Universidad del País Vasco Euskal Herriko Unibertsitatea

ENGLISH FRIENDLY COURSES (EFC) 2024-2025
CAMPUS OF BIZKAIA

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.

MASTER COURSES FACULTY OF SCIENCE AND TECHNOLOGY (310)

https://www.ehu.eus/en/web/zientzia-teknologia-fakultatea/en-home
Contact: ciencia.internacional@ehu.eus

English Friendly Courses taught in SPANISH:

	COURSE	SEMESTER[1]	CREDITS	SCHEDULE[2]	LINK TO SYLLABUS
Master´s Degree in Chemical Engineering					
504253	Ampliación de Reactores Químicos	1st	4,5	M	➡
504254	Optimización Avanzada de Procesos Químicos	1st	4,5	A	➡
504255	Modelado y Simulación de Procesos Químicos	1st	6	A	➡
504263	Combustibles desde fuentes alternativas al petróleo	2nd	3	M	➡
504265	Tecnologías de Refinería y Petroquímica	2nd	3	A	➡
504267	Tecnologías catalíticas para el control de la contaminación del aire	2nd	3	A	➡
504270	Valorización de residuos	2nd	3	A	➡
Master´s Degree in Synthetic and Industrial Chemistry					
504304	Síntesis Química Avanzada	1st	3	A	➡
504306	Síntesis Estereocontrolada	1st	3	A	
504309	Química Orgánica Avanzada	1st	3	A	
504312	Productos Naturales. Síntesis, biosíntesis y aplicaciones	2nd	3	A	➡

[1] SEMESTER: Annual: September 2024 to May 2025
1st: September 2024 to January 2025
2nd : January 2025 to May 2025
[2] SCHEDULE: Morning (M)/ Afternoon (A): begins at 13.30

Universidad del País Vasco Euskal Herriko Unibertsitatea

ENGLISH FRIENDLY COURSES (EFC) 2024-2025
CAMPUS OF BIZKAIA

MASTER COURSES FACULTY OF ECONOMICS AND BUSINESS (321)

https://www.ehu.eus/en/web/ekonomia-enpresa-fakultatea/hasiera
Contact: economicas.internacional@ehu.es

	COURSE	SEMESTER[3]	CREDITS	SCHEDULE[4]	LINK TO SYLLABUS
Master in Business Management from an Innovation and Internationalization Perspective					
502122	Globalización y Gestión Financiera	1st	3	A	
502109	Marketing Ecológico: Estrategias y Técnicas de Investigación para un desarrollo sostenible	2nd	3	A	
502110	Comportamiento del consumidor y dirección de marca	2nd	3	A	
502120	Gobierno y control de la empresa familiar	2nd	3	A	
Master´s degree in Economics: Economic Analysis Tools					
503485	Econometría	1st	4	M	
503486	Técnicas de inferencia estadística	1st	3	A	
503487	Análisis básico de series temporales	1st	3	A	
503501	Economía ambiental	1st	3	M	
503506	Teoría de Juegos	1st	3	M	
503488	Temas de Estadística y Series Temporales	2nd	6	M	
503504	Economía Recursos Naturales y Política Ambiental	2nd	6	M & A	

[3] SEMESTER: Annual: September 2024 to May 2025
1st: September 2024 to January 2025
2nd : January 2025 to May 2025

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

Universidad del País Vasco Euskal Herriko Unibertsitatea

ENGLISH FRIENDLY COURSES (EFC) 2024-2025
CAMPUS OF BIZKAIA

MASTER COURSES FACULTY OF MEDICINE AND NURSING – BILBAO (327)

https://www.ehu.eus/es/web/medikuntza-erizaintza-fakultatea/erasmus-incoming-students
Contact: medicina.internacional@ehu.eus

	COURSE	SEMESTER[7]	CREDITS	SCHEDULE[8]	LINK TO SYLLABUS
Master's Degree in Public Health					
502862	Creación de un protocolo y desarrollo de un proyecto de investigación	2nd	9	M	

[7] SEMESTER: Annual: September 2024 to May 2025
1st: September 2024 to January 2025
2nd : January 2025 to May 2025
[8] SCHEDULE: Morning (M)/ Afternoon (A): begins at 13.30

