE. Guía para la adaptación del sistema de gestión ambiental a la norma UNE-EN-ISO 14001-2015. Edita: Gobierno Vasco (2015)
- Sociedad Pública de Gestión Ambiental–IHOBE. Manual Práctico de Ecodiseño. Operativa de Implantación en 7 pasos. Edita: Gobierno Vasco (2000).

Detailed bibliography

- Basque Ecodesign Center Ecodiseño para una Economía circular: Claves para fomentar un modelo económico sostenible. Cuaderno de Ideas nº13. Edita: Gobierno Vasco (2016).
- Bureau Veritas Business School. Auditorías Ambientales. Fc Editorial (2011)
- Carrillo, J., Del Río, P. y Könnölä, T. Eco-Innovación: Claves para la Competitividad Sostenible y la Sostenibilidad Competitiva. Editorial Netbiblo (2011)
- Consejería de medio ambiente y de ordenación del territorio de la comunidad de Madrid. Guía práctica para la aplicación del reglamento EMAS (2013). Disponible en: https://www.comunidad.madrid/sites/default/files/doc/medio-ambiente/emas_reglamento_guia_practica_rev_2013.pdf Último acceso: julio 2019
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- Sociedad Pública de Gestión Ambiental del Gobierno Vasco- IHOBE. Identificación y Evaluación de Aspectos Ambientales. Mini guía del Taller. Edita: Gobierno Vasco (2009)

Journals

Environmental Management. Editorial Springer. Disponible en: https://link.springer.com/journal/267. Último acceso: julio de 2019
Journal Environmental and Sustainability Indicators. Editorial Elsevier. Disponible en https://www.journals.elsevier.com/environmental-and-sustainability-indicators. Último acceso: julio de 2019
Journal of Environmental Management. Editorial Elsevier. Disponible en: https://www.journals.elsevier.com/journal-of-environmental-management Último acceso: julio de 2019
Revista Técnica de Medio Ambiente (RETEMA). Editorial C. & M. Publicaciones. Madrid. Disponible en: https://www.retema.es/ Último acceso: julio de 2019

Web sites of interest

US Environmental Protection Agency (EPA) http://www.epa.gov
International Standards Organization (ISO) http://www.iso.org
European Environment Agency (EEA) http://www.eea.eu.int
Diario Oficial de las Comunidades Europeas (DOCE) http://europa.eu.int/eur-lex/
Ministerio para la Transición Ecológica https://www.miteco.gob.es/es/
Asociación Española de Normalización y Certificación(AENOR) http://www.aenor.es
Gobierno Vasco. Departamento de Medio Ambiente , Planificación Territorial y Vivienda http://www.euskadi.eus/gobierno-vasco/departamento-medio-ambiente-politica-territorial/inicio/
Sociedad Pública de Gestión Ambiental del Gobierno Vasco- IHOBE http://www.ihobe.es

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GTELEC30 - Bachelor's Degree in Telecommunications Engineering **Year** Fourth year

COURSE

27833 - Telecommunications Circuits (2) **Credits, ECTS:** 4,5

COURSE DESCRIPTION

This subject continues the work developed by the subject Electronic circuits, which is focused on other more basic analogue subsystems and on the operation of the operational amplifier. Telecommunication circuits delves into the acquisition of competencies related to these and other more complex electronic systems, such as analogue multipliers, oscillators and phase locked loops, and various circuits based on the usage of operational amplifiers.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

This subject works the following module (M05SE) competencies:
M05SE2 Ability to select specialized electronic circuits and devices for transmission, routing and terminal configuration, in both fixed and mobile environments.
M05SE5 Ability to design electronic analogue and digital circuits, analogue-digital and digital-analog conversion, radiofrequency circuits, power management and electric energy conversion for telecommunication applications and computing.
M05SE6 Ability to understand and use the feedback theory and control of electronic systems.
Students will acquire the ability to select specialized electronic circuits and devices for telecommunications; design basic circuits; understand and use feedback theory and control of electronic systems.

CONTENIDOS TEÓRICO-PRÁCTICOS

Contents, list of topics:
1. Circuits with operational amplifiers (instrumentation amplifier, current sources, boosters, feedback, compensation)
2. Power amplifiers
3. Timers
4. Oscilators
5. Multiplier circuits and wave shaping circuits
6. Phase locked loops
7. A/D and D/A converters

TEACHING METHODS

In this subjects, master classes (3 credits) are complemented with the implementation of various practices (1.5 credits) for the design, simulation and assembly of the electronic circuits under study.
Not face-to-face teaching will be devoted to the preparation of the master classes, search for information, consultation of specification sheets and application notes, and the preparation of the electronic project to be carried out in the laboratory.
Attendance to laboratory practices is mandatory.
In the event that sanitary conditions prevent the carrying out a teaching activity and / or face-to-face assessment, a non-contact modality will be activated and the students will be informed promptly.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30			15					
Horas de Actividad No Presencial del Alumno/a	45			22,5					

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Individual assignments 20%
- Teamwork assignments (problem solving, Project design) 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Composition of the final grade. It consists of three parts:
60% written final exam (FINAL TEST)
20% continuous evaluation of the laboratory project (PROJECT LAB)
20% reports of the design and simulation exercises proposed (INDIVIDUAL EXERCISES)

To pass the course will require that all three parts that make up the final mark are passed.
The deadline for renouncing continuous assessment will be that set by UPV/EHU regulations.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation of the second call will have the same composition as the ordinary call.
The notes of individual exercises and laboratory project will be saved, if approved
in the ordinary call, for the extraordinary session.
Students who have not passed the part corresponding to the individual exercises or the lab project will have a complementary test to evaluate those contents.

MANDATORY MATERIALS

Notes and presentations used in master classes.
Notes and presentations for the laboratory project.
The course has a MOODLE web page (eGela).

BIBLIOGRAFÍA

Basic bibliography

A.B. Wiliams. Designer’s Handbook of Integrated Circuits. McGraw Hill, 1984.
A.S. Sedra, K.C. Smith. Microelectronic Circuits. Oxford, 2017.
S. Franco. Design with O.A. and Analog I.C. McGraw-Hill, 2001.
T.C. Carusone et al. Analog Integrated Circuit Design. Wiley, 2011.
R. Mancini. Op Amps for everyone. Texas Instruments. 2001.
W. Jung, Op Amp Applications Handbook, Newnes, 2006.

Detailed bibliography

S. Soclof. Design and Applications of Analog Integrated Circuits. Prentice-Hall, 1991.
R.E. Best, Phase-locked loops : design, simulation, and applications, McGraw-Hill, 2003.
D.H. Wolaver. "Phase Loop Circuit Design". Editorial Prentice Hall. 1991.
J.G. Graeme. Designing with Operational Amplifiers. McGraw Hill, 1977.
J.G. Graeme, G.E. Tobey y L.P. Huelsman. Operational Amplifiers. Design and Applications. McGraw Hill, 1971.
Y.J. Wong y W.E. Ott. Function Circuits. Design and Applications. McGraw Hill, 1976.
Nonlinear Circuits Handbook. Analog Devices, 1976.

Journals

Data sheets from producers and suppliers of integrated circuits and devices.

Web sites of interest

OBSERVATIONS

This course has a MOODLE web page (eGela).

COURSE GUIDE 2022/23

Faculty 363 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GIEIAU30 - Bachelor's Degree in Industrial Electronics and Automation Engine **Year** Third year

COURSE

25996 - Digital Electronic Systems **Credits, ECTS:** 6

COURSE DESCRIPTION

Although nowadays there are many available technologies for the development of embedded electronic systems, microprocessor/microcontroller-based system design is still the most demanded and extended approach. In this undergraduate course, you will learn the fundamentals of a microcontroller architecture and their most common peripheral modules, and how they can be correctly configured and programmed for various applications with emphasis on embedded control. With that purpose, a Microchip PIC24F family microcontroller will be the reference device for the proposed practical programming exercises and labs.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Competencies: Those specified on the memory of the verified study programme:

https://gestion-servicios.ehu.es/plantillas/Ingenier%EDa%20Electronica%20Industrial%20y%20Autom%E1tica.pdf

Learning outcomes:
A1. Acquiring the capacity to gather and analyze relevant information about electronic embedded systems and their applications.
A2. Obtaining solid knowledge of the basic architecture and operation of microcontroller-based systems.
A3: Developing fundamental skills in the use of EDA tools for programming, debugging and verifying microcontroller-based systems (C language).
A4. Acquiring the capacity to develop a simple but complete application project based on microcontrollers.
A5. Acquiring the abilities to apply embedded software programming skills to the development of an embedded feedback control application.

CONTENIDOS TEÓRICO-PRÁCTICOS

Lectures:
LECTURE 0: Introduction to embedded systems. A modern perspective.
LECTURE 1: Fundamentals of computer architecture.
LECTURE 2: Microcontrollers. The PIC24F: I/O ports.
LECTURE 3: The PIC24F. Timing: clock sources and timers.
LECTURE 4: The PIC24F. Executing programs: CPU and memory organization. Use of pointers.
LECTURE 5: The PIC24F. Resets and interrupts.
LECTURE 6: The PIC24F. Serial communication modules: SPI, I2C and UART.
LECTURE 7: The PIC24F. Capturing signals: Input Capture modules and integrated ADC.
LECTURE 8: The PIC24F. Pulsed signal generation: Output Compare modules.
LECTURE 9: The PIC24F. Microcontroller-based embedded control design.

Labs:
LAB 0: The Microchip development environment: MPLAB-X IDE and MPLAB-ICD3.
LAB 1: Configuring I/O ports.
LAB 2: Configuring clock sources. Loop programming: the use of timers.
LAB 3: A real time chronometer: programming interrupts.
LAB 4: Serial communications: controlling an I2C sonar.
LAB 5: Capturing pulses: programming a frequency meter.
LAB 6: Generating PWM signals.

Project: Development of a simple autonomous vehicle.

TEACHING METHODS

The different teaching formats are as follows:
M: Master Classes (lectures). Presentation of the topics established in the program of the course. Slides will be used for this purpose.
PA: Complementary to the Master Classes. Exercises and practical questions that help to fix the concepts.
PL: Laboratory practices. Practical complement to the course.

Lectures provide the fundamental knowledge in the architecture and configurability of the microcontroller and its peripherals, as well as practical guidelines for embedded programming. Each week this knowledge is put in practice

through proposed practical exercises and labs.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30		15	15					
Horas de Actividad No Presencial del Alumno/a	30		30	30					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Exercises, cases or problem sets 15%
- Teamwork assignments (problem solving, Project design) 25%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Unless otherwise specified, the "mixed" assessment will apply to you.

In case any student want to be evaluated by means of a final 100% theoretical-practical test (art. 44 of the regulations), he/she must inform the professor, at the latest, four weeks before the end of the lecture period.

A student who does not show up for the final exam will have a NOT TAKEN as a grade.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Same conditions to the first call apply.

MANDATORY MATERIALS

MPLAB X ID User guide.
PIC24FJ128 Datasheet.
PIC24F Reference manual.
Microchip explorer 16 board user's guide.
XC16 compiler user's guide.

BIBLIOGRAFÍA

Basic bibliography

[1] "Computer Organization & Design: The Hardware/Software Interface". by David A. Patterson, John L. Hennessy, Morgan Kaufmann Publishers, 2012.
[2] L. Di Jasio, "Programming 16-bit microcontrollers in C. Learning to Fly the PIC 24", Newnes, 2012.

Detailed bibliography

[1] "Microcontrollers : from assembly language to C using the PIC24 family", by Bryan A Jones, Robert B Reese, J W Bruce. Charles River Media, Inc. Rockland, MA, USA, 2014.
[2] T. Wilmshurst, "Designing Embedded Systems with PIC Microcontrollers", 2nd Ed., Newnes, 2011.

Journals

https://www.embedded.com/
https://www.automationworld.com/technologies/embedded-control
https://www.embedded-computing.com/
http://www.embedded-control-europe.com/magazine

Web sites of interest

http://www.microchip.com/pagehandler/en-us/products/picmicrocontrollers
http://www.microcontroladorespic.com/
http://www.microchip.com/mplab/mplab-xpress
https://www.mbed.com/en/

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 363 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GIIGSI30 - Bachelor's Degree in Computer Engineering in Management and In **Year** Third year

COURSE

26025 - Information System Security Management Systems **Credits, ECTS:** 6

COURSE DESCRIPTION

Information Systems, which may include computer equipment, networks and data carriers, are responsible for working with the sensitive information of any organization. These Information Systems are threatened by risks and threats that may have different origins. We may encounter physical risks such as damage caused by a natural disaster, or by unauthorized access to information; and logical risks generated by a computer attack such as a virus, denial-of-service attacks, etc.

In this subject, the different risks to which the information and the systems that contain it can be subjected will be studied, in order to know them in depth and thus be able to control them and minimize their impact.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Ability to integrate information and communications technology solutions and business processes to meet the information needs of organizations, allowing them to achieve their objectives effectively and efficiently, thus giving them competitive advantages.

Ability to determine the requirements of the information and communication systems of an organization attending to aspects of security and compliance with regulations and current legislation.

Ability to actively participate in the specification, design, implementation and maintenance of information and communication systems.

Ability to understand and apply the principles of risk assessment and apply them correctly in the development and implementation of action plans.

CONTENIDOS TEÓRICO-PRÁCTICOS

1.- Introduction
This topic will analyze the security risks that an organization faces and study how to evaluate and estimate the impact that these risks may have.

2.- Introduction to encryption
The main purpose of information encryption is its protection. This topic will address the basic ideas about encryption, as well as its history.

3.- Symmetric encryption
Most common algorithms and their applications.

4.- Asymmetric encryption
Most common algorithms and their applications.

5.- Secure communications
Application of encryption in secure communications: certificates, SSH connections, etc.

6.- Bitcoin
Bitcoin is an interesting application of encryption, as well as other concepts such as distributed databases. A basic technical introduction to Bitcoin and its Blockchain will be offered.

7.- Backups
Backups ensure the completeness of the information and its usability in case of loss of the original information. This topic will look at different ways and systems of backing up.

8.- Physical security
There is no point in having an information system protected against all kinds of logical risks, if anyone can physically access and manipulate it. The physical security of information systems and data is essential.

9.- Network Security
Information is rarely isolated on a machine without connection to any network. Taking security measures to protect communication networks is an essential step to secure information.

10.- Security in Web Systems

Every day more and more data is in systems connected to the Web that can be accessed from anywhere on the planet. There are many aspects of security that must be taken into account in the implementation of such systems to prevent unwanted access.

11.- The human factor
Throughout this topic, social engineering and different ways of protecting people's information will be studied, since they are often the weakest link in the information protection chain.

12.- Malware What is malicious code (malware)? How can it be detected and avoided? This topic will look at the main ways to protect yourself from malware and its effects. To do this, we will study what types of malware exist, the characteristics of each of them and their effects on information systems.

13.- Legislation
In the field of computer security it is essential to know the current legislation in this area. This topic will analyze the most important laws that are in force and their effects on information systems.

14.- Computer forensics
In this topic, the procedures for the autopsy of a computer equipment will be studied.

15.- Talks (To be defined)
Talks about Bitcoin, Pentest, etc. by industry experts

TEACHING METHODS

The master classes (M) will be used mainly for the presentation of the theoretical concepts associated with computer security and the resolution of doubts raised by the students. However, in some master classes and in some computer practices (PO) these concepts will be reinforced through the resolution of exercises, either individually or in small groups. It is recommended to use the laptop in class, especially with a GNU/Linux operating system.

PO classes that are not used for the resolution of exercises, will be used to apply the active methodology of Problem-Based Learning. From time to time students will be provided with a series of exercises that they can work on individually or in groups.

In case of confinement, classes and tutorials will be carried out telematically. The evaluation system will continue to adapt the tests for online performance.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	45				15				
Horas de Actividad No Presencial del Alumno/a	67,5				22,5				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Multiple choice test 30%
- Exercises, cases or problem sets 30%
- Teamwork assignments (problem solving, Project design) 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the ordinary call, by default, the students are covered by the continuous evaluation system, although there is the option of taking advantage of the final evaluation indicating it by email. In the continuous evaluation system, the evaluation will be divided into three parts, each of them with a theoretical and a practical exam, whose grades will average. Each exam will deal with the subject seen in class and the laboratory reports made up to that date and since the previous exam.

In addition, throughout the semester a series of assignments will be carried out that will influence the final grade of the subject to different extents. In the final evaluation system there will be a single theoretical and a practical exam that will correspond to the entire syllabus of the subject. The final grade of the subject will be calculated using the arithmetic average of both exams.

ASSIGNMENT EVALUATION:

The detection of plagiarism anywhere in a work will mean a score of 0 in that work. The works must be written correctly, so at the very moment a third serious spelling mistake is detected, the work will no longer be corrected and its mark will be the one corresponding to the part of it that has been evaluated.

COPY CASES:
If a copy is detected between jobs from two different groups, both jobs will be evaluated with 0. In the case of exams, article 46.2 of the current regulations regarding the evaluation of students will apply.

WAIVER OF THE CALL:
To renounce the call and appear as "Not Presented" in the continuous evaluation mode, you must request it by email within the established deadlines. In the final assessment mode, it is enough not to sit for the final exam.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Students who do not pass the subject in their ordinary call will have to take a theoretical exam and a practical one in the extraordinary call on the complete syllabus of the subject. Students who have followed the continuous evaluation system will have the possibility to indicate in the exam itself if they want the final grade of the subject to be calculated using only the grades of the exams or if they want the grade of the work carried out throughout the semester to be taken into account.

WAIVER OF THE CALL: In case of not taking the theoretical or practical exam, an assessment of "Not Presented" will be obtained.

MANDATORY MATERIALS

Class notes, support material for teaching in the classroom and laboratories.

BIBLIOGRAFÍA

Basic bibliography

Enciclopedia de la Seguridad Informática, Álvaro Gómez Vieites, RAMA 2006

Detailed bibliography

The governance of privacy. C.J. Bennett y C.D. Raab, Massachussets Institute of Technology Press 2006
Beyond Fear. B. Schneier, Beyond Fear: Thinking Sensibly About Security in an Uncertain World; 2006; Springer
Vigilancia permanente. Edward Snowden. Planeta, 2019
Social Engineering: The Science of Human Hacking. Christopher Hadnagy, Wiley 2018
El pequeño libro rojo del activista en la red. Marta Peirano, Roca 2015
Grokking Bitcoin. Kalle Rosenbaum, Manning 2019

Journals

Auditoría + Seguridad informática
IEEE Security & Privacy

Web sites of interest

Blog de Bruce Schneier sobre seguridad (Accessed 12/05/2022)
https://www.schneier.com/

Agencia Española de Protección de Datos (Accessed 12/05/2022)
http://www.agpd.es

Red temática de criptografía y seguridad de la información (Accessed 12/05/2022)
http://www.criptored.upm.es

Equipo de seguridad de rediris (Accessed 12/05/2022)
http://www.rediris.es/cert/

Instituto nacional de ciberseguridad (Accessed 12/05/2022)
https://www.incibe.es/

Blog sobre seguridad (Accessed 12/05/2022)
https://krebsonsecurity.com

Malware scanner (Accessed 12/05/2022)
https://www.virustotal.com

OBSERVATIONS

If a work is rated with a 0 due to plagiarism, the subject will be suspended in its ordinary call.

COURSE GUIDE 2022/23

Faculty 363 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GMECAN30 - Bachelor`s Degree in Mechanical Engineering **Year** Third year

COURSE

26621 - Industrial Structures and Buildings **Credits, ECTS:** 9

COURSE DESCRIPTION

Industrial Structures and Constructions is a specific subject of Mechanical Engineering. The studies will allow students to design, calculate and define structures (estimation of the loads to be applied, calculation schemes and dimensioning of elements), the essential basis for the realization of professional projects of industrial constructions.

To address this subject without excessive difficulty, it is essential to follow the sequence of subjects expected in the course of studies and therefore, it is considered essential:

- Having passed the subject of Applied Mechanics.

- Having attended the subject of Elasticity and Resistance of Materials (third year, first semester), mastering concepts related to hyperstaticity, static equilibrium, tensions and deformations, section forces and moments (bending, shear, axial and torsion), sizing and checking of sections and obtaining axial, shear and moment diagrams.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Competences in Specific Technology, Mechanical Module:

Knowledge and capacity for the calculation and design of industrial structures and constructions.

Learning outcomes/results:

- Know, understand and apply the theoretical and technological concepts required to identify and establish structural systems and provide the student with the necessary training to meet the performance requirements set out in applicable standards and the functional requirements.

- Apply appropriate scientific methodology: analyze the qualitative problematic situation and quantitatively propose hypotheses and solutions to solve structural problems of varying complexity.

- Effectively communicate the knowledge, procedures, results, skills and aspects related to structural design, using specific vocabulary and terminology, and appropriate means.

- Work effectively in multidisciplinary and multilingual environments, integrating skills and knowledge to make decisions related to the design and management of structural projects in the industrial field.

- Develop designs and projects in the field of industrial constructions in accordance with the corresponding construction technology and making use of available techniques and tools to solve structural problems

- Know, understand and apply the legislation, specifications, regulations and mandatory standards in the field of industrial constructions.

CONTENIDOS TEÓRICO-PRÁCTICOS

The following topics will be discussed:

1: Introduction to structural design.

Structural concept. Materials. Structural safety. Limit states. Static determination and indetermination of structures.

2: Articulated knot structures.

Statically determined flat trusses. Classification. Determination of forces. Sizing of bars. Instability.

3: Structures of rigid knots.

Analysis of rigid knot structures. Rigidity, distribution and transmission of moments. Relationships between deformations and forces.

4: Loads on buildings.

Applicable regulation CTE-SE-AE. Load hypothesis. Security coefficients. Combinations of loads.

5: Characterization of industrial buildings.

Basic schemes to calculate industrial buildings. CTE-SE-A, CTE-SE-SE. Typologies of industrial buildings. Trusses and beams.
Porticos of rigid knots. Sizing of structural elements. Roofing materials. Purlins. Pillars or columns. Calculation of bracing elements. Windproof beams.

6: Introduction to reinforced concrete.

Normative. Cement. Types of cement. Water. Aggregates. Additives. Reinforcements. Properties of fresh concrete. Properties of hardened concrete. Durability. Categorization of concretes. Adherence. Layout of reinforcements.

7: Bases of calculation of reinforced concrete sections.

Ultimate limit states. Service Limit States. Characteristic values and calculation values. Security Coefficients. Geometrical and mechanical characteristics of sections.

8: Sizing of reinforced concrete sections.

Simplified calculation diagrams. Deformation domains. Dimensioning of rectangular sections with simple and compound bending. Reinforced concrete supports. Simple compression. Minimum eccentricity. Buckling. Transverse reinforcement and shear force. Contribution of concrete. Sizing of reinforcements.

9: Matrix calculation of structures.

Rigidity method. Calculation basis. Displacements, forces and torques, and reactions. Loads applied on the bars.

TEACHING METHODS

The lectures will have explanations of the theoretical part of the subject, basic and essential for the realization of the practical parts.

In the seminar exercises, reports (team work), oral presentations and other tasks of practical application will be assigned, requiring the students to apply their knowledge to practical cases.

In computer practices problems will be solved using different software.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	60	15			15				
Horas de Actividad No Presencial del Alumno/a	60	40			35				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 50%
- Exercises, cases or problem sets 20%
- Individual assignments 5%
- Teamwork assignments (problem solving, Project design) 25%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The percentage of the final grade corresponding to each of the evaluation systems used in the subject is the following:

- 50% Various assignments developed throughout the semester (reinforced concrete practices, problems, work of a truss, work-project...).

- 10% Partial examination of the theory of Reinforced Concrete.

- 40% Final written exam (theory and practical exercise).

In order to pass the subject, the obligation to exceed 40% of the maximum possible score in all the following partial notes:

- in the written final exam (a minimum of 4 out of 10 being required for both the theoretical part and the practical exercise)

- in the exercises corresponding to the calculation of a truss

- in the partial examination of reinforced concrete theory

- in the work-project carried out in a group

- in the practical exercises of reinforced concrete

The student will be qualified in the ordinary call if he/she attends the final test. Therefore, in order to renounce evaluation, it is sufficient not to attend this final test.

In accordance with article 8 of the regulations governing the evaluation of students in official degree programs, evaluation systems, students who request the final evaluation of the subject, in addition to the final written exam, must deliver and defend, on the date that is established, the reports corresponding to the calculation of a truss and the work-project of an industrial structure, as well as complete the examination of the theory and the practical exercise for the sizing of sections of reinforced concrete.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary call will be qualified only students who attend the final written exam.

In accordance with article 9 of the Regulations governing the Evaluation in the Extraordinary Call, students who have not delivered the different tasks developed during the semester must prove attainment of knowledge and competences inherent to the subject through a written final exam, in addition to a specific test, which may include an oral exam and the completion of exercises with the calculation software used in the subject. The evaluation of the competences and learning results developed in the reports corresponding to the calculation of a truss and the work-project will be exigible. For this reason, the delivery of these documents will be allowed up to the date of the final examination, unless other planning is established and communicated through eGela, before the review of the ordinary call. Students who have not participated in the continuous evaluation and do not wish to take advantage of this new delivery, must communicate before the date established for the extraordinary call their interest in being evaluated in it, in order to prepare the evaluation activities necessary to evaluate and measuring learning outcomes in a comparable way, in accordance with the provisions of the aforementioned article 9.

MANDATORY MATERIALS

Standards:
- CTE-DB-SE
- CTE-DB-SE-AE
- CTE-DB-SE-A
- EHE

Software:
- Prontuario Informático del Hormigón estructural EHE-08 (Computing Compendium of Structural Concrete EHE-08)
- CESPLA

BIBLIOGRAFÍA

Basic bibliography

THEORY OF STRUCTURES:

- Cálculo matricial de estructuras (Matrix calculation of structures), Manuel Vázquez, Col. ITOP Madrid, 1992

- Teoría de Estructuras (Theory of Structures), Vol. 3 Pedro José Landa, José Luis Ramírez, Eduardo Rojí, ETSII Bilbao, 1995

LOADS:

- Acciones en la edificación (Loads on buildings), Francisco Fiol Femenia, Francisco Fiol Oliván, 2008

STEEL STRUCTURES:

- Estructuras de acero II. Uniones y sistemas estructurales (Steel structures II. Joints and structural systems), Ramón Argüelles Álvarez, Bellisco, 2007

- Estructuras de acero I. Fundamento y cálculo según CTE, EAE y EC3 (Steel structures I. Basis and calculation according to CTE, EAE and EC3), Ramón Argüelles Alvarez, Bellisco, 2013

- Naves industriales con acero (Industrial buildings with steel), Alfredo Arnedo Peña, APTA, 2009

REINFORCED CONCRETE STRUCTURES:

- Jiménez Montoya: Hormigón armado (Reinforced concrete), Álvaro García Meseguer, Francisco Morán Cabré, Juan Carlos Arroyo Porter, Gustavo Gili, 2010

STANDARDS

- CTE-DB-SE-AE: SEGURIDAD ESTRUCTURAL: BASES DE CÁLCULO Y ACCIONES EN LA EDIFICACIÓN (STRUCTURAL SECURITY: BASIS OF CALCULATION AND LOADS IN BUILDINGS)

- CTE-DB-SE-A: SEGURIDAD ESTRUCTURAL: ACERO (STRUCTURAL SAFETY: STEEL)

- EHE-08: INSTRUCCIÓN DE HORMIGÓN ESTRUCTURAL (STRUCTURAL CONCRETE STANDARD)

- UNE 76-201-88. CONSTRUCCIONES METÁLICAS. CAMINOS DE RODADURA DE PUENTES GRÚA (METALLIC CONSTRUCTIONS. RAILS OF BRIDGE CRANES)

Detailed bibliography

THEORY OF STRUCTURES:
- Teoría de las estructuras (Theory of structures), Jesús Zurita Gabasa, Univ. Pública Navarra, 2007
- Curso de análisis estructural (Course of structural analysis), Juan Tomás Celigüeta, EUNSA, 2003
- Structural Analysis, R.C. Hibbeler, Prentice Hall, 2006

STEEL STRUCTURES:
- Construcción y arquitectura industrial. Colección de problemas resueltos (Construction and industrial architecture. Resolution of typical problems), José Miguel Montalvá Subirats, Héctor Saura Arnau, U. Politécnica Valencia, 2012
- Estructuras metálicas para edificación Tomos I – II (Metal structured systems for building Volumes I – II), José Monfort LLeonart, U. Politécnica Valencia, 2002
- Edificación agroindustrial: estructuras metálicas (Agroindustrial building: metallic structures), Miguel Ángel Garcimartín, Mundi-Prensa, 1999

REINFORCED CONCRETE STRUCTURES:
- Proyecto y cálculo de estructuras de hormigón: en masa, armado y pretensado (Design and calculation of concrete structures: mass concrete, reinforced concrete and prestressed concrete), José Calavera, INTEMAC, 2008

STANDARDS
- EAE: INSTRUCCIÓN DE ACERO ESTRUCTURAL (STRUCTURAL STEEL STANDARD)
- EUROCODIGO 1: ACCIONES EN ESTRUCTURAS (LOADS IN STRUCTURES)

Journals

Web sites of interest

www.constructalia.com
www.apta.com.es
www.ascem.org
http://people.fsv.cvut.cz/~wald/CESTRUCO/_aa_Textbook.htm

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty	363 - Faculty of Engineering - Bilbao	**Cycle**	Not Applicable
Degree	GMECAN30 - Bachelor`s Degree in Mechanical Engineering	**Year**	Second year

COURSE

27682 - Applied Mechanics | **Credits, ECTS:** 9

COURSE DESCRIPTION

The main objective of this subject is the study of statics, kinematics and dynamics of rigid bodies, essential background for subjects related to the theory of machines and mechanisms, elasticity and resistance of materials. This subject is based on fundamental principles of physics and mathematics, and will enlarge the practical vision of the students, providing them with the resources needed to analyse different mechanical problems.

Moreover, in this subject the students will get an opportunity to realize how useful the knowledge they already have is, and the application it has in the engineering field. The concepts developed in this subject will be based on vector calculus and matrix algebra, and these will be used on mechanical systems.

The skills developed in this subject are the base of other third year subjects of the Mechanical Engineering Bachelor's Degree: Elasticity and Resistance of Materials, Kinematics and Dynamics of Machines, Design of Machines, Structures and Industrial Constructions and Mechanical Technology. These skills are also the base of Mechanical Engineering that any engineer of the branch of Industrial Engineering (Bachelor's Degree in Electricity and Bachelor's Degree in Industrial Electronics and Automation included) should master.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

* Specific skills:

- Get to know, understand, and apply the concepts and basic principles of resistance of materials and of mechanisms and machines. These concepts and principles will be essential in the study of advanced methods and theories of mechanical engineering.

- Apply the strategies of the scientific methodology: analyse any problematic situation in a qualitative and quantitative way and set up a hypothesis and solution by applying the methods used in applied mechanics.

- Express correctly the theoretical knowledge, solution methods, and the results obtained for problems dealing with the equilibrium and movement analysis of mechanical systems, using the specific terminology and vocabulary.

* Transversal skills:

- Ability to work efficiently in team, proposing and debating different ideas and taking decisions along with the other team members.

- Have a responsible attitude, be organized in the work and willingness for the learning process.

* Learning results:
After studying this subject, the students must have acquired the following abilities related to the mechanical analysis and calculus:

- To model a mechanical system composed of rigid elements and simple mechanical elements.