Universidad del País Vasco Euskal Herriko Unibertsitatea

ENGLISH FRIENDLY COURSES (EFC) 2024-2025
CAMPUS OF BIZKAIA

MASTER COURSES FACULTY OF ENGINEERING – BILBAO (345)

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

	COURSE	SEMESTER[5]	CREDITS	SCHEDULE[6]	LINK TO SYLLABUS
Master's Degree in Telecommunications Engineering					
504005	Sistemas electrónicos de comunicaciones	Annual	9	M	➡
504007	Microelectrónica	1st	4,5	M	➡
504010	Convergencia e Integración de Redes de Acceso y Troncales	1st	4,5	M	➡
504022	Gestión y Metodología en Investigación	1st	3	M	➡
504023	Seguridad y Sistemas Distribuidos	1st	4,5	A	➡
504026	Tecnologías del Habla	1st	4,5	A	➡
504027	Procesado de señales biomédicas	1st	4,5	A	➡
504014	Laboratorio de circuitos digitales	2nd	4,5	M	➡
504018	Diseño avanzado de comunicaciones vía radio	2nd	7,5	M	➡
Master's Degree in Industrial Engineering					
503302	Diseño y Desarrollo de Producto	1st	4,5	A	➡
503905	Sistemas Integrados de Fabricación	1st	3	M	➡
503915	Dirección de Proyectos	1st	6	A	➡
503924	Laboratorio de Diseño de Producto	1st	4,5	A	➡
503955	Integración de Sistemas Industriales	1st	4,5	A	➡
503956	Automatización y Robótica	1st	6	A	➡

[5] SEMESTER: Annual: September 2024 to May 2025
1st: September 2024 to January 2025
2nd : January 2025 to May 2025
[6] SCHEDULE: Morning (M)/ Afternoon (A): begins at 13.30

	COURSE	SEMESTER[5]	CREDITS	SCHEDULE[6]	LINK TO SYLLABUS
503922	Diseño y Modelado Paramétrico	2nd	4,5	M	
503923	Ciclo de Vida del Producto	2nd	4,5	M	
503959	Gestión de Recursos Hidráulicos y centrales Hidroeléctricas	2nd	6	M	
503960	Oleohidráulica	2nd	3	M	
Master in Advanced Materials Engineering					
503320	Comportamiento mecánico de materiales	1st	4,5	A	
Master in Space Science and Technology					
501990	Física Espacial	1st	3	A	
501991	Fundamentos de Instrumentación Óptica	1st	3	A	
501994	Materiales para el Espacio I: Fundamentos	1st	3	A	
502005	Interferometría Espacial	2nd	3	A	
502006	Astronomía y Astrofísica	2nd	3	A	
502007	Física del Sistema Solar	2nd	3	A	
502001	Ensayos No Destructivos: Materiales Espaciales	2nd	3	A	
Master in Control Engineering, Automation and Robotics					
504137	Robótica Industrial	2nd	4,5	M	
204140	Integración de Sistemas Industriales	2nd	4,5	A	
Master in Mechanical Engineering					
504244	Metrología Dimensional	1st	6	A	

Universidad del País Vasco
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COURSE GUIDE 2024/25

Faculty 310 - Faculty of Science and Technology **Cycle** .

Degree INQUI15b - Master in Chemical Engineering **Year** .

COURSE

504253 - Advanced chemical reactors **Credits, ECTS:** 4,5

COURSE DESCRIPTION

This course is a continuation of the course Reactor Design of the Bachelor Degree in Chemical Engineering. The knowledge acquired in the design of conventional reactors, as well as new reactors for new processes for Chemical Reaction Engineering, Biochemistry and Electrochemistry is expanded.
The following aspects are addressed: i) fundamentals, analysis and design of reactors for heterogeneous (gas-solid, gas-liquid, liquid-liquid, gas-liquid-solid, solid-solid), electrochemical and biological (with microorganisms and enzymes) processes; ii) reactor selection and optimization of process conditions for catalytic, non-catalytic and multiphase processes; iii) analysis of the current state of technological development and prospects for innovation in the fields of knowledge and industrial implementation; v) analysis of the role of chemical reactors in sustainability and new processes of energy and environmental interest.
The course is closely related to others in the Master's program, such as Modelling and Simulation of Chemical Processes (calculation tools to simulate and design certain configurations of chemical reactors are discussed), as well as with several elective courses describing processes of energy and environmental interest with chemical reactors (such as Refinery and Petrochemical Technologies, Fuels from alternative sources to petroleum, Hydrogen: raw material and energy vector).