- To evaluate how the different loads are transmitted to the supports in simple isostatic structures.

- To analyse the kinematics of simple mechanical systems, obtaining the velocities and accelerations of points and elements, expressed in fixed and mobile reference systems.

- To obtain the gravity centres and inertia properties of rigid bodies and planar surfaces.

- To analyse the dynamics of simple planar and spatial mechanical systems.

- To evaluate the variation of internal forces in simple beams under point or distributed forces.

- To evaluate the stress in simple elements.

- To transmit all the previous results in a clear and comprehensive way to a specialized audience.

CONTENIDOS TEÓRICO-PRÁCTICOS

- Lesson 1: Force systems
Basic knowledge of calculus with vectors. Definitions and properties of the momentum generated by a force acting about an axis and a point. Concept and properties of a pair of forces. Equivalence and reduction of force systems.

- Lesson 2: Centroids
Concept and properties of gravity centre and static moment. Centroids of elemental figures. Theorems of Pappus-Guldin.

- Lesson 3: Static equilibrium
Study of structural systems, fundamental axiom of the static equilibrium of a rigid body. Concepts of links and mechanical action. Calculus of the forces and reactions that appear in the different elements of a mechanical system. Analysis of isostatic structures and methods solve lattices.

- Lesson 4: Friction
Study of the simplified hypothesis of Coulomb to analyse the friction in a sliding movement, friction coefficient and friction angle. Industrial applications of the friction.

- Lesson 5: Funicular bodies
Equilibrium study of funicular bodies, cables working under the effect of point and distributed forces. Study of catenaries.

- Lesson 6: Kinematics of the rigid body
Velocity and acceleration concepts applied to a particle. Analysis of the simple movements of translation and rotation of a solid body. Meaning of the angular velocity vector and angular acceleration vector. Law of vector derivatives in mobile frames. Velocity and acceleration fields. Study of the relative movement of a point and a body with respect a mobile system.

- Lesson 7: Kinematics of planar movement
Particularities of planar motions. Concepts of instant centre of rotation and how its position changes in time. Concepts of moving centrode and fixed centrode. Geometry of the planar movement, graphical calculus of velocities. Study of accelerations in a pure rolling movement. Instantaneous acceleration centre.

- Lesson 8: Inertia propierties of solid bodies
Inertia moments with respect to axis, planes and points. Inertia products. Steiner theorems. Inertia tensor and the main inertia direction of a body.

- Lesson 9: Dynamics of the rigid body
Elemental magnitudes in dynamics, quantity of movement, kinematic moment and kinematic energy. Fundamental theorems in dynamics. Expressions of the kinematic moment and the kinematic energy in solid bodies. Concept of inertia force and gyroscopic momentum. Application of D'Alembert principle in the dynamic analysis of mechanisms. Energetic theorems.

- Lesson 10: Dynamics of bodies with a fixed axis
Study of bodies with a rotation movement about a fixed axis. Calculus of the reaction forces in the links. Equilibrium of rotors.

- Lesson 11: Dynamics of planar movement
Study of the magnitudes and equations of dynamics for a planar case. Analysis of the different possible cases and how to solve them. Application to mechanical systems that are part of machines and mechanisms.

- Lesson 12: Inertia momentums of a surface
Description of the moments and products of inertia for planar surfaces. Main moments of inertia and main directions of inertia, obtained by applying the circle of Mohr.

- Lesson 13: Internal forces
Concept of internal force in a section of a body. Axial force, shear force and bending moment. Representation of the corresponding diagrams.

- Lesson 14: Normal tensions
Concept of normal tension and unitary deformation in the axis of a body. Relation between the tension and the deformation, Hooke law. Relation between the tensions and the internal forces in a section.

TEACHING METHODS

The main theory lectures will be complemented with exercises solving lectures and computer practise.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	60	30							
Horas de Actividad No Presencial del Alumno/a	75	60							

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 80%
- Teamwork assignments (problem solving, Project design) 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Tasks: 20% of the final mark:

During the scholar year, students will be asked to develop different tasks (10 approximately).

Written exam: 80% of the final mark:

* Exams period in the first semester:
- First partial exam: from lesson 1 to lesson 7. To pass the exam, students must earn a minimum mark of 5/10. Students who pass the exam will not be tested again on this material in the second partial exam.

* Exams period in the second semester. There are two possible cases:
- Second partial: from lesson 8 to lesson 14. To be eligible for this option, students must have passed the first partial. The final mark of the subject will be the GEOMETRIC mean of the marks obtained in the two partials.
- Final exam: all syllabus. Students who did not pass or appear for the first partial must take this exam.

Additional information:

- Students who apply to the final evaluation will be evaluated with a single exam, the results of which will constitute the 100% of the final mark of the subject. Students who want to be evaluated with the final evaluation system must apply for it within the deadline established in the Norma reguladora de Evaluación del alumnado en las titulaciones de Grado de la UPV/EHU before the 4th week of the second semester.

- In all exams, partial and final, the theory part will account for 40% of the mark of the exam, and the exercises will account for 60%.

- Students who do not attend the second partial or the final exam will get a final mark of No presentado (did not attend).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

- Students who have not passed the ordinary evaluation will get the chance of writing a final exam of the whole subject.

- By default, the marks of the tasks will be also taken into account in this evaluation (20% of the final mark), so the mark obtained in final exam will be the 80% of the total mark in the subject.

- If in any case the mark obtained in the final exam is higher than the one obtained after considering the tasks, the final mark in the subject will be the higher mark.

- The evaluation for students who do not attend the exam will be "Not presented".

MANDATORY MATERIALS

Lectures book: Mecánica Aplicada -Erik Macho- 2021 Edition

Software GIM: http://www.ehu.eus/compmech/software/

BIBLIOGRAFÍA

Basic bibliography

- F.P. Beer, E.R. Johnston Jr., et al., Vector Mechanics for Engineers, New York: McGraw-Hill, ISBN 0-07-293110-8.

- F.P. Beer, E.R. Johnston Jr., et al., Mechanics for Engineers: Statics and Dynamics, New York: McGraw-Hill, ISBN 0-07-004584-4.

- Rao, A. V., Dynamics of Particles and Rigid Bodies: A Systematic Approach, Cambridge University Press, 2006

Detailed bibliography

Ingeniería mecánica, Estática. Hibbeler. Prentice Hall
Ingeniería mecánica, Dinámica. Hibbeler. Prentice Hall

Estática, Mecánica para ingeniería. Bedford, Fowler. Addison Wesley
Dinámica, Mecánica para ingeniería. Bedford, Fowler. Addison Wesley

Mecánica para ingenieros: Estática y Dinámica. López, Vázquez. Noela

Mecánica de materiales. Gere, Timoshenko, Stephen. Grupo Editorial Iberoamérica.
Mecánica de materiales. Beer, Johnston, Russell. Mc Graw-Hill
Mecánica de materiales. Hibbeler. Prentice-Hall
Mecánica de materiales. Popov. Limusa

Journals

Web sites of interest

OBSERVATIONS

In case of a State of Emergency or similar situation when in-person activities are not allowed, classes, evaluations and any other activity will be carried out online. Students will be informed throw official channels (eGela and university official e-mail).

COURSE GUIDE 2022/23

Faculty 363 - Faculty of Engineering - Bilbao
Cycle Not Applicable

Degree GMECAN30 - Bachelor`s Degree in Mechanical Engineering
Year Fourth year

COURSE

27684 - Project Management
Credits, ECTS: 6

COURSE DESCRIPTION

The subject "Project Management" has been changing its name along with the successive changes of study programmes; it has been called "Technique Office and Projects", "Technique Office" only and "Projects" only. However, it has maintained its fundamental educational objective: to develop the capacity to the student to elaborate technique projects and all the functions related to them. In fact, it is directly focused on the elaboration of his "Grade Final Work"; after its successful presentation, it is when he will be able to fully execute his profession, with the corresponding professional attributes for his speciality, legally regulated.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Methodology, organisation and project management.

CONTENIDOS TEÓRICO-PRÁCTICOS

THE ENGINEERING Competences and environment of industrial engineering
GENERAL THEORY OF THE PROJECT General theory of the Project and its application in engineering projects
ENGINEERING PROJECTS AND NORMALISED DOCUMENTATION Generation of engineering projects and reports. The Technique Office and the development of Normalised Documentation.
PROJECT MANAGEMENT Engineering project management. Basic knowledge and its application in computer systems. The quality in Project Management.

TEACHING METHODS

Both in lecture-based and computer-based teaching theoretic-practical activities could be made if necessary.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15				45				
Horas de Actividad No Presencial del Alumno/a	22				68				

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 30%
- Exercises, cases or problem sets 30%
- Teamwork assignments (problem solving, Project design) 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Continuous evaluation of the student work and the competences worked (individual and in group, in-person and non in-person) by weighting the following aspects or tasks:
1. EXAMS (30%)
2. GUIDED ACTIVITIES: Technique project or draft: 40%, indispensable achieving evaluation criteria to weight the qualification.
3. DELIVERABLES (questions, problems, works, presentations ...) (30%)
Laboratory-based exercises and the proposed deliverables, related with the contents and competences of the subject, are compulsory and subjected to continuous evaluation. In order to be qualified, it is necessary to present the proposed works in the form and dates proposed by the lecturer responsible of the subject. So as to not distort the principles of the continuous evaluation and competence-based teaching, those students that have not presented laboratory-based exercises and deliverables on time, will not have the possibility of presenting them later.
In the continuous evaluation, those students that are not presented to the final exam will be considered as NOT PRESENTED; otherwise, they will be considered PRESENTED.
ORDINARY CALL AND EXCEPTIONAL CASES (art. 43 of the current normative)
Those students that are presented to the ordinary call (and the exceptional cases) will have a unique final exam. This could include parts related to laboratory-based exercises and deliverables done during the course or others similar to those, since they form part of the contents developed in the normal development of the subject.

In the event that health conditions prevent the completion of a teaching activity and/or face-to-face assessment, a non-

face-to-face modality will be activated, of which students will be promptly informed.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Those students that are presented to the ordinary call (and the exceptional cases) will have a unique final exam. This could include parts related to laboratory-based exercises and deliverables done during the course or others similar to those, since they form part of the contents developed in the normal development of the subject.

In the event that health conditions prevent the completion of a teaching activity and/or face-to-face assessment, a non-face-to-face modality will be activated, of which students will be promptly informed.

MANDATORY MATERIALS

eGela platform of UPV/EHU.

BIBLIOGRAFÍA

Basic bibliography

PMI. "A guide to the Project Management Body of Knowledge (PMBoK) 6th edition", 2017.
Alonso Girón J.M. La Oficina Técnica. Los Autores Bilbao 2000.
Santos Pera J.A. Pérez Manso A. Ingeniaritza-Proiektuak: Proiektuaren Teoria Orokorra dokumentazio Arautua eta Kudeaketa - Artekopi S.L. Bilbao 2008
Cos del Castillo Teoría General del Proyecto. ED Síntesis. Madrid 1997
Gómez García J.F. Gestión de Proyectos. Ed FC Madrid 2000
PMI Standard Commitee. Fundamentos de la Dirección de proyectos. AEIPRO. Madrid 2001

Detailed bibliography

Wiest J.D. Técnicas CPM y PERT ed. Paraninfo. Madrid 1972
Romero López C. Programación y control de Proyectos. Ed. Pirámide. Madrid 1983.
Morilla Abad I. Guía Metodológica y Práctica de la Realización de Proyectos. C.I.C.C y Puertos. Madrid 1986
Companys P. Organización de la Producción. Diseño de Sistemas Productivos. Ed. UPC Barcelona 1991
Díaz Martín A. El Arte de Dirigir Proyectos. ED. Samper S.A. Bilbao 1995
Jordán Reyes M. Organización Planificación y Control. UNED Madrid 1991
Santos Sabrás F. Ingeniería de Proyectos. Eunsa. Pamplona. 1999.
Sevilla López J.M. Manual Para la Redacción de Proyectos en la Administración Pública. CIE Dossat 2000. Madrid 2000.
UNE 157001-2002
Código Técnico de la edificación CTE Mayo 2006
Ley de Contratos de las Administraciones Públicas¿. (BOE 129, 95/5/19)

Journals

International Journal of Project Management.
IPMA - Newsletters
Técnica Industrial.
Dyna - Ingeniería e Industria.
IMHE
Electronic Designs
Ingeniería Química
Era Solar

Web sites of interest

http://www.aeipro.com/
http://www.ipma.ch/Pages/default.aspx
http://www.4pm.com/
http://www.pmi.org/Pages/default.aspx
http://www.elsevier.nl/locate/inca/30435

OBSERVATIONS

This guide collects basic guidelines of common application to all the faculty of the subject. Later, each docent could provide to his students a "group subject guide" with more detailed information.

COURSE GUIDE 2022/23

Faculty	363 - Faculty of Engineering - Bilbao	**Cycle**	Not Applicable
Degree	GIIGSI30 - Bachelor's Degree in Computer Engineering in Management and In	**Year**	Second year

COURSE

27700 - Structures of Data and Algorithms | **Credits, ECTS:** 6

COURSE DESCRIPTION

This subject will allow students to acquire the skills to develop software projects of medium complexity, emphasizing aspects such as modularity, data structures and measurement of the efficiency of algorithms.

In addition, recursion-based programming techniques will be introduced, along with advanced data structures, including lists, queues, stacks, trees, hash tables, and graphs.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Competencies:

- M02CM01. Ability to design, develop, select and evaluate computer applications and systems, ensuring their reliability, security and quality, in accordance with ethical principles and current legislation and regulations.

- M02CM06. Knowledge and application of the basic algorithmic procedures of computer technologies to design solutions to problems, analyzing the suitability and complexity of the proposed algorithms.

- M02CM07. Knowledge, design and efficient use of the most appropriate data types and structures to solve a problem

- M02CM08. Ability to analyze, design, build and maintain applications in a robust, safe and efficient way, choosing the most appropriate paradigm and programming languages.

CONTENIDOS TEÓRICO-PRÁCTICOS

Topic 1. Analysis of algorithms. The cost function. Function orders. Analysis of sorting and search algorithms. Practical exercises.

Topic 2. Recursive design of algorithms. Recursive design methodology. Implementation of recursive programs. Practical examples and exercises.

Topic 3. Abstract data types. Linear data structures: Lists, Stacks and Queues. Examples of applications with these structures. Efficiency analysis.

Topic 4. Hash tables. Hashing function. Efficiency analysis of hash tables. Open and closed hashing.

Topic 5. Trees. Binary Trees. Binary search trees. Analysis of the efficiency of algorithms on trees: search and traversals.

Topic 6. Graphs. Representation and algorithms of graph traversals.

Topic 7. Analysis, Design and Implementation of solutions for the resolution of a problem.

TEACHING METHODS

The lectures (M) will be used for the exposition and discussion of the theoretical concepts that will later be applied in the practical work. Likewise, the concepts acquired will be reinforced by solving exercises, either individually or in small groups.

During the COMPUTER OR LABORATORY PRACTICES (GO) the practical work associated with the subject will be developed under the supervision of the teacher.
Group work will be required to solve problems or proposed projects.

Throughout the course a practice structured in four deliveries will be developed. It will be developed autonomously by the student, with the guidance of the teacher, and the result will be reflected in four software modules in operation and the documentation of the set of work carried out. The evaluation of this activity will have an impact of 40% in the evaluation process.

Within the lecture activities, written exercises will be considered both in the classroom and in the laboratory to complete the other 60% of the evaluation.

ONLINE CLASSES (EXCEPTIONAL SITUATIONS)
In cases where capacity limitations require it, a second classroom will be enabled at the same time to allow the development of the class to be followed (using streaming or similar techniques). In the event that the health situation

requires it, teaching will become online, for which the resources provided by the university will be used (eGela, videoconference, ...)

In the event that classes cannot be held in person, classes will be held online. As this is an alternative to an exceptional situation, all the tools and grading percentages that take place during this type of class, and are affected by the situation, will be adapted to the online world by the teacher(s) of the subject. These adaptations will be properly disseminated through eGela or other usual channels of communication with that teacher and with their students. The date/time of these classes will be the same as that marked by the center in its face-to-face calendar.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	45				15				
Horas de Actividad No Presencial del Alumno/a	67,5				22,5				

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Teamwork assignments (problem solving, Project design) 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The subject has two modes of evaluation: the final (or overall) evaluation and the continuous evaluation. Continuous assessment, to which students may voluntarily take part, is offered exclusively to students who can carry out continuous monitoring of the subject within the established framework of dedication and attendance at face-to-face activities, as indicated in article 43 of the current regulations regarding student assessment.

Pre-registration in the continuous evaluation mode will take place on the established dates. The pre-registration will become final after the confirmation of the request by the student on the dates established (by week 12 with 70% of the weight of the evaluation already taken) and after verification of the partial performance by the teaching staff.

The different activities of continuous evaluation with their corresponding weights will be the following:
- Group project with Deliverables (40%)
- Partial and final exams (60%)

Continuous assessment will require attendance at face-to-face classes, practical activities, assignments and exams. To pass the subject (final grade), the student must obtain at least 3 points in the overall of the different exams (partial and final), out of a total of 6 points.

In the event that the overall mark of the exams does not exceed 3 points (out of a total of 6), the mark of the practical works will not be included in the average, that is, the final mark will be calculated by weighting the mark of the exams over 10.

The FINAL evaluation for students who do not carry out the continuous evaluation consists of:
- Final Exam (100%)

The test will consist of a written exam that will cover 100% of the contents of the subject. To take this test, it is recommended that you have previously completed the practical work for the subject.

NO SHOW:
- When the student does not appear for the final written exam, they will obtain a "Not Presented" qualication regardless of their participation in the continuous evaluation.

COPY CASES:
Article 44 of the current regulations regarding the evaluation of students will be applied.

ONLINE EXAM (EXCEPTIONAL SITUATIONS)
In the event that the exam cannot be carried out in person, the exam will be carried out electronically. As this is an alternative to an exceptional situation, this type of exam will follow the structure, guidelines and specificities established by the teacher(s) of that subject, and which will be properly disseminated through eGela or other usual channels of communication with that teacher and with your students. The date/time of said exam will be, as always, the one marked by

the center in its official calendar.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The EXTRAORDINARY evaluation consists of:
- Final Exam (100%)

This will consist of a written exam that will cover 100% of the contents of the subject. To take this test, it is recommended that you have previously completed the practical work for the subject.

ONLINE EXAM (EXCEPTIONAL SITUATIONS)
In the event that the exam cannot be carried out in person, the exam will be carried out electronically. As this is an alternative to an exceptional situation, this type of exam will follow the structure, guidelines and specificities established by the teacher(s) of that subject, and which will be properly disseminated through eGela or other usual channels of communication with that teacher and with your students. The date/time of said exam will be, as always, the one marked by the center in its official calendar.

MANDATORY MATERIALS

- UPV/EHU Moodle.
- Course notes.
- Support programs, statements of work and document templates.

BIBLIOGRAFÍA

Basic bibliography

Book title: Algorithms, 4th Edition.
Autor: Robert Sedgewick and Kevin Wayne.
Editor: Pearson. (http://algs4.cs.princeton.edu/home/)

Book title: Java software Structures, Third Edition
Autor: LEWIS, JOHN; CHASE, JOSEPH
Editor: Pearson Educación, 2010

Book title: Competitive Programming 3
Autor: Halim, Steven; Halim, Felix
2013

Detailed bibliography

Título Libro: ESTRUCTURAS DE DATOS EN JAVA
Autor: M. Allen Weiss
Editor: Addison Wesley, 2001

Título Libro: Estructuras de datos y métodos algorítmicos. Ejercicios resueltos
Autor: N. Martí, Y. Ortega, J.A. Verdejo.
Editor: Pearson/Prentice Hall, 2003. ISBN 84-205-3849-3.

Journals

Web sites of interest

http://es.wikipedia.org/wiki/Estructura_de_datos

http://en.wikipedia.org/wiki/List_of_data_structures

http://java.sun.com

http://www.eclipse.org/

https://www.geeksforgeeks.org/competitive-programming-a-complete-guide/?ref=shm

Hash Code is a team programming competition, organized by Google, for students and professionals around the world. You pick your team and programming language and we pick an engineering problem for you to solve. This year’s contest kicks off with a Qualification Round, where your team can compete virtually from wherever you’d like, alongside your virtual Hub. Top teams will then be invited to compete from our virtual World Finals. https://codingcompetitions.withgoogle.com/hashcode/archive

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 363 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GIIGSI30 - Bachelor's Degree in Computer Engineering in Management and In **Year** Third year

COURSE

27706 - Administration of Databases **Credits, ECTS:** 6

COURSE DESCRIPTION

This module is a follow-up to the 2nd year "Databases" and 3rd year "Database Design" modules, where students have been presented with essential concepts about relational databases and the SQL language.

The main goal of Database Administration is to present a set of tools and techniques to manage users and data in modern databases. In order to take this module, students should have:
• Solid foundations of the SQL language.
• Knowledge about database design and the relational model.
• Skills to use the Unix/Linux shell.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

On completion of the module a student should be able to:
• Install and configure a Database Management System (SI1).
• Create user accounts and manage permissions (SI2, SI5).
• Deploy database logging systems (SI2, SI5).
• Understand and use backup and recovery techniques (SI2, SI5).
• Understand concurrency control mechanisms (SI3).
• Optimise SQL queries (SI3, SI5).
• Understand the challenges of distributed data management (SI1, SI3).

CONTENIDOS TEÓRICO-PRÁCTICOS

1 - INTRODUCTION
The main duties of a DataBase Administrator. A DBMS is installed and configured.
2 - SECURITY
Access control mechanisms and risks.
3 - LOG
Logging as a tool for audit.
4 - BACKUP
Backup policies and the recovery process.
5 - CONCURRENCY-CONTROL
Different concurrency-control protocols: lock-based and time-stamp based.
6 - OPTIMISATION
Optimization of SQL queries based on relational algebra.
7 - DISTRIBUTED DATA MANAGEMENT
Main features and challenges of distributed database systems.

TEACHING METHODS

Theory sessions (CLASES MAGISTRALES - M), where theoretical concepts and algorithms are described.

Exercise sessions (GRUPOS DE AULA - GA), where exercises related to the theory are presented and solved.

Practise sessions (GRUPOS DE ORDENADOR - GO), which happen in computer rooms. Practical use cases are presented, which have to be solved with computers.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30		15		15				
Horas de Actividad No Presencial del Alumno/a	45		22,5		22,5				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 75%
- Teamwork assignments (problem solving, Project design) 25%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The criteria established in the current regulations are applied for the choice of assessment system (continuous or final), and also for changes to the assessment system (from continuous to final or vice versa).

===Continuous assessment===

This will consist of 3 mid-course exams and 6 practical work sessions.

The assessment of the subject is divided into 3 parts. The weight of each of the 3 parts in the final grade of the subject is as follows:
- Part I represents 25% of the final grade
- Part II represents 40% of the final grade
- Part III represents 35% of the final grade

Each of the parts consists of a mid-course exam and 2 practical sessions. All the test will be marked out of 10 points.

The mid-course exams will be done during lecture hours and the dates will be announced at the start of the term.

The practical sessions will be done during the computer work groups and attendance at these is COMPULSORY. Teamwork will be done in all the practical sessions (usually teams of 2 people) and students will not be allowed to work individually. Assessment of the practical sessions will be done during the computer work groups and the grade PASSED/NOT PASSED will be communicated to the student immediately. An unjustified absence from a work group will be graded as NOT PASSED for the corresponding practical work session. The grade for the practical session will be individual and will be made public after it has been completed. The calendar of practical sessions and the corresponding work groups will be announced at the start of the term.

In each of the 3 parts of the subject, it is COMPULSORY to pass the practical sessions to take the mid-course exam. Otherwise, the grading for that part will be 0 points. The deadline for passing the practical sessions will be announced at the start of the term.

It is also COMPULSORY to exceed the minimum grade in all the mid-course exams (3.5/10) and in the weighted average (5/10) of these to pass the subject. If these minimum marks are not reached, the maximum grade for the subject will be 4 points.

The grade for each part of the subject will be calculated using the weighted average between the grade for the mid-course exam (75%) and that of the practical sessions (25%) if the minimum grade is reached in the mid-course exam. Otherwise, the grade will be 0 points.

===Final assessment===

This will be made through a final written exam and a final practical exam.

The final exams (written and practical) will be done on the day and time officially set by the school, first the final written exam and then the final practical exam. The grade for both exams will be between 0 and 10 points.

Optionally, the final practical exam can be validated by passing the practical laboratory sessions proposed in the modality of continuous assessment.

To pass the subject, the student must pass both final exams, and the final grade will be obtained by calculating the weighted average between the mark for the written exam (75%) and the practical exam (25%). Otherwise, the final grade final may not be higher than 4 points.

===Presentation vs. Withdrawal===

- The grade obtained will be "Presented" if the student takes the third mid-course exam (in continuous assessment) or any of the final exams (in final assessment).
- The grade obtained will be "Not Presented" if the student does not take either the third mid-course exam (in continuous assessment) or any of the final exams (in final assessment).

===Code of misconduct===

The criteria stated in Article 67 of the current regulations will apply.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The criteria established in the current regulations are applied for the choice of assessment system (continuous or final), and also for changes to the assessment system (from continuous to final or vice versa).

===Continuous assessment===

The assessment of the subject is divided into 3 parts (I, II and III). Each of the parts consists of a mid-course exam and 2 practical sessions. It is COMPULSORY to have passed all the practical sessions during the course. Otherwise, the grading of the corresponding mid-course exam will be 0 points. The weight of each of the 3 parts in the final grade of the subject is as follows:
- Part I represents 25% of the final grade
- Part II represents 40% of the final grade
- Part III represents 35% of the final grade

All the mid-course exams will be marked out of 10 points.

It is also COMPULSORY to exceed the minimum grade in all the mid-course exams (3.5/10) and in the weighted average (5/10) of these to pass the subject. If these minimum marks are not reached, the maximum grade for the subject will be 4 points.

The grade for each part of the subject will be calculated using the weighted average between the grade for the mid-course exam (75%) and that of the practical sessions (25%) if the minimum grade is reached in the mid-course exam. Otherwise, the grade will be 0 points.

===Final assessment===

This will be made through a final written exam and a final practical exam.

The final exams (written and practical) will be done on the day and time officially set by the school, first the final written exam and then the final practical exam. The grade for both exams will be between 0 and 10 points.

Optionally, the final practical exam can be validated by passing the practical laboratory sessions proposed in the modality of continuous assessment.

To pass the subject, the student must pass both final exams, and the final grade will be obtained by calculating the weighted average between the mark for the written exam (75%) and the practical exam (25%). Otherwise, the final grade final may not be higher than 4 points.

===Presentation vs. Withdrawal===

- The grade obtained will be "Presented" if the student takes the third mid-course exam (in continuous assessment) or any of the final exams (in final assessment).
- The grade obtained will be "Not Presented" if the student does not take either the third mid-course exam (in continuous assessment) or any of the final exams (in final assessment).

=== Code of misconduct ===

The criteria stated in Article 67 of the current regulations will apply.

MANDATORY MATERIALS

All the necessary material will be available at the university's eGela platform.

BIBLIOGRAFÍA

Basic bibliography

* Fundamentals of Database Systems (7th edition). R.A. Elmasri and S.B. Navathe. Addison-Wesley, 2015.
* Database Systems: A Practical Approach to Design, Implementation, and Management (5th edition). T. Connolly and C. Begg. Addison-Wesley, 2009.
* Database Systems: Design Implementation and Management (9th edition). P. Rob and C. Coronel. Cengage Learning, 2009.

Detailed bibliography

* Database system concepts (6th edition). A. Silberschatz, H.F. Korth and S. Sudarshan. McGraw-Hill, 2011.

* Database: Principles, Programming, and Performance (2nd edition). P. O'Neil and E. O'Neil. Elsevier Science, 2001.
* Principles of Distributed Database Systems (3rd edition). M.T. Ozsu and P Valduriez. Springer, 2011.
* Distributed Database Systems. D. Bell and J. Grimson. Addison-Wesley, 1992.
* Managing Distributed Databases. Building bridges between database islands. D.K. Burleson. J. Wiley & sons, 199.
* Database Administration. The Complete Guide to Practices and Procedures. C.S. Mullins. Addison-Wesley, 2002.
* Database Tuning. Principles, Experiments and Troubleshooting Techniques. D. Shasha and P. Bonnet. Morgan-Kaufmann, 2002.
* The Manga Guide to Databases. Mana Takahashi and Shoko Azuma, Trend-Pro Co. Ltd. No Starch Press, 2009.

Journals

Web sites of interest

* MySQL web page: http://www.mysql.com

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 363 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GIIGSI30 - Bachelor's Degree in Computer Engineering in Management and In **Year** Fourth year

COURSE

27709 - Systems Administration **Credits, ECTS:** 6

COURSE DESCRIPTION

This module is a follow-up to the content presented in the 2nd year "Introduction to Operating Systems" and 3rd year "Database Administration" modules, where students have used Linux-based systems at user level and conducted basic administration tasks.

The main goal of Systems Administration is to present a set of tools and techniques, both classic and modern, to manage users, files and software in Linux-based environments. In order to take this module, students should previously know:
• Basic Unix/Linux shell usage.
• Understanding of how TCP/IP computer networks work.
• Understanding of basic computer architecture.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

On completion of the module a student should be able to:
• Manage users and groups in Linux-based environments, both at local and network level.
• Set up services to manage users and files Linux-based computer networks.
• Deploy virtualisation and container technologies to manage software in Linux systems.
• Configure container orchestration technologies.
• Process and analyse logs from a Linux system.

CONTENIDOS TEÓRICO-PRÁCTICOS

This module is arranged in the following topics:

1. Local administration: User/file management and shell scripting in Unix/Linux systems.
2. Network services: Services to manage files and users in a Linux network.
3. Virtualisation and containers: Tools to manage and distribute software.
4. Container orchestration: Tools to manage the distributed execution of software containers.
5. Log analysis: Tools to ingest, analyse and visualise logs from a Linux system.

Topics 3 to 5 present modern tools to manage Linux systems and their content might change slightly or get updated over the course of the module.

TEACHING METHODS

Theory and practice sessions.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30				30				
Horas de Actividad No Presencial del Alumno/a	45				45				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 30%
- Individual assignments 30%
- Teamwork assignments (problem solving, Project design) 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Students who choose continuous assessment will get their grade based on three tasks:
• Individual exam, 30% of the final grade. Practical exam in which students will have to solve several exercises related to what is presented in topics 1 and 2.

• Individual assignment, 30% of the final grade. Development of an individual assignment composed of a set of exercises related to what is presented in topics 3 and 4.
• Group project, 40% of the final grade. Development of a project in a group of 2 or 3 students. Students can choose to use any tool/technique presented in the module.

For more information about this assessment method, get in touch with the teaching staff.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Students who choose final assessment will get their grade based on a single exam at the end of the module. This exam has a written part related to the theoretical aspects of the module (50% of the grade) and a practical part with exercises similar to those done in the practice sessions (50% of the grade).

For more information about this assessment method, get in touch with the teaching staff.

MANDATORY MATERIALS

All the necessary material will be available at the university's eGela platform.