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Application of the knowledge from Mathematics, Physics, Chemistry, Biology, and other natural sciences obtained from their studies, experience, and practice, using critical thinking to establish technical solutions that are viable from the economic point of view.
Design of products, processes, systems, and services of the chemical industry, as well as the optimization of others that have already been developed, based on the diverse areas of Chemical Engineering: process understanding, transport phenomena, separation processes, and chemical, nuclear, electrochemical, and biochemical reactions.
Conceptualize engineering models, apply innovative methods in the resolution of problems and the application of proper computer applications for the design, simulation, optimization and control of the processes and the systems.
Have the ability to solve non-familiar problems, not-completely defined, and have competing specifications, considering the multiple ways of solution, including the most innovative ones, choosing the best and evaluating the different design solutions.
Manage and supervise all types of facilities, processes, systems and services of the different industrial areas related to chemical engineering.
Design, build and implement methods, processes and facilities for the integrated management of solid, liquid and gaseous supplies and wastes in industries, with the ability to assess their impacts and risks.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

After completing the course, students will be able to:
- Describe the characteristics of heterogeneous conventional reactors and newly designed reactors.
- Select the most suitable reactor for each process, depending on production, economic, safety, energetic and/or environmental criteria.
- Formulate and handle material and energy conservation equations of reactors.
- Design reactors under real flow conditions by means of flow models.
- Design and optimize the operating conditions of the reactors.

Theoretical and Practical Contents

1. Introduction: Current state and future prospects in reactor design. Chemical reaction engineering knowledge. New challenges for reactors in the chemical industry: energy, environment, materials. Emerging sectors. Conventional and newly designed heterogeneous reactors.
2. General aspects of catalytic reactors: catalysts, reaction mechanisms and kinetic equations. Consideration of the physical transport stages in the kinetics. Consideration of deactivation. Reactors for kinetic studies. Conventional configurations and new reactors.
3. Fixed bed catalytic reactors: Homogeneous and pseudohomogeneous design models. Considering real flow. Considering deactivation in the design. Strategies for attenuating deactivation.
4. Fluidized bed catalytic reactors: Different fluidization regimes and reactors. Bubbling fluidized bed: fluid dynamics, bed properties, design of the distributor, mixing and segregation indices, flow models for predicting conversion. Pneumatic transport reactors. New reactors.
5. Gas-solid non-catalytic reactors, General aspects: Reactions and kinetic models. Structural and non-structural models. Shrinking core models for particles of constant size: control of different stages. Particles of decreasing size.

6. Gas-solid non-catalytic reactors, Reactor configurations: Fixed and moving beds. Consideration of size distribution. Continuous fluidized bed reactors. Consideration of size distribution and residence time. Reactors for instantaneous reactions. Reactors for new processes of energy and environmental interest.
7. Biphasic reactors (G-L, L-L, S-S), General aspects: Reactions and kinetic modelling. Application of the two-film theory for obtaining kinetic equations in different regimes. Acceleration factor. Transport coefficients. S-S reactions.
8. Biphasic reactors (G-L, L-L, S-S), Reactor configurations: Consideration of flow models. Design of towers for fast reactions. Reactor-settler. Combination of reactors. S-S reactors.
9. G-L-S reactors: Solid reactant in fixed bed (trickle bed). Design for different regimes. Solid reactant in suspension. Comparison of reactors and contact strategies.
10. Electrochemical and nuclear reactors: Energetic and environmental applications. Batch and continuous reactors (stirred tank and plug flow). Combination of reactors. Scale-up solutions. Nuclear reaction engineering.
11. Bioreactors with microorganisms: Kinetics. Structured and unstructured models. Discontinuous and continuous reactors. Mass transfer.
12. Biological reactors with enzymes: Dissolved enzymes. Kinetics. Discontinuous and continuous reactors. Immobilization of enzymes. Reactors with immobilized enzymes.
13. Reactors for the petrochemical industry: FCC unit. Hydroprocessing units. Innovations in the design. Adaptation to new feeds. Challenges and future prospects.
14. Reactors for sustainability: Environmental determining factors. Contribution of reactor design to sustainability. New processes and innovations and future prospects for reactor design.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Groupwork	9,5	0 %
Case analysis	15	40 %
Expositive classes	23	100 %
Handling sources and resources	25	0 %
Exercises	40	40 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	17	6	17		5				
Horas de Actividad No Presencial del Alumno/a	25	9	25,5		8				