BIBLIOGRAFÍA

Basic bibliography

- The Linux Philosophy for SysAdmins: And everyone who wants to be one. David Both. 2018. https://www.apress.com/us/book/9781484237298

Detailed bibliography

- Systems Performance: Enterprise and the Cloud, 2nd Edition. Brendan Gregg. 2021. http://www.brendangregg.com/systems-performance-2nd-edition-book.html
- The Kubernetes Book (Updated Feb 2020). Nigel Poulton. 2020. https://nigelpoulton.com/books

Journals

Web sites of interest

- docker.com
- kubernetes.io
- phoronix.com
- stackoverflow.com

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 363 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GIIGSI30 - Bachelor's Degree in Computer Engineering in Management and In **Year** Fourth year

COURSE

27710 - Professionals Aspects of Computer Science **Credits, ECTS:** 6

COURSE DESCRIPTION

The objective of this subject is to collaborate in the comprehensive training of the student with general professional skills, not strictly technical, that every engineer in any area should have for the correct exercise of their profession, thus facilitating professional incorporation in the area of Information Technology.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Reflect on professional ethics and deontology, as well as learn about related institutions and laws. Training for expertise and auditing in computer science. Training to work in development teams through the use of collaborative tools. Properly write technical reports. Successful presentations in public.

CONTENIDOS TEÓRICO-PRÁCTICOS

Introduction
Social Aspects: Social Impact of Computing
Ethical Aspects: Ethics and Professional Responsibility
Legal Aspects: Computer Law, Personal Data Protection, Software Protection, Intellectual Property, Electronic Commerce, Web, LSSI, Computer Crime
Professional Aspects: Computer Expertise, Computer Audits, Group Work, Collaborative Tools

TEACHING METHODS

In each subject the basic concepts will be explained and later the students will have to deepen in each case with exercises or works.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	45				15				
Horas de Actividad No Presencial del Alumno/a	67,5				22,5				

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Exercises, cases or problem sets 40%
- Teamwork assignments (problem solving, Project design) 60%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Students will have to pass a test with basic concepts of the subject. Once the test has been passed, the grade will be based on the work and exhibitions that the students will carry out in class.

Any student who does NOT take the basic concepts test will be graded as NOT PRESENTED.

Students who, in compliance with current regulations, and after the center's permission obtain a final test, will have to take the basic concepts test plus a written test with cases and theory related to the subject.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The student will have to take an exam that will account for 100% of the grade and will cover sections A, B, C and D, except those that were approved in the ordinary call.

MANDATORY MATERIALS

The material provided to students on the Moodle platform.

BIBLIOGRAFÍA

Basic bibliography

BARROSO, Porfirio. Etica Y Deontologia Informatica. Fragua, 2006
Carlos Barriuso Ruiz. Interacción Del Derecho Y La Informática. Dykinson, 1996
Ull Pont, Eugenio. Legislación Informática. Uned, 2003

Detailed bibliography

Vázquez Dodero Juan Carlos y Albert Domingo. Las nuevas tecnologías y los equipos humanos: el nuevo escenario. Harvard Deusto Business Review, 2001

Journals

Web sites of interest

http://www.agpd.es
http://www.pmi.org

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 363 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GIIGSI30 - Bachelor's Degree in Computer Engineering in Management and In **Year** Fourth year

COURSE

27711 - Data Mining **Credits, ECTS:** 6

COURSE DESCRIPTION

Good programming skills are required as well as basic statistics.

Related topics:
- computation
- statistics and operative research
- machine learning
- artificial intelligence
- business intelligence
- decision support systems

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

By the end of the course the student will be able to:
describe information extraction fundamentals and its potential scope on information systems.
apply data mining approaches to particular tasks related to knowledge discovery, business intelligence and decision support systems.

CONTENIDOS TEÓRICO-PRÁCTICOS

Introduction to Data Mining: Goal. Applications. Approaches: Classification, Association, Clustering. Data and data-sources. Pre-processing. Feature selection. Data imbalance.

Clustering: Signal compression. Approaches: k-means, hierarchical, agglomerative. Applications (e.g. homes, species, customer trends).

Predictive models: Inference algorithms: neural networks, bayesian networks, random forest, logistic regression etc. Evaluation metrics (e.g. confusion matrix, precision, recall, f-score, AUC). Ensemble models. Multi-class mono-label vs. multi-class multi-label prediction models. Real tasks and international research challenges. Applications: clinical diagnoses.

Association rules. Applications on customer segmentation and recommender systems. Inference algorithms. Assessment metrics.

TEACHING METHODS

The approach is mainly practical, the classes are taken in the lab. Programming labs are carried out and presented in groups. By the end of the course a research-style poster is presented covering a related article or a self-implemented application.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30				30				
Horas de Actividad No Presencial del Alumno/a	45				45				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 40%
- Exercises, cases or problem sets 60%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Assessment parts and weighting: over 10.0 pts

60% (~ 6.0 pts): Labs and works carried out throughout the course
40% (~ 4.0 pts): Exam

Two requirements must be satisfied:
1. Achieve, at least, 40% on both parts i.e. minimum 2.4 points at labs and 1.6 points at the exam.
2. Summing up both parts together, achieve, at least, 5.0 points out of 10.0.

In order to evaluate the labs: in the ordinary call continuous assessment is carried out. In the remaining calls (either extraordinary call or calls taken in advance) a lab-exam is taken in replacement of the continuous assessment.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Assessment parts and weighting: over 10.0 pts
60% (~ 6.0 pts): Labs and works carried out throughout the course
40% (~ 4.0 pts): Exam

Two requirements must be satisfied:
1. Achieve, at least, 40% on both parts i.e. minimum 2.4 points at labs and 1.6 points at the exam.
2. Summing up both parts together, achieve, at least, 5.0 points out of 10.0.

In order to evaluate the labs: in the ordinary call continuous assessment is carried out. In the remaining calls (either extraordinary call or calls taken in advance) a lab-exam is taken in replacement of the continuous assessment.

MANDATORY MATERIALS

eGela

BIBLIOGRAFÍA

Basic bibliography

Alpaydin, Ethem. Introduction to machine learning. MIT press, 2009.

Witten, Ian H., et al. Data Mining: Practical machine learning tools and techniques. Morgan Kaufmann, 2016.

Tom Mitchell. Machine Learning. McGraw Hill, 1997.

Murphy, K.P. (2012).Machine Learning: A Probabilistic Perspective. MIT Press.

Detailed bibliography

Bishop, C. (2006). Pattern Recognition and Machine Learning. Springer.

Duda, R. O., Hart, P. E., and Stork, D. G. (2000). Pattern Classification. Wiley-Interscience.

R. Baeza, Ribero: Modern Information Retrieval. acm press. 1999.

Kuncheva, L. (2004). Combining Pattern Classifiers. Wiley.

Journals

ACM Transactions on KDD
IEEE Transactions on Knowledge and Data Engineering
Data Mining and Knowledge Discovery (DMKD)
ACM SIGKDD Explorations
Data & Knowledge Engineering (DKE)

Web sites of interest

http://www.cs.waikato.ac.nz/ml/weka/
http://kaggle.com/
http://www.kdd.org/
http://www.kdnuggets.com/
http://www-stat.stanford.edu/%7Ejhf/ftp/dm-stat.pdf

OBSERVATIONS

ENGLISH FRIENDLY COURSE (EFC):
The lecturers are willing to tutor, conduct examinations and/or accept papers in English, although classes are given in Spanish. They are purposed for international students with a medium level of Spanish, but they manage better in English.

Siguiendo el Protocolo sobre ética académica y prevención de las prácticas deshonestas o fraudulentas en las pruebas de evaluación y en los trabajos académicos en la UPV/EHU (Protocolo ética y plagio), se informa que, con carácter general, y salvo que se indique lo contrario, durante el desarrollo de una prueba de evaluación quedará prohibida la utilización de libros, notas o apuntes, así como de aparatos o dispositivos telefónicos, electrónicos, informáticos, o de otro tipo, por parte del alumnado.

COURSE GUIDE 2022/23

Faculty 363 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GIIGSI30 - Bachelor's Degree in Computer Engineering in Management and In **Year** Fourth year

COURSE

27712 - Advanced Software Design **Credits, ECTS:** 6

COURSE DESCRIPTION

Most of the software design and development techniques seen in the first three years of the degree are applied to build desktop or web applications. In this module, students will learn to design and develop mobile applications, by translating the skills they already have into a new framework: the Android development environment.

In order to take this module, students should previously know:
• Object-oriented programming using Java or a similar programming language
• Relational database design and SQL
• Working in groups

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

On completion of the module a student should be able to:
• Understand the importance of design as a part of the software development process
• Understand and use third-party software libraries
• Acknowledge, understand and use software design patterns correctly as part of the software development process
• Understand and develop web-service oriented architectures
• Understand the fundamentals of mobile application development

CONTENIDOS TEÓRICO-PRÁCTICOS

This module is arranged in the following topics:

1. Fundamentals of Android
2. User interfaces: layouts and fragments
3. Notifications and dialogs
4. Local storage: files and databases
5. Services and broadcast messages
6. Background work with WorkManager
7. Third party libraries: RxJava and others
8. Google Play Services
9. Remote databases
10. Push notifications with Firebase
11. Cross platform frameworks

Due to the changing nature of the mobile-application development ecosystem, some of these topics might change slightly or get updated over the course of the module.

TEACHING METHODS

Theory and practice sessions.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30				30				
Horas de Actividad No Presencial del Alumno/a	45				45				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Individual assignments 60%
- Teamwork assignments (problem solving, Project design) 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Students can choose between two methods of assessment: continuous and final.

Students who choose continuous assessment will get their grade based on three tasks:
• Individual exam, 30% of the final grade. Practical exam in which students will have to solve several exercises related to what is presented in topics 1 and 2.
• Individual assignment, 30% of the final grade. Development of an individual assignment composed of a set of exercises related to what is presented in topics 3 and 4.
• Group project, 40% of the final grade. Development of a project in a group of 2 or 3 students. Students can choose to use any tool/technique presented in the module.

Students who choose final assessment will get their grade based on a single exam at the end of the module. This exam has a written part related to the theoretical aspects of the module (50% of the grade) and a practical part with exercises similar to those done in the practice sessions (50% of the grade).

For more information about the assessment method, get in touch with the teaching staff.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

For more information about the assessment method, get in touch with the teaching staff.

MANDATORY MATERIALS

All the necessary material will be available at the university's eGela platform.

BIBLIOGRAFÍA

Basic bibliography

Android Developer website: https://developer.android.com/

Detailed bibliography

Flutter: https://flutter.dev/
Unity: https://learn.unity.com/

Journals

Web sites of interest

Android Developer website: https://developer.android.com/
Flutter: https://flutter.dev/
Unity: https://learn.unity.com/

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 363 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GMECAN30 - Bachelor`s Degree in Mechanical Engineering **Year** Third year

COURSE

27723 - Mechanical Technology **Credits, ECTS:** 6

COURSE DESCRIPTION

The topic Mechanical Technology is focused on providing a deeper insight on the contents related to Manufacturing Technologies, that have been previously studied in the topic Manufacturing and Production Systems.
Therefore, the behaviour of tools and machines that take part in forming processes will be deeply analysed. Programming of machine-tools and Computer Aided manufacturing (CAM), non-conventional machining processes, and quality and cost control of manufactured products are also addressed inside the topic.
Thus, the main objective is to set the criteria for the design of a given manufacturing process, including process parameters, use of software tools, and optimum tool design and selection.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Specific:
1. To know, understand and be able to apply the concepts of the science and technology required for professional development of Mechanical Technology in industrial engineering, that are required to adapt to new situations.
2. To be able to communicate the knowledge, procedures, results, skills and aspects related to the manufacturing process in the field of industrial engineering, using the vocabulary, specific terminology and adequate means.
3. To be able to carry out studies, measurements, calculus, reports, and other analogue jobs related to the manufacturing process.
4. To be able to develop designs, projects, and processes in the field of industrial engineering related to Mechanical Technology.
5. To be able to successfully work in a multidisciplinary and multilingual environment, by integrating skills and knowledge that lead to the decision-making process relative to the manufacturing process within the field of industrial engineering.
Transversal:
1. To be able to analyse the manufacturing problem from a qualitative and quantitative point of view, to be able to place solutions for manufacturing by using the manufacturing and production methods and technologies in the field of industrial engineering.

CONTENIDOS TEÓRICO-PRÁCTICOS

Module I. Design of plastic deformation operations
1. Deformation behaviour of metal sheets
2. Design of sheet forming operations
3. CAE for metal sheet forming
4. Material behaviour during plastic deformation

Module II. Casting processes
5. Development of sand casting processes
6. Permanent mould casting
7. CAE for casting processes

Module III. Machining processes
8. Cutting tools
9. Turning
10. Milling
11. Grinding

Module IV. Metrology complements
12. Coordinate measuring machines
13. Metrology of surface finish

Module V. Other manufacturing processes
14. Additive manufacturing
15. Sintering

TEACHING METHODS

In THEORETICAL classes, fundamentals of the explained manufacturing processes will be addressed, together with other subjects related to the control and the development of these processes. The multiple relations between manufacturing

processes and other engineering disciplines will also be described. In these classes, the basis for the resolution of practical exercises and for the workshop practices that will be part of this subject.

During the workshop practices part of the knowledge acquired in the theory classes will be reinforced using software, instruments and/or machines for that purpose.

Workshop practices will be carried out in groups of at most 25 students, who will work in couples (or in groups of three if necessary) and in some of the practical sessions, the teacher will collect the result sheets filled by the students.

Due to the situation because of the presence of COVID-19 during 20/21 academic course and its probable extension to the 21/22 academic course, a non face-to-face methodology has been designed in order to carry out the practical classes. Taking into account that during these practical classes industrial machines and equipment are used, and in order to ensure the security distance, virtual sessions are proposed both to carry out the practice and to fill and send the students made reports. Anyway, the proposed methodology will be conditioned to the evolution of the actual crisis and to the current regulations.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30				24			6	
Horas de Actividad No Presencial del Alumno/a	60				21			9	

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Multiple choice test 80%
- Exercises, cases or problem sets 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The ordinary exam evaluation will be done attending to the following criteria:
- There will be two evaluation modes, continuous and final evaluation. By default, all students will be subject to continuous evaluation. If any student wants to do final evaluation, he/she will have to ask to the lecturer during the first 9 weeks of academic course, as the normative explains.
- ALL THE CONTENTS EXPLAINED IN THEORETICAL AND PRACTICE CLASSES ARE SUITABLE TO BE ASKED IN THE EXAM.
- If the student does not examine the subject in the ORDINARY call, he/she will obtain a "Not attended" regardless of his/her participation in the workshop or laboratory practices during the academic year.
- In the case of the sanitary conditions, do not allow a face-to-face teaching/evaluating activity, a virtual activity will be activated and the student will be informed promptly.

CONTINUOUS EVALUATION

The evaluation of the contents of the subject will be done by two written exams and the evaluation of the work done in practice classes.
- 1st Exam
  o Test type exam that will include the contents corresponding to modules I and II.
  o Its relative value in final mark will be 30%.
- 2nd Exam
  o Test type exam + practical written exercise that will include the contents corresponding to modules III, IV and V.
  o Its relative value in final mark will be 40%.
- Evaluation of practice classes:
  o To approve this part will be necessary to go and make all the practical classes.
  o The evaluation will consist of solving practical exercises similar to those solved in workshop or in classroom. The solved exercise will have to be uploaded to eGela platform.
  o The evaluation will be carried out after each group of practice classes (QF+QK, PS, CAM, CNC, MD)
  o Its relative value in final mark will be 30%.

TO APPROVE THE SUBJECT BY CONTINUOUS EVALUATION THE WEIGHT AVERAGE MARK MUST BE 5 OR

HIGHER AND THE MINIMAL MARK IN EACH TOPIC MUST BE AT LEAST 4.5.
THE PERSON WHO DO NOT APPROVE THE 1ST EXAM AND/OR PRACTICES AT THE 1ST ATTEMPT WILL HAVE THE POSSIBILITY OF MAKING AGAIN THE EXAM(S) TOGETHER WITH THE 2nd EXAM.