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	75 %	85 %
Practical tasks	15 %	25 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

3 tasks (non-presential):
1. Written exam (75 %): 2 midterm exams composed of 5/6 theoretical/practical questions. These questions are answered individually, after a period of preparation using available material on e-gela and bibliographic media. If students pass these midterm exams, do not have to do the corresponding parts in the final one.
Assessment criteria: The evaluation of each question will be based on clarity of expression, adequate writing, ability to synthesize and concreteness, as well as originality of the answer (possible internet search for information considered necessary).
Deadlines: The week following completion of the assessed topics in each partial exam (unless agreed to modify the deadline).
2. Individual written work (15 %): A written work on advanced reactor design for a process selected by each student will be carried out. This work will include fundamental aspects of reactor design, of any of the types and for any of the heterogeneous reactions studied in the course or others. The recommended length is around 12 pages (20 pages maximum) including title, nomenclature and bibliography (10 citations maximum).
Assessment criteria: Interest of the reactor studied; Interest of the content of the work from the point of view of reactor design; Concreteness and clarity; Quality and timeliness of the references.
Deadline: The week following the end of the course (unless agreed to modify the deadline).
3.Exercises (10 %): Design exercises of fixed bed and fluidized bed catalytic reactors will be carried out, using in the first case Scilab calculation software. The calculation program will be delivered, as well as the result obtained in the design of each reactor.

Evaluation criteria: Clarity of the calculation program and correctness of the values obtained; adequate description of the resolution procedure(s) used.
Deadline: Before the twelfth week of the course.

Withdrawal: The student will have to give advance notice regarding his/her withdrawal from the ordinary call in writing, at least one week before the exam. To do so, he/she will have to send an email to all of the lecturers of the subject in addition to the coordinator of the Master’s Degree.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

2 tasks (non-presential):
1. Written exam (80 %): 10 theoretical/practical questions.
2. Individual written work (10 %): same one as the one described for the ordinary call.
The assessment criteria are the same as the ones for the ordinary call.

Withdrawal: the same ones as for the ordinary call.

MANDATORY MATERIALS

- E-gela virtual classroom.
- Scilab Software.

BIBLIOGRAPHY

Basic bibliography

Froment, G.F., Bischoff, K.B., Chemical Reactor Analysis and Design, 2nd Ed, John Wiley, Nueva York, 1990.
Levenspiel, O., The Chemical Reactor Omniboook, OSU Book Stores Inc., Corvallis, USA , 1996.
King, M.B., Winterbottom, M., Naumann, E.B., Reactor Design for Chemical Engineers, Blackie Academic & Professional, 1997.
Coker, A.K., Kayode, C.A., Modeling of Chemical Kinetics and Reactor Design, Elsevier Inc., 2001.

Detailed bibliography

Kunii, D., Levenspiel, O., Fluidization Engineering, Butterworth-Heinemann, Newton, USA, 1991.
Rawlings, J.B., Ekerdt, J., Chemical Reactor Analysis and Design Fundamentals, Nob Hill Publishing, Madison. Wisconsin, 2002.
Jakobsen, H.A., Chemical Reactor Modeling, Springer Berlin Heilderberg, Berlin, 2008.
Ranade, V.V., Chaudhari, R.V., Gunjal, P.R., Trickle Bed Reactors, Elsevier B.V., 2011.
Kunii, D., Chisaki, T., Rotary Reactor Engineering, Elsevier B.V., Amsterdam, 2011.

Journals

AIChE Journal, Chemical Engineering Education, Chemical Engineering Journal, Chemical Engineering Science, Industrial Engineering Chemistry Research

Web sites of interest

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 310 - Faculty of Science and Technology **Cycle** .

Degree INQUI901 - Chemical Engineering **Year** .

COURSE

504254 - Advanced optimization of chemical processes **Credits, ECTS:** 4,5

COURSE DESCRIPTION

The chemical industry The chemical industry is undergoing huge changes worldwide, to the increased cost of energy, increasingly stringent environmental regulations, and global competition in product pricing and quality. One of the most important engineering tools for addressing these issues is optimization. Modifications in plant design and operating procedures have been implemented to reduce costs and meet constraints, with an emphasis on improving efficiency and increasing profitability.
The course focuses on three key aspects: Firstly on how to formulate optimization problems appropriately because many engineers and scientists find this phase of their decision-making process the most exasperating and difficult; secondly on modeling the optimization problem and thirdly on the analysis of optimization results.

To apply optimization effectively in the chemical industries, both the theory and practice of optimization must be understood, both of which are explained in this course. It is organized into four parts: linear programming, integer programming, nonlinear programming and design of experiments focused on plant optimization.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Apply knowledge of mathematics, physics, chemistry, biology, and other natural sciences, obtained through study, experience, and practice, with critical reasoning to establish economically viable solutions to technical problems
To design products, processes, systems and services for the chemical industry, as well as the optimization of others already developed, taking as a technological base the different areas of chemical engineering, including processes and transport phenomena, separation operations and chemical, nuclear, electrochemical and biochemical reaction engineering.
Conceptualize engineering models, apply innovative problem-solving methods and appropriate computer applications for the design, simulation, optimization and control of processes and systems.
Manage and supervise all types of installations, processes, systems and services in the different industrial areas related to chemical engineering.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Tras cursar la asignatura, el alumnado será capaz de:
- Identificar un problema de optimización en el ámbito de la ingeniería química.
- Definir un problema de optimización (lineal, entera o no-lineal).
- Seleccionar el método de optimización apropiado para la resolución de cada problema.
- Implementar el método de optimización y resolver el problema utilizando un software de cálculo apropiado.
- Analizar el resultado de un problema de optimización

Theoretical and Practical Contents

INTRODUCTION: Formulation of a optimization problema; types of problems; Review of basic techniques.
LINEAR PROGRAMMING: Problem definition. Simplex Algorithm. Examples and applications in Chemical Engineering.
NON-LINEAR PROGRAMMING: Problem definition. Nelder and Mead algorithm. Gradient based methods. Examples of regression application. Applications to Chemical Engineering.
INTEGER PROGRAMMING: Problem definition. Branching and dimensioning method. Dynamic programming. Practical examples.
DESIGN OR EXPERIMENTS: Design of optimization experiments. Advantages of experimental design. Minimum squares for linear models. Introduction to EVOP techniques. Examples.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Presentation and defence of projects	5	100 %
Exercises	10	20 %
Expositive classes	15	100 %
Handling sources and resources	17,5	0 %
Groupwork	30	30 %
Case analysis	35	40 %

TYPES OF TEACHING

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

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	0 %	50 %
Presentations	30 %	60 %
Practical tasks	40 %	70 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The assessment is continuous based on works made throughout the term. These works will be graded attending to criteria of originality, degree of difficulty, appropriateness, coherence, resolution, and presentation. At the end, students will take an individual test.

Students can resign the ordinary call until one month before classes are over. In this case, the student must send a written resignation to any of the teachers in charge for the subject.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary assessment call, students will have take and exam and submit and present a individual work on optimization.

MANDATORY MATERIALS

Matlab.

BIBLIOGRAPHY

Basic bibliography

Edgar, T.F., Himmelblau, E., Optimization of Chemical Processes, McGraw-Hill, 1988.
Box, G.E.P., Hunter, W.G., Hunter, J.S., Estadística para Investigadores, Reverté, Barcelona, 1988.

Box, G.E.P., Hunter, W.G., Hunter, J.S., Estadística para Investigadores, Reverté, Barcelona, 1988.

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Douglas, J.M., Conceptual Design of Chemical Processes, McGraw-Hill, Chem. Eng. Series, 1988.
Puigjaner, L.,Ollero, P., Prada, C., Jiménez, L., Estrategias de Modelado, Simulación y Optimización de Procesos Químicos, Ed. Síntesis, 2006.
Taguchi, G., Introductiont to Quality Engineering. Designing Quality into Products and Proceses, Quality Resources, 1990

Journals

Industrial & Engineering Chemistry Research
Chemical Engineering Science
Chemical Engineering Processing

Web sites of interest

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 310 - Faculty of Science and Technology **Cycle** .

Degree INQUI901 - Chemical Engineering **Year** .