FINAL EVALUATION
- In the exam all the contents explained both in theoretical and in practical classes can be asked.
- To approve the subject:
  o The minimal mark in each part of the exam must be at least 4.5.
  o The weight average mark must be 5 or higher.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The extraordinary exam evaluation will be done attending to the following criteria:
- Only the final evaluation will be possible.
- In the exam all the contents explained both in theoretical and in practical classes can be asked.
- To approve the subject:
  o The minimal mark in each part of the exam must be at least 4.5.
  o The weight average mark must be 5 or higher.
- If the student does not examine the subject in the EXTRAORDINARY call, he will obtain a "Not attended" regardless of his participation in the workshop or laboratory practices during the academic year.
- In the case of the sanitary conditions, do not allow a face-to-face teaching/evaluating activity, a virtual activity will be activated and the student will be informed promptly.

MANDATORY MATERIALS

Notes and documentation provided by the subject's faculty.

BIBLIOGRAFÍA

Basic bibliography

• Fresado de Alta Velocidad. Proceso, Máquinas y Aplicaciones. L. Norberto López de Lacalle
• Manual de programación CNC Fagor 8070
• Manual de programación CNC Siemens 840D

Detailed bibliography

• Mecanizado de alto rendimiento. L.N. López de Lacalle y otros
• El Mecanizado Moderno. Sandvik
• Manual Práctico NX_CAD. Siemens
• Manual NX_CAM. Siemens
• Manual CAPPS 6.2
• DIN 66025.
• ISO 6983-1:1982

Journals

MHE.
• Fundipres.
• Moldpres.
• Surfaspress.
• Journal of Manufacturing Science and Engineering. ASME.

Web sites of interest

• http://www.ehu.es/manufacturing
• http://www.fagorautomation.com
• http://www.coromant.sandvik.com/es
• http://www.automation.siemens.com/doconweb
• http://www.plm.automation.siemens.com/es_es
• http://www.iso.org/iso/search.htm

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 363 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GMECAN30 - Bachelor`s Degree in Mechanical Engineering **Year** Third year

COURSE

27724 - Machine Design **Credits, ECTS:** 9

COURSE DESCRIPTION

The subject of Machine Design is a compulsory subject of the third year of the Mechanical Engineering Degree. Its purpose is to provide the concepts, procedures and decision analysis techniques required for the mechanical design of various machine elements. In this sense, the mechanical engineer faces in his professional life many situations in which he must design, analyze, interpret failures, redesign, maintain or/and select different machine elements efficiently. This process requires considering throughput specifications or the performance of each element at the individual level, as well as the interfaces between these elements as part of a machine.
The understanding and practical application of the design theories and methodologies explained in this subject requires previous knowledge acquired in the subjects of Applied Mechanics and Elasticity and Strength of Materials. It is more than advisable (not to say practically mandatory) to have passed these subjects, since the subject of Machine Design takes as a starting point the concepts acquired in these subjects. In addition, although it is not essential, it is also advisable to have passed the subject of Machine Kinematics and Dynamics.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

To know, understand and apply the fundamentals of Machine Design, in such a way that they enable students to apply advanced methods and theories in their professional development in areas of Mechanical Engineering. This skill will also provide them with great versatility to adapt to new situations.
To apply properly the strategies of the scientific methodology: analyze the problem situation qualitatively and quantitatively, propose hypotheses and solutions for solving typical problems of Machine Design, in the field of Mechanical Engineering., and finally, to understand and interpret the results.
To express correctly, using the appropriate means, the theoretical knowledge, resolution methods, results and inherent aspects of the propounded problems by the calculation, construction and testing of machines, within Mechanical Engineering, using the specific vocabulary and terminology of the subject.
To work effectively in a team, integrating skills and knowledge to formulate ideas, discuss proposals and adopt decisions in the development of own works of Machine Design and within the field of Mechanical Engineering.
To develop designs, projects and processes in the field of Machine Design, and within the field of Mechanical Engineering. As well as making measurements, calculations, studies, reports and other similar work, related to problematic situations to sort out in the field of the specialty.
To know, understand, interpret and apply the legislation correctly, specifications, regulations and mandatory standards in Machine Design, within the field of Mechanical Engineering.

CONTENIDOS TEÓRICO-PRÁCTICOS

The theoretical-practical contents taught in Machine Design classify into the following main sections:
Chapter I: a logical and unified introduction to Machine Design.
Chapter II: the study of the behavior of materials under static stresses: stress concentrations, failure theories and fracture mechanics.
Chapter III: explains the classic methods of analysis of materials under variable loads of fatigue, both in the case of uniaxial and multiaxial stresses.
Chapter IV: given its current wide use in the field of mechanical design, a brief overview of the Finite Element Method in the mechanical computer design is given.
Chapter V: applying the knowledge acquired in the previous chapters, as well as in previous subjects of the Degree, this chapter addresses the design of the main elements of machines widely used in mechanical engineering, such as shaft, clutches, brakes, belts, bearings, screwed joints, etc.

TEACHING METHODS

This subject has master classes and seminars.
In the master classes, the professor will explain the theoretical concepts of the different chapters of the subject. To follow the class, the student will have reference books (in English), a course book (in Spanish) and some PowerPoint presentations (pdf files) in Spanish. These PowerPoint presentations are a summary of the course book, prepared so that the student can follow the explanations of the professor and take notes. Occasionally there will be exercises/activities to strengthen the theoretical concepts, trying to encourage the participation of the student.
In the seminars, the professor will propose and solve the exercises corresponding to the content explained in the lectures. He/she will encourage each student to solve each exercise individually before the seminar, and that he/she discusses with the other students and the professor the proposed solution. In this way, the student will assimilate better the concepts of each exercise and will acquire skills related to oral communication, the ability to synthesize and teamwork.
On the other hand, in the seminars the teacher will propose each week an exercise/activity that the students (in groups of 2 to 4 students) will have to solve and deliver trough the eGela platform. The objective of this weekly group work is to

perform a continuous assessment of the student (the qualification of these group assignments will count towards the final grade of the subject), as well as to enhance their ability to work in groups.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	60	30							
Horas de Actividad No Presencial del Alumno/a	60	75							

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Teamwork assignments (problem solving, Project design) 30%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation of the subject in the ordinary call will be carried out through the CONTINUOUS assessment system by means of the following evaluation activities:

1. DELIVERABLES: Throughout the course, students must perform individual and / or group work in which the knowledge acquired in the subject (hereinafter deliverable) is applied. Each deliverable will consist in the resolution of proposed exercises or complementary activities proposed weekly, and that the professor will guide in the seminars, tutorials ... Each individual / group will have to deliver each week the exercise / activity proposed the previous week, realizing in this way a continued monitoring of the course. The weight of the note of the deliverables on the final grade of the subject is 30%. Any deliverable that does not meet the requirements established by the teaching staff in terms of delivery time and medium, content and clarity / readability, will obtain a score of 0 out of 10.

2. 1st PARTIAL + 2nd PARTIAL: Once the first 8 lessons had been taught, a non-obligatory individual theoretical-practical partial examination will be carried out (during the 7th or 8th week of the term). Students, who wish to, may take the first partial exam to evaluate the content corresponding to the first 8 lessons. The weight of the note of the 1st partial on the final grade of the subject is 35%. In order to assist the partial exam, it will be mandatory requirement:
2.1. Obtain a grade of PASSED on the deliverables related to the first 8 subject-matters.
2.2. Students who pass this first partial exam will have passed the first part of the subject and may take the final exam only with the subject corresponding to the last 7 lessons. The weight of the partial exam grade will be 35%. The minimum requirement for the achievement of the mean between the scores of each of the exercises that is composed each of the exams, is to obtain a minimum score of 2/10. Those students who have passed the first partial exam and want to take only the second partial, must obtain a grade of PASSED on the deliverables related to the last 7 subject-matters.

3. ORDINARY FINAL EXAM: for students who have not passed the first partial or have not submitted to it, at the end of the course, a final theoretical-practical individual exam will be held. The weight of the individual exam grade on the final grade of the subject is 70%. The minimum requirement for the achievement of the mean between the scores of each of the exercises that is composed each of the exams, is to obtain a minimum score of 2/10. The rest 30% will be related to the deliverables and to obtain a grade of PASSED is mandatory.

Therefore, to pass the subject in ordinary call it is necessary to pass independently both the individual exam (each partial exam: 1st partial and 2nd partial, or only the final one) and the deliverables.

For those students who EXPRESSLY RESIGNATE THE CONTINUOUS ASSESSMENT by email to the professor before the 9th week of the course (according to Official regulations governing the Students Assessment in undergraduate degrees of UPV / EHU), the subject evaluation In the ordinary call, it will be carried out through the FINAL evaluation system through the following assessment activity:

1. FINAL written exam. This exam will contain an additional exercise that includes the evaluation of the skills associated to the deliverables.

The minimum requirement for the achievement of the mean between the scores of each of the exercises that is composed each of the exams, is to obtain a minimum score of 2/10.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation of the subject in the supplementary call will be carried out through the FINAL assessment system by means of the following evaluation activities:

1. FINAL written exam.

The minimum requirement for the achievement of the mean between the scores of each of the exercises that is composed each of the exams, is to obtain a minimum score of 2/10.

MANDATORY MATERIALS

https://ocw.ehu.eus/course/view.php?id=441. (Spanish)

Power Point presentations in pdf format (Spanish) to download form eGela.

Exercises collection in pdf format (Spanish) to download form eGela.

BIBLIOGRAFÍA

Basic bibliography

-Budynas, R.G., Nisbett J.K., Shigley's mechanical engineering design, McGraw-Hill, New York (2011).
-Norton, R.L., Machine design: an integrated approach, Prentice Hall, New Jersey (2000).
-Juvinall, R.C., Marshek, K.M., Fundamentals of machine component design, Wiley, New York (1991).
-Spotts, M.F., Shoup, T.E. Hornberger, L.E., Design of machine elements, Pearson/Prentice-Hall, New Jersey (2004).
-Niemann, G., Machine elements: design and calculation in mechanical engineering, Springer, Berlin (1978).
-Deutschmann, A.D., Wilson, C.E., Machine design: theory and practice, Macmillan, New York (1975).
-Bickford, J.H., An introduction to the design and behavior of bolted joints, CRC Press, New York (1995)

Detailed bibliography

N/A - Not applicable

Journals

Electronic Journals for Mechanical Engineering.
- Mechanical Engineering Education.
- Journal of Mechanical Design.
- Journal of Mechanical Engineering Science.

Web sites of interest

http://www.aenor.es/
http://www.skf.com/
http://www.geartechnology.com/
http://www.indarbelt.es/
http://www.infomecanica.com/
http://www.cadersa.es/

OBSERVATIONS

• CONTINUOUS ASSESSMENT SYSTEM
• Qualification percentages:
o Written exam (%): 70
o Teamwork (problem solving, activities, design project) (%): 30

In the case that health conditions do not allow:
- Carrying out a face-to-face teaching activity, a non-face-to-face modality will be activated of which the students will be informed promptly.
- Carry out the face-to-face exams, other evaluation methods will apply through eGela. In general, they could consist of the following elements: deliverables, questionnaires, tasks and oral test.

COURSE GUIDE 2022/23

Faculty 363 - Faculty of Engineering - Bilbao **Cycle** Not Applicable

Degree GMECAN30 - Bachelor`s Degree in Mechanical Engineering **Year** Fourth year

COURSE

27728 - Computational Fluid Mechanics **Credits, ECTS:** 6

COURSE DESCRIPTION

In this course, you learn the operation and use of Computational Fluid Dynamics (CFD) codes. Interest in numerical methods in engineering is increasing, both in the scientific and industrial spheres, especially as the computational capacity of the equipment increases, and they are able to solve complex models such as the equations that govern the flows of fluids.

The approach of the course is very applied, and its development requires basic knowledge of Fluid Mechanics and Numerical Methods acquired in previous courses. The tasks that will be developed in this course will allow the students to face a simulation of a CFD problem and choose the appropriate parameters to obtain satisfactory results in certain quality and term. For this, the basic understanding of the Finite Volume Method and different discretization approaches of the governing equations is necessary. The course complements the knowledge acquired throughout the Bachelor's Degree in Mechanical Engineering in a state of the art discipline, such as CFD which is demanded by many different sectors: Automotive, Energy, Construction...

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The learning outcomes of the course are the following:

1- To know, understand and apply the concepts of the science and technology of computational fluid mechanics in order to adapt to new situations.
2 - Apply the strategies of the scientific methodology: analyze the problem situation qualitatively and quantitatively, pose hypotheses and solutions to solve problems of computational fluid mechanics.
3- Properly communicate the knowledge, procedures, results, skills and aspects of computational fluid mechanics using the specific vocabulary and terminology and the appropriate means.
4- To develop designs, projects and processes of computational fluid mechanics according to the specific technology applying the legislation, the specifications and the mandatory regulations and working in multidisciplinary and multilingual environments.
5- Carry out measurements, calculations, studies and reports on the operating parameters of the different types of computational fluid dynamics cases.

CONTENIDOS TEÓRICO-PRÁCTICOS

Summary of contents: Solution of Fluid Mechanics problems addressed and solved by numerical methods, which implies the use of computer calculation systems.

The theoretical contents:
1- Philosophy and field of application of computational fluid dynamics.
2- Equations that govern the flow: continuity, momentum and energy.
3- Mathematical considerations of differential equations. Generalities. Differential equations: hyperbolic, parabolic and elliptical. Simplifications of the Navier-Stokes equation.
4- Preliminary discretization techniques. Discretization. Approximation of the derivatives. Accuracy of the discretization process. Implicit and explicit approach. Theoretical framework: convergence, stability, accuracy of the solution.
5- Brief notes on the theory of similarity. Physical meaning of the dimensionless numbers.
6- Turbulent flow. Reynolds equations averaged over time. Equation models of turbulent kinetic energy. Boundary layer.
7- Basic computational methods applied to incompressible flow. Resolution of the transport equation. Methods to solve the current function. Boundary conditions. Methods to solve the pressure-velocity equation.
8- Basic computational methods applied to compressible flow. Methods for the numerical treatment of shock waves.
9- Generation of meshes and adequate transformations of the equations
10- Multiphase flow. Eulerian and Lagrangian approximation. VOF method (volume of Fluid)

The practical contents:
1- User-level learning of a commercial code of computational fluid dynamics.
2- Application of the theoretical concepts in practical exercises of computer simulation of real fluid mechanics problems. Comparison tests in laboratory vs. Simulation.

TEACHING METHODS

In this course, different teaching methodologies are used, the most used being problem solving. Individual and in couple

work will be enhanced through the use of computer and bibliographic resources that help students understand the different aspects of the subject.

Master lectures on the conceptual contents of the subject will be taught, with student participation in occasional debates about those contents.

The resolution of issues and problems in the classroom will be done in a participatory manner. Real problems will be provided, which will deepen the theoretical knowledge of the subject and relate the CFD with other related areas. The formulation of questions and open discussion will be encouraged, so that students acquire skills related to oral communication, the ability to synthesize and work in teams.

In computer practices, the concepts studied will be applied to real cases using a commercial program of Computational Fluid Dynamics.

To facilitate and ensure student learning, successive reports will be delivered on the problems raised. Evaluation feed-back will be provided, so that students have the opportunity to become aware of their learning, as well as ways to improve it.

In the event that health conditions prevent the performance of a teaching activity and/or evaluation in person, a non-presential modality will be activated of which the students will be informed punctually.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15		30		15				
Horas de Actividad No Presencial del Alumno/a	22,5		45		22,5				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Exercises, cases or problem sets 10%
- Individual assignments 10%
- Teamwork assignments (problem solving, Project design) 80%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

El alumnado que a principio de curso justifique alguno de los motivos recogidos en el artículo 43.1.c de la normativa de gestión de las enseñanzas de grado de la EHU/UPV, podrá obtener el 100% de la nota mediante un examen teorico-práctico.
El resto del alumnado será calificado por las diferentes tareas desarrolladas a lo largo del curso.