COURSE

504255 - Modelling and simulation of chemical processes **Credits, ECTS:** 6

COURSE DESCRIPTION

This subject is a core subject from the Chemical Engineering field and therefore it is mandatory, like in any other Chemical Engineering Master’s Degree in Spain or around the world. In order to take advantage of the course, it is necessary to have studied the basic subjects of Chemical Engineering. This includes subjects that deal with transport phenomena (Fluid Mechanics, Heat Transfer, and Mass Transfer), as well as those that deal with the design of chemical reactors (Kinetics of Chemical Processes and Reactor Design) and separation processes (Separation Processes). Moreover, it is recommended to have knowledge of the following subjects: Numerical Methods, Thermodynamics, Instrumentation and Control of Chemical Processes, and Programming. All of these subjects are included in the Chemical Engineering Bachelor Degree in addition to many other technical Bachelor Degrees. The knowledge and use of scientific programming languages such as Scilab and Matlab or that of process simulation in steady state (Pro II, ASPEN, HYSIS, or DWSIM) is desirable, but not imperative. The subject is closely related to all the contents from the Master’s that broaden the knowledge of the foundations of Chemical Engineering: Advanced Chemical Reactors, Advanced Process Control, Advanced Separation Processes, and Advanced Optimization of Chemical Processes.

Studying and passing this subject provides the student with the ability to approach the modelling and simulation of non-steady physic-chemical processes of industrial interest, using the calculus capacity of microprocessors to build tools that give way to address the effect of the design variables and those of operation conditions on the results of the process. The possibilities to actually apply the knowledge acquired in this subject in real professional practice are then unlimited.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Aplicar conocimientos de matemáticas, física, química, biología y otras ciencias naturales, obtenidos mediante estudio, experiencia, y práctica, con razonamiento crítico para establecer soluciones viables económicamente a problemas técnicos

Diseñar productos, procesos, sistemas y servicios de la industria química, así como la optimización de otros ya desarrollados, tomando como base tecnológica las diversas áreas de la ingeniería química, comprensivas de procesos y fenómenos de transporte, operaciones de separación e ingeniería de las reacciones químicas, nucleares, electroquímicas y bioquímicas

Conceptualizar modelos de ingeniería, aplicar métodos innovadores en la resolución de problemas y aplicaciones informáticas adecuadas, para el diseño, simulación, optimización y control de procesos y sistemas

Tener habilidad para solucionar problemas que son poco familiares, incompletamente definidos, y tienen especificaciones en competencia, considerando los posibles métodos de solución, incluidos los más innovadores, seleccionando el más apropiado, y poder corregir la puesta en práctica, evaluando las diferentes soluciones de diseño

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Tras cursar la asignatura, el alumnado será capaz de:
- Identificar los fenómenos fundamentales que controlan un proceso
- Desarrollar el modelado matemático
- Resolver las ecuaciones mediante herramientas de cálculo avanzadas
- Evaluar la adecuación del modelo desarrollado en base al análisis de los resultados
- Proponer y ejecutar la simulación de situaciones diversas y estudiar la respuesta del modelo

Theoretical and Practical Contents

Mass and Momentum balances in steady and non-steady state. Transfer in the interface. Microscopic Mass and Momentum balances in steady and non-steady state: equation of continuity. Velocity profiles.
Macroscopic Energy Balances in steady and non-steady state. Transfer in the interface.
Microscopic Energy Balances: temperature profiles in solid and fluid mediums.
Macroscopic and Microscopic Mass Balances in multicomponent systems. Concentration profiles with one or more independent variables. Transfer in the interface.
Macroscopic and Microscopic Mass Balances in multicomponent systems with chemical reactions. Inclusion of the kinetic model to the Mass balance. Concentration profiles with one or more independent variables. Numerical methods for the resulting equations of the modelling: multiple linear equations, multiple non-linear equations, ordinary differential equations, and partial differential equations.
Preparation of the developed model by computer software for evaluation and external use.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Presentation and defence of projects	6	100 %
Expositive classes	12	100 %
Handling sources and resources	17	0 %
Groupwork	30	40 %
Case analysis	40	30 %
Exercises	45	40 %

TYPES OF TEACHING

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

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	0 %	40 %
Presentations	20 %	40 %
Practical tasks	40 %	80 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EVALUATION CRITERIA:

(1) Voluntary exercises: 30%
Theoretical exercises: In order to obtain the maximum grade a well-written and reasoned report, with a well-explained approach to the balances corresponding to the proposed system is required.
Practical exercises: In order to obtain the maximum grade the following are required: a checked algorithm that has been validated functionally. Moreover, a report must contain: 1) the approach to the balances corresponding to the proposed system, 2) the required mathematical development to obtain the system model, 3) a flow-chart of the algorithm that explains the resolution strategy, and 4) an analysis of the results obtained by simulation.
The maximum grade of this section is reached by properly carrying out 5 of the 8 proposed exercises.
(2) GUI Exercise: 20%
The evaluation of the GUI will be carried out by the following criteria:
Operability (0-10, weight: 5)
Number of elements (1 point/element, weight: 1)
Number of different elements (1 point/type of element, weight: 3)
Aesthetics (0-10, weight: 2)
Originality (0-10, weight: 2)

(3) Continuous assessment of the subject: 10%
Glossary: each original contribution will be valued at 1 point
Forum:
Question: 1 point
First answer: 2 points
Excellent answer: 3 points
All the points obtained in the glossary and the forum will be summed.
The student will have to obtain 40 points in order to reach the maximum grade of this section.
(4) Final Exam: 40%
The student will have to carry out a complete modelling and simulation of the process in question. All the material available in egela is allowed for its use in the exam.

FINAL MARK:

A minimum mark of 4/10 is required in each section that is evaluated.

WITHDRAWAL:

The student will have to give advance notice regarding his/her withdrawal from the ordinary call in writing, at least 24

hours before the exam. To do so, he/she will have to send an email to all of the lecturers of the subject in addition to the coordinator of the Master’s Degree.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EVALUATION CRITERIA:

The same ones as for the ordinary call.

WITHDRAWAL:

The student will have to give advance notice regarding his/her withdrawal from the ordinary call in writing, at least 24 hours before the exam. To do so, he/she will have to send an email to all of the lecturers of the subject in addition to the coordinator of the Master’s Degree.

MANDATORY MATERIALS

Egela virtual classroom
Software: Scilab and Matlab

BIBLIOGRAPHY

Basic bibliography

Ingham, J., Dunn, I.J., Heizle, E., Prenosil, J.E., Snape, J.B. Chemical Engineering Dynamics. An Introduction to Modelling and Computer Simulation. 3rd Ed. Wiley-VCH, 2007
Bird, R.B., Steward, W.E., Lightfoot, E. N., Transport phenomena, 2nd edition, Wiley (2005)

Detailed bibliography

Ramírez, W.F., Computational Methods for Process Simulations, Butterworths, 1989.
Welty, J.R., C.E. Wicks, R.E. Wilson, and G. Rorrer, Fundamentals of Momentum, Heat, and Mass Transfer, 4th edition, Wiley (2000).
Constantinides, A., Mostoufi, N., Numerical Methods for Chemical Engineers with Matlab Applications, Prentice Hall (1999)
Marchand, P., Holland, O.T., Graphics and GUIs with Matlab, 3rd edition, Chapman & Hall/CRC (2003)

Journals

www.sciencedirect.com/science/bookseries/15707946

Web sites of interest

http://www.berkeleymadonna.com
www.mathworks.es/

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 310 - Faculty of Science and Technology **Cycle** .

Degree INQUI15b - Master in Chemical Engineering **Year** .

COURSE

504263 - Fuels from alternative sources to oil **Credits, ECTS:** 3

COURSE DESCRIPTION

"Fuels from Alternative Sources to Petroleum" is an elective subject of 3 ECTS credits, which is taught in the second semester of the Master's Degree in Chemical Engineering. The objective of the course is to advance in the knowledge of chemical technologies for obtaining products of interest and automotive fuels from alternative raw materials to petroleum (coal, natural gas and vegetable biomass). The current status and prospects for the development of technologies to obtain and valorize the different alternative raw materials are studied.
First, the raw materials related to C1 chemistry (coal and natural gas via synthesis gas, and methanol/dimethylether) are analyzed and then the so-called biofuels (bioethanol, biodiesel and biooil or pyrolysis liquid) are studied.
At the end of the subject, the student will be able to make a critical analysis of the technological status and viability of the different processes for obtaining fuels by alternative means to oil.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