Es necesaria la asistencia al 80% de las horas presenciales para poder ser calificado, de lo contrario se calificará como "no presentado".

El estudiante obtendrá la calificación de "no presentado" si participa de menos de la mitad de las tareas que forman parte de la evaluación continua.

En la convocatoria extraordinariaEl estudiante que participe de la evaluación continua,

Si el estudiante ha participado de la evaluacion continua,La nota obtenida en la evaluación continua se podrá utilizar en la calificación de la convocatoria extraordinaria.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Para los alumnos que hayan participado de la evaluación continuada, y no hayan superado la asignatura, se realizará una prueba final complementaria al trabajo realizado a lo largo del curso.

Para los alumnos que NO hayan participado de la evaluación continuada, podrá obtener el 100% de la nota mediante un examen teórico-práctico. En estos casos, es necesario ponerse en contacto con el profesor al menos un mes antes de la fecha del examen.

MANDATORY MATERIALS

Apuntes de la asignatura.
Tablas y diagramas de mecánica de fluidos.
Star CCM+ User Guide

BIBLIOGRAFÍA

Basic bibliography

ANDERSON, J.D.: "Computational Fluid Dynamics. The Basics with Applications". McGraw-Hill, 1995
CHUNG, T.J.: "Computational Fluid Dynamics". Cambridge University Press, 2002.
WILCOX, D.C: "Turbulence Modeling for CFD" ISBN 0-9636051-0-0. Library of Congress Cataloging in Publication Data, 1994.

Detailed bibliography

VERSTEEG, H.K. y MALALASEKERA, W.:"An Introduction to Computational Fluid Dynamics".Pearson, 1995, 2007.
ANDERSON, J.D.: "Computational Fluid Dynamics. The Basics with Applications". McGraw-Hill, 1995
CHUNG, T.J.: "Computational Fluid Dynamics". Cambridge University Press, 2002.
WILCOX, D.C: "Turbulence Modeling for CFD" ISBN 0-9636051-0-0. Library of Congress Cataloging in Publication Data, 1994.

Journals

Web sites of interest

www.cfd-online.com

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 364 - Faculty of Engineering - Bilbao
Cycle Not Applicable
Degree GCIVIL30 - Bachelor`s Degree in Civil Engineering
Year Second year

COURSE

26589 - Geotechnical Engineering
Credits, ECTS: 6

COURSE DESCRIPTION

This course belongs to the common module of the Civil area of the degree. Contents include the basic concepts and applications of Soil Mechanics and Rock Mechanics. It is directly related to core subjects such as Geology, Physics and Calculus, and provides the necessary knowledge for other subjects in the third and fourth academic years: Transportation Infrastructure, Construction Engineering, Building, etc.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Specific competences

M02CM05. Knowledge of geotechnics and soil and rock mechanics and its application in carrying out studies, projects, constructions and exploitations in which earthmoving, foundations and retention structures are necessary.

Transversal competences (level 2)

MEC1. Students will have proven to possess and understand the specific knowledge of the subjects in the second year, starting from their previous knowledge.
MEC2. Students will be able to solve specifics problems of subjects belonging to the second year reasonably and taking into account the knowledge of the first year.
MEC3. Students will be able to collect and interpret relevant data in order to solve problems and justify the solutions taking into account technical and scientific aspects.
MEC4. Students will be able to communicate correctly and clearly ideas, opinions and specific issues related to the subjects in written form.

CONTENIDOS TEÓRICO-PRÁCTICOS

Introduction. Purpose of Geotechnics. Rocks and soils. Historical failures.
Basic characteristics of soils and rocks. Constitutive elements. Physical properties.
Soil and rock classification. Identification tests. Soil and rock classification systems.
Stress in soils. Effective and total stress. Stress in saturated soils.
Settlement analysis in soils. Components. Limitations of settlement. Immediate settlement. Consolidation settlement. Secondary compression.
Soil strength. Failure criteria. Direct shear test. Triaxial compression tests. Other tests.
Rock strength. Failure criteria. Uniaxial compression test. Triaxial compression test.
Mechanical behaviour of rock masses. Discontinuities. Failure criteria. Deformability. Tests.
Bearing capacity. Definition. Relevant factors. Verification.
Lateral earth pressures. Limit states. Coulomb’s theory.

TEACHING METHODS

Theoretical lessons: 2.5 hours/week. Practical lessons (exercises and problems): 1.5 hours/week. Two laboratory lessons (1.5 hours/each).

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	37,5		19,5	3					
Horas de Actividad No Presencial del Alumno/a	56,25		29,25	4,5					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 37%

- Exercises, cases or problem sets 55%
- Teamwork assignments (problem solving, Project design) 8%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Alternative 1

Continuous assessment through two examinations and one laboratory report. First examination weights 60 %, second examination weights 32 % and laboratory report weights 8% of the course score.

Contents of the examinations: theoretical questions (40%), either multiple choice questions or short-answer questions, and exercises (60%).

Both examinations and laboratory report are compulsory. In the second examination, minimum score is 3.0.

According to the article 8.3 of the Assessment Regulations, students will have the right to be assessed through a final examination, regardless of whether he/she has taken part in the continuous assessment. Students will have to submit the renouncement to the continuous assessment to the professor in charge of the course along the first nine weeks of the semester.

In addition, according to the article 12.1 of the Assessment Regulations, if the student has taken part in the continuous assessment, he/she may renounce this assessment up to one month before the end of period of teaching. The renouncement must be submitted in written form to the professor in charge of the course.

Alternative 2

Global examination containing theoretical questions (40%), either multiple choice questions or short-answer questions, and exercises (60%).

It is accepted that those students who have not attended the examination are renouncing the assessment.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Global examination containing theoretical questions (40%), either multiple choice questions or short-answer questions, and exercises (60%).

It is accepted that those students who have not attended the examination are renouncing the assessment.

MANDATORY MATERIALS

- CTE. DB-SE-Cimientos. Ministry of Public Works.
- Guía de cimentaciones para obras de carretera. Ministry of Public Works.
- Geotecnia: ensayos de campo y laboratorio. AENOR.
- ASTM Standards. American Society of Testing Materials.
- Eurocode 7. European Committee for Standardisation.

BIBLIOGRAFÍA

Basic bibliography

- Soils and Foundations. C. Liu, J.B. Evett
- Soil mechanics in engineering practice. K. Terzaghi, R.B. Peck, G. Mesri
- Essentials of Soil Mechanics and Foundations. D.F. McCarthy.
- Soil Mechanics. Principles and Practices. G.E. Barnes.

Detailed bibliography

- Decoding Eurocode 7. A. Bond, A. Harris.
- Geotechnical Engineering. D.P. Coduto, M-C.R. Yeung, W.A. Kitch.
- Geotechnical Engineering. R. Lancellotta.
- Soil Mechanics and Foundations. M. Budhu.
- Engineering Properties of Soils and Rocks. F.G. Bell.

Journals

- Geotechnique
- Journal of Geotechnical and Geoenvironmental Engineering (ASCE)

- Rock Mechanics and Rock Engineering
- Computers and Geotechnics
- Canadian Geotechnical Journal

Web sites of interest

- International Society for Soil Mechanics and Geotechnical Engineering
www.issmge.org/home/index.asp?sid=296&mid=1
- International Society for Rock Mechanichs and Rock Engineering
www.isrm.net
- Geotechnical Engineering Web Site
www.geoengineer.org

OBSERVATIONS

If sanitary conditions prevent a regular teaching activity and/or face-to-face assessment, a distance learning will start. Students will be informed as soon as possible.

COURSE GUIDE 2022/23

Faculty 364 - Faculty of Engineering - Bilbao
Cycle Not Applicable
Degree GCIVIL30 - Bachelor`s Degree in Civil Engineering
Year Fourth year

COURSE

26595 - Environmental Engineering
Credits, ECTS: 6

COURSE DESCRIPTION

The main aim of the course is to provide the student with a background knowledge in environmental pollution from an engineering point of view. The course is focused on pollution sources, remediation and treatment technologies, environmental impact assessment, environmental management and environmental regulation. Students are introduced to the mechanisms of environmental pollution and treatment methodologies, as well as to the evaluation and remediation of the environmental impact caused.
"Environmental Engineering" is taught during the first semester of the fourth year of the Degree. It requires prior knowledge and skills acquired in previous basic and specific courses, in particular in "Environmental Science and Technology". It is a compulsory course.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The competences acquired in the course will allow students to:
- Apply methodologies in order to perform environmental impact assessment studies.
- Apply environmental technologies, sustainable solutions, and pollution remediation technologies in different environmental media (air, water, waste, and soils).

CONTENIDOS TEÓRICO-PRÁCTICOS

The theoretical and practical contents comprise six modules and eleven topics:
Module I. Fundamentals of environmental engineering.
Topic 1. Environmental engineering. Environmental pollution and sustainability. Environmental chemistry: Units of concentration, equilibrium processes, material and energy balances.
Module II. Water
Topic 2. Water pollution. Water uses and demands. Water pollution. Quality indicators. Regulation
Topic. 3. Urban and industrial wastewater treatment technologies. Wastewater characterization: urban and industrial wastewater. Municipal and industrial wastewater treatment plants. Water and sludge lines. Municipal wastewater treatments: pretreatment, primary, secondary, and advanced treatments. Industrial wastewater treatments. Sludge treatments. Treated wastewater reuse.
Module III. Air
Topic 4. Atmospheric Pollution. Introduction to air pollution: concepts, scales, structure and composition of the atmosphere. Energy balance. Main atmospheric pollutants: sulfur, nitrogen, carbon, and halogenated compounds. Pollutants' sources and adverse effects. Dispersion of air pollutants. Atmospheric stability. Air quality and regulation. Noise pollution.
Topic 5. Industrial emission control and reduction technologies. Characterization and reduction of industrial emissions. Equipment: cyclones, baghouses, electrostatic precipitators, scrubbers.
Module IV. Waste
Topic 6. Waste management and characterization. Waste types and regulation. The European Waste Catalogue. Municipal waste characterization and management. Industrial waste. Hazardous wastes.
Topic 7. Waste treatment technologies. Municipal waste treatment: biological treatment (composting), thermal treatments (incineration, pyrolysis, gasification), and landfills. Industrial waste treatment. Hazardous waste treatment. Construction and demolition waste.
Module V. Soil
Topic 8. Soil pollution. Context. Soil characterization. Soil pollutants: heavy metals, acid rain, salinization, phytosanitary products (insecticides, herbicides, fungicides), mining activity, organic products (pesticides). Regulation.
Topic 9. Recovery of polluted soils. Containment techniques: barriers and sealing. Confinement techniques: physical-chemical stabilization, injection of solidifiers, vitrification. Decontamination techniques: physical-chemical, biological, thermal, and mixed treatments.
Module VI. Environmental Management
Topic 10. Environmental Impact Assessment. Basic concepts. Environmental Impact Assessment. Regulation.
Topic 11. Environmental Management Systems and Environmental Audits. Sustainable development. ISO 14001 standard and EMAS regulation. Environmental Audits.

Practice in the field include three visits to industrial facilities:
Session 1. 1.1.- Wastewater treatment plant, 1.2.- Storm tank
Session 2. 2.1. Zabalgarbi - Municipal waste thermal valorization plant. 2.2. Mechanical and biological treatment plant
Session 3. 3.1. Artigas municipal waste landfill - Leachate treatment plant of the Artigas Urban Waste Landfill. 3.2. Bizkaiko konpostegia - Composting plant.

TEACHING METHODS

The course will be delivered by means of:
- Lectures (MC), which will be used to explain core contents in order to develop students' knowledge and understanding of these concepts.
- Classroom practices (CP), which will be used to solve practical activities, problems, etc.
- Practice in the field (FP), which will be used to visit industrial facilities.

If the health situation avoids the development of any teaching or evaluation activity, a non-presential alternative will be used and the students will be promptly informed.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	37,5		12,5						10
Horas de Actividad No Presencial del Alumno/a	56,25		18,75						15

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 56%
- Multiple choice test 24%
- Exercises, cases or problem sets 12%
- Field practices 8%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS ASSESSMENT is used in both ordinary and extraordinary sessions.

Written exams comprising theory and problems (multiple choice test, theoretical questions and exercises)
- Three mid-term exams (eliminatory for students with a minimum grade of 5.0/10 and passing at least two or more mid-term exams).
- A final exam, if the student does not pass two or more mid-term exams: 80 % (mid-term exam of one part, with its corresponding grade).
- Practical face-to-face activities: 12 %
- Practice in the field: 8 %

Notes:
Students will withdraw from the ordinary session by default if they do not take the ordinary final exam.
Any student wishing to waive continuous evaluation and wishing to be marked by FINAL ASSESSMENT instead by continuous assessment in the ordinary session should request this in a written document from the lecturer responsible for the course before the ninth week after the course starts.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

There are two options:
1) CONTINUOUS ASSESSMENT. This is the default option; students are assessed by means of:
- Final exam: 80%
- Practical activities: 12%
- Practice in the field: 8%
2) FINAL ASSESSMENT, for any student wishing to waive continuous evaluation (see section 6.2). Students are required to take a single exam (100% of the mark), comprising all the concepts and skills covered throughout the course.

MANDATORY MATERIALS

Materials required to follow the sessions will be shared with the students though eGela virtual platform:
- Lecture materials and documents,
- Problems' wordings and instructions for practical activities.
- Links to useful websites and reports.

BIBLIOGRAFÍA

Basic bibliography

This section contains a basic bibliography in English (resources in Spanish are included in the corresponding guide).

- Baird, C. (2005). Environmental chemistry (3rd ed.). W.H. Freeman.
- Kiely (1996) Environmental Engineering, McGraw-Hill College.
- Manahan, S. E. (2001). Fundamentals of environmental chemistry (2th ed.). Lewis. –
- Metcalf & Eddy (2003) Wastewater Engineering: Treatment and Reuse, McGraw-Hill Science Engineering.
- Tchobanouglous (1993) Integrated Solid Waste Management: Engineering Principles and Management Issues, McGraw-Hill Science Engineering.

Detailed bibliography

- Dullien, F.A.L. (1989). Introduction to Industrial Gas Cleaning. Academic Press.
- Kreith, F., Tchobanoglous, G., & Kreith, F. (2002). Handbook of solid waste management (2nd ed., Ser. Mcgraw-hill handbooks). McGraw-Hill.
- Seinfeld, J.H. (1986). Atmospheric Chemistry and Physics of Air Pollution. John Wiley & Sons.
- Seinfeld, J.H. y Pandis, S.N. (1998). Atmospheric Chemistry and Physics. From Air Pollution to Climate Change. John Wiley & Sons.
- Stern, A.C. (Editor) (1986). Air pollution. Academic Press.
- Tchobanoglous, G. and Kreith, F. (2002) Handbook of Solid Waste Management. McGraw-Hill.
- Tchobanoglous, G., Burton, F. L., Stensel, H. D., Burton, F. L., & Metcalf & Eddy. (2003). Wastewater engineering: treatment and reuse (4th ed. /, Ser. Mcgraw-hill series in civil and environmental engineering). McGraw-Hill.
- Vallero, D. (2008). Fundamentals of Air Pollution. Elsevier.
- Wallace, J.M., Peter V. H. (2006) Atmospheric Science. An Introductory Survey. Editorial Elsevier.
- Wentz, C.A. (1995). Hazardous Waste Management. McGraw-Hill.

Journals

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Web sites of interest

Basque Government. Department of the Environment, Territorial Planning and Housing. http://www.euskadi.eus/gobierno-vasco/departamento-medio-ambiente-politica-territorial/inicio/
Eur-lex. Access to the Official Journal http://europa.eu.int/eur-lex/
European Environment Agency (EEA) http://www.eea.eu.int
Ministry for Ecological Transition and Demographic Challenge - MITECO, Spanish Government https://www.miteco.gob.es/es/
Public Society for Environmental Management of the Basque Government – IHOBE http://www.ihobe.es
United States Environmental Protection Agency (EPA) http://www.epa.gov

OBSERVATIONS

Conditions and clarifications:
If the health situation avoids the development of any evaluation activity, a non-presential alternative will be used and the students will be promptly informed.
1.- Any student that passes the three mid-term exams will be exempt to take the final exam (average grade of 5.0/10), with the exception of those students who not pass practical activities and practice in the field or if the final grade is < 5,0.
2.- The mark obtained in practical activities and in practice in the field will be considered if the student:
- Passes all mid-term exams and he/she is exempt to take the final exam.
- Does not pass one of the mid-term exams, but the grade of the failed part is >=4,0.
- Does not pass the final exam, but her/his grade is >=4,0.
3.- The mark obtained in the practice in the field will be carried over for two academic years.
4.- Any student assumes to obey academic regulation and to take "Environmental Engineering" course with an ethical behaviour and honesty. Hence, plagiarizing exams or activities will be strongly penalized and may lead to fail the course.

COURSE GUIDE 2022/23

Faculty 364 - Faculty of Engineering - Bilbao
Cycle Not Applicable
Degree GCIVIL30 - Bachelor`s Degree in Civil Engineering
Year Fourth year

COURSE

27783 - Acoustics and Noise Control in Civil Engineering
Credits, ECTS: 4,5

COURSE DESCRIPTION

The subject gives a detailed introduction to the principles and practice of acoustics and presents the possible solutions to noise problems with special interest in construction related situations.

It is divided into three blocks: first, we establish the basic principles of acoustics and sound perception. In a second block, we introduce the absorption to study the optimal acoustic conditions of a given space (factories, theaters, restaurants, …), taking into account that the noise/sound and the receiver are in the same space. Finally, we deal with sound isolation, where the sound and the receiver occupy different spaces. We analyze the isolation from traffic, airports, machine vibrations, and in all kind of buildings.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Competencies:
- At the end of the course the students should know and understand the basics of the subject.
- Show the capacity of solving specific situations related to acoustics.
- Be able to find and interpret the relevant data to give solutions to acoustics problems considering technical, economical and legal aspects.
- Be able to present (in writing and through oral presentations) their results in a well-structured manner.

CONTENIDOS TEÓRICO-PRÁCTICOS

Syllabus:

1. Basic acoustic concepts: waves, measurement of sound intensity, harmonics, octaves, normal modes.
2. Sound perception: the effect of noise on the human being, volume, frequency, spectrum of hearing.
3. Indoor acoustic concepts: reflection, diffraction, absorption, reverberation.
4. Absorption in enclosed spaces. Methods of sound absorption and materials.
5. Soundproofing. Aerial noise, structural noise. Transmission loss. Mass law. Methods and materials.

Computer sessions:

1. Waves: normal modes in 1 and 2 dimensions, speed of sound in different media.
2. Noise map of the area surrounding our School: direct measurement using the QGIS program.
3. Noise map using noise prediction software, CadNa (Datakustik). Comparison with what we obtain through direct measurements.
4. Calculation of the soundproofing of different partitions using the software INSUL, where we can experiment with different thickness and materials.

TEACHING METHODS

This course has 45 hours of class. 2/3 of the hours correspond to theory classes while the rest is devoted to the computer sessions, where we work with software specifically designed to study acoustics and noise control. Besides, there are 6h/week of office hours, which can be held in English.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30				15				
Horas de Actividad No Presencial del Alumno/a	45				22,5				

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

Evaluation methods

- Continuous evaluation

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 30%
- Multiple choice test 30%
- Exercises, cases or problem sets 20%
- Oral presentation of assigned tasks, Reading¿ 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

1st option:

60% of the mark is obtained from the tests done along the course.
20% from the work done in the computer sessions
20% from the presentation of a paper of something related to the subject.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

100% of the mark from an exam.

MANDATORY MATERIALS

BIBLIOGRAFÍA

Basic bibliography

"Master Handbook of Acoustics", F. Alton Everest and Ken C. Pohlmann
"Industrial Noise Control and Acoustics", R. F. Barron
Notes and presentations found in http://egela.ehu.eus

Detailed bibliography

"Engineering Noise Control", D.A. Bies and C.H. Hansen
"Noise and Vibration Control Engineering" L.L. Beranek

Journals

“Acoustics in Practice”
“Applied acoustics”

Web sites of interest

https://phet.colorado.edu/en/simulations/category/physics/sound-and-waves
http://www.acs.psu.edu/drussell/demos.html
https://euracoustics.org/activities/acoustics-in-practice

OBSERVATIONS

COURSE GUIDE 2022/23

Faculty 364 - Faculty of Engineering - Bilbao

Cycle Not Applicable

Degree GCIVIL30 - Bachelor`s Degree in Civil Engineering

Year Third year

COURSE

27792 - Transport Infrastructure

Credits, ECTS: 10,5

COURSE DESCRIPTION

After having studied in the first two academic years of the degree the basic subjects of the Engineering, oriented to the Civil Engineering, at the 3rd academic year the student start receiving specific knowledge about the working areas of the Civil Engineering: transport, management of hydraulic resources, water supplies, sanitary systems, calculation and design of metal and concrete structures, damn and prestressed concrete elements, design and construction of ports, basic elements of construction, etc. All these areas are developed in the subjects of the 3rd academic years. All these competences are oriented to the work role of the civil engineer.
With this aim, in this subject competences about the most widely employed infrastructures for the passenger and freight transport are developed: the road and the railroad, which are an extensive field where a lot of civil engineers work.
Thus, students will learn how to manage a road, comprising all the stages: plan, project the layout and the pavement according to the specific regulations, construction and verification in situ and afterwards, maintenance and management.
Similarly, students will be able to develop any of the steps of the construction of railroad lines: plan, project, construction, maintenance and management, always taking into account all the specific regulations of the sector and the characteristics of the rolling stock.
Moreover, geotechnical features of the subgrade are also developed since they are necessary to place over these infrastructures. Furthermore, more sustainable materials and technics for road construction that are being developed at present are exposed.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SPECIFIC COMPETENCES

M04CM04. Capacity for construction and maintenance of roads. Capacity for gauging and projecting the elements of a basic road system.

M04CM05. Capacity for construction and maintenance of railway lines with knowledge to apply the specific regulations, distinguishing the characteristics of the rolling stock.

M04CM07. Capacity for the construction of geotechnical Works

CROSS-CUTTING COMPETENCES

MEC1. Students demonstrate that they have and understand the specific knowledge of the subject included in the speciality module, based on their previous knowledge.

MEC2. Resolution of specific problems of their speciality in a well-reasoned way, integrating the acquired knowledge from both basic and specific modulus.

MEC3. Collect and interpret relevant data to allow reasoned solutions, taking into account legal and economical features

MEC4 (written). Transmit written opinions and specific lessons on the subjects with confidence, fluently and in a structured way

MEC5. Integrate knowledge from various areas to give adequate solutions in specific technical areas with autonomy (handling regulations, rules, software, complex bibliography).

CONTENIDOS TEÓRICO-PRÁCTICOS

Roads and airports (1. Semester)
Sections:
1. The road system
 - History of road networks
 - Present-day road networks
 - Road administration
 - The vehicle
 - The driver and the pedestrian
2. Circulation of vehicles and traffic analyses
 - Circulation of vehicles

- Traffic analyses

3. Capacity, levels of service and road planning
- Capacity and levels of services
- Road planning

4. Horizontal alignment
- Road geometry regulations. Velocity and sight distance
- Straights and curves
- Transition curves (clothoids) and grade transitions

5. Vertical alignment
- Grades and vertical curves
- Vertical curves
- Coordination of horizontal and vertical alignment

6. Transverse sections and representation on drawings
- Transverse section
- Representation on drawings

7. Crossroads
- General design considerations
- Elements and distances
- Intersections
- Interchanges
- Roundabouts
- Selection of crossroad type

8. Earthworks. Platforms. Use and protection of the roadway
- Earthworks and mass-diagram
- Use and protection of the roadway
- Construction of more sustainable roads

9. Surface and subterranean drainage
- Surface drainage
- Subterranean drainage

10. Soil classifications. Tests. Subgrades. Granular and cement-treated bases. PG-3
- Soil and rock mass classifications
- Compaction and subgrade strength tests
- Soil stabilization
- Granular layers
- Cement-treated bases
- PG-3 regulations
- Sustainable materials in subgrades and in bases.

11. Bituminous pavements
- Bituminous binders
- Bituminous mixes
- Surface treatments
- Execution of bituminous pavements
- Sustainable materials in bituminous materials

12. Concrete pavements
- Main concrete pavements
- Execution

13. Surface characteristics of bases. Pavement design
- Surface characteristics of pavements. Roughness and skid resistance
- "Norma 6.1-IC Secciones de firmes" standard
- Standard for pavement design of the Basque Country

14. Road maintenance
- Road maintenance and management
- Remedial maintenance techniques
- Pavement recycling

15. Airport infrastructure. Airport pavements
- Airport infrastructure
- Airport pavements

Railways, bridges and tunnels (2. Semester)

16. The context of the railway
17. Geometry of the railway line
- Introduction to the railway structure
- Horizontal alignment

- Vertical alignment. Grade in curves

18. The rail
 - Characteristic of the steel
 - Rail wear
 - Short bar and Long Welded Bar
 - Welding
19. Rail fastenings
20. Sleepers
 - Timber sleepers
 - Steel sleepers
 - Concrete sleepers
21. Track ballast
 - Ballast and sub-ballast
 - Subgrade layers
22. Joints
23. Rail distressing
24. Track devices
 - Crossover
 - Bretelle
25. Rail machinery
 - Main rail machinery
 - Light rail machinery
26. Railway renewal
 - Track renewal
 - New tracking
27. Track qualification
 - 1st and 2nd levelling
 - Verification of track geometric parameters
28. High Speed Train
29. Bridges
30. Tunnels
 - Rock mass classifications
 - Tunnelling methods: Tunnelling Boring Machines (TBM), roadheader, drill and blast
 - Lining
 - Special Works

TEACHING METHODS

In the theoretical lessons the theoretical concepts are developed.

In the practical lessons the theoretical concepts will be applied in problems according to the requirements indicated in the corresponding regulations.
More sustainable materials and technics for road construction are exposed for being applied in the project of the infrastructure

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	75		30						
Horas de Actividad No Presencial del Alumno/a	112,5		45						

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Teamwork assignments (problem solving, Project design) 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

WRITTEN EXAM (60 % of the mark)

There will be an exam in each of the convocations and the entire subject will be evaluated.

In February, out of the official convocation of January, there will be a partial exam of the first part of the subject. This part will not be included in the ordinary convocation (May/June) if the mark is 6.0 or greater (>= 6.0/10.0). There will not be a partial exam of the second part. Only those with a mark of 6,0 or greater in the partial exam of February will do an exam about the second part of the subject (railways, bridges and tunnels). The rest of students will do a global exam.

In the extraordinary convocation the entire subject will be evaluated.

PRACTICAL PROJECT (40% of the mark)

During the practical lessons of the 2nd semester a project to be developed about a road will be presented. In this project, apart from the fulfillment of the standards for geometric design of the road and the design of the pavement section, it will be positively evaluated the employment of sustainable materials in the pavement structure, the recycling of some parts of the pavement, and the design of geometric layout with the mínimum environmental impact.

It has to be finished in the 29th week.

In order to pass the subject, both parts, the written exam and the practical project, must have a mark of 5.0 or over out 10.0.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

WRITTEN EXAM (60% of the mark)

In the extraordinary convocation the entire subject will be evaluated.

PRACTICAL PROJECT (40% of the mark)

In case of not passing the practical project in the ordinary convocation, it can be given in the date of the exam of the extraordinary convocation, with the corrections included according to the professor’s suggestions.

In order to pass the subject, both parts, the written exam and the practical project, must have a mark of 5.0 or over out 10.0.

MANDATORY MATERIALS

Manuals:

Sections 1, 2 and 3

Heriberto Pérez Acebo (2018) CARRETERAS. Volumen I: Red viaria y tráfico. Servicio Editorial Universidad del País Vasco UPV/EHU

Sections 4, 5, 6 and 7

Heriberto Pérez Acebo (2016) CARRETERAS. Volumen II: Trazado. Servicio Editorial Universidad del País Vasco UPV/EHU.

Section 30

Javier Gallo Laya, Heriberto Pérez Acebo, David García Bragado. (2016) Excavación, sostenimiento y técnicas de corrección de túneles, obras subterráneas y labores mineras. Servicio Editorial Universidad del País Vasco UPV/EHU.

Rest of sections:
- • Notes of the subject
- • Indicated regulations and laws
- • Articles from scientific journals about sustainable materials in roads

BIBLIOGRAFÍA

Basic bibliography

Roads and airports

- Carlos Kraemer et al. Ingeniería de carreteras. Vol I. 2º ed. Mc Graw - Hill Interamericana de España, 2009.
- Carlos Kraemer et al. Ingeniería de carreteras. Vol II. Mc Graw - Hill Interamericana de España, 2004.
- Highway Capacity Manual. A Guide for Multimodal Mobility Analysis.(2016). Transportation Research Board. The National Academies of Sciences, Engineering and Medicine: Washington, DC, USA.
- Marcos García Cruzado. Ingeniería aeroportuaria, Escuela Técnica Superior de Ingenieros Aeronáuticos, Madrid, 2006.
- Departamento de Vivienda, Obras Públicas y Transporte (2012). Norma para el dimensionamiento de firmes de la Red de Carreteras del País Vasco. Gobierno Vasco.
- PG-3
- AASHTO (2011). A policy on Geometric Design of Highways and Streets. The Green Book. 6th edition. American Association of State Highway and Transportation Officials, Washington, DC, USA.
- Schroeder, B., Cunningham, C., Findley, D., Foyle, R. (2010) ITE Manual of Transportation Engineering. Institute of Transportation Engineers. Washington, DC.
- Findley, D.J., Schroeder, B.J., Cunningham, C. M. Brown, T. H. (2016) Highway Engineering: Planning, Design and Operations. 1st. Edition. Butterworth-Heinemann. Elsevier,

Railroads, bridges and tunnels

- Andrés López Pita. Infraestructuras ferroviarias. TTT Temas de Transporte y Territorio 12. Ediciones UPC. Barcelona, 2006.
- Bernhard Licthberger. Manual de Vía. Infraestructura, superestructura, conservación, rentabilidad. Eurailpress, 2007.
- Normativa, Recomendaciones e Instrucciones. ADIF y Ministerio de Fomento. Centro de Publicaciones, 2006.

Detailed bibliography

- Salvador Monleón Cremades. Cuadernos de concepción de puentes. Universidad Politécnica de Valencia, 2002.
- Carlos López Jimeno. Ingeo túneles. ETS Ingenieros de Minas. Madrid, 2001.
- Andrés López Pita. Explotación de líneas de ferrocarril. TTT Temas de Transporte y Territorio 15. Ediciones UPC. Barcelona, 2008.
- Francisco Javier González Fernández y Julio Fuentes Losa. Ingeniería Ferroviaria. UNED, 2006.

Journals

- Hormigón y Acero.
- Ingeopres.
- Informes de la Construcción.
- Revista de Obras Públicas.
- Vía Libre.
- Carreteras.
- Rutas.

Web sites of interest

- www.fomento.gob.es. Ministerio de Fomento.
- www.adif.es . Administrador de Infraestructuras Ferroviarias.
- www.aecarretera.com, AEC-Asociación Española de la Carretera.
- www.carreteros.org. Normativa y legislación de carreteras y aeropuertos.
- www.aena.es. Aeropuertos Españoles y Navegación Aérea.
- www.euskadi.eus
- www.bizkaia.eus
- www.araba.eus
- www.gipuzkoa.eus

OBSERVATIONS