To know the current status of the technologies for the valorization of alternative raw materials to oil (coal, natural gas, biomass), both those related to C1 chemistry (via synthesis gas) and biofuels (bioethanol, biodiesel and biooil).
Handle bibliographic sources that allow access to the scientific and technological advances, to international trends in the use of alternative technologies and raw materials to oil, and to studies and data offered by specialized agencies and business groups.
Identify the best options among the technological proposals studied according to the context and possibilities of each region.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

After taking the course, students will be able to:
- Know the processes of obtaining fuels from alternative sources to oil.
- Analyze the feasibility of using raw materials: oil, coal, natural gas and biomass.
- Know how to discriminate between the different catalytic processes for the sustainable production of fuels.
- To be able to design technologies related to C1 chemistry and to the production of biofuels.
- To estimate the CO2 valorization capacity in biorefinery processes.

Theoretical and Practical Contents

LESSON 1: THE BIOREFINERY. Socioeconomic perspectives of petroleum supply and petrochemical industry. Alternative sources for energy production and automotive fuels. Industrial exploitation and sustainability. Intermediate compounds and key steps in alternative technology to petrochemicals. C1 chemistry. Biofuels.

LESSON 2: SYNTHESIS GAS AS A FEEDSTOCK.
I. Synthesis gas production. Coal gasification. Steam reforming and partial oxidation of natural gas. Biomass gasification. Obtaining from methanol.
II. Transformation of synthesis gas into fuels and intermediates. Fischer-Tropsch technology. Methanol synthesis. Gasoline synthesis in one reaction stage. One-step and two-step dimethylether (DME) synthesis.

LESSON 3: BIOETHANOL AS A FUEL AND RAW MATERIAL. Obtaining and purification of ethanol from biomass. Technological status of biomass fermentation. Bioethanol concentration. Properties as a fuel. Formation of emulsions for gasoline and diesel engines. Bioethanol valorization. Transformation to olefins and automotive fuels. Reforming to obtain hydrogen.

LESSON 4: BIODIESEL. Composition and properties as a fuel. Direct use and emulsions. Storage problems. Obtaining biodiesel. Raw materials. Pyrolysis of vegetable oils. Transesterification: mechanism and kinetics, feed requirements, catalysts, reaction technologies and operating conditions. Economic feasibility of biodiesel utilization.

LESSON 5: BIOOIL FROM BIOMASS PYROLYSIS. Composition, properties and storage. Direct use as fuel. Combustion in diesel engines, formation of emulsions. Valorization by catalytic transformation: Obtaining olefins and fuels. Obtaining hydrogen by reforming. Catalysts, kinetic modeling and reactor technology.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Presentation and defence of projects	3	100 %
Handling experimental equipment and facilities	4	100 %
Groupwork	6	0 %

Exercises	10	30 %
Case analysis	10	20 %
Expositive classes	18	100 %
Handling sources and resources	24	0 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	18	5	3	4					
Horas de Actividad No Presencial del Alumno/a	22	11	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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	50 %	70 %
Presentations	15 %	30 %
Practical tasks	15 %	30 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation of the subject in the ordinary call will consist of:
1. The completion of theoretical-practical tasks (papers, exhibitions, laboratory practices), with a weighting of 50%, being necessary a minimum score of 3.
2. Final written exam on, with a weighting of 50%, being necessary a minimum score of 3.
In order to pass the course, a minimum grade of 5 will be required, as an average of the two previous sections.
In order to waive the ordinary exam, a signed letter must be submitted to the professor (at least 10 days before the exam) indicating such intention.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation of the subject in the extraordinary call will consist of a final exam, with a weighting of 100%. In no case will be considered the negative results obtained during the ordinary call.
In order to waive the extraordinary exam, a signed letter must be submitted to the professor (at least 10 days before the exam is held) indicating such intention.

MANDATORY MATERIALS

eGela teaching material: theoretical presentations, notes, bibliography, etc.

BIBLIOGRAPHY

Basic bibliography

- Kamm, B., Gruber, P.R. (Eds.). Biorefineries- Industrial Processes and Products, Status and Future Directions, John Wiley & Sons, Inc., Chichester (UK), 2005.
- Klass, D.L., Biomass for Renewable Energy, Fuels, and Chemicals, Academic Press, San Diego, 1998.

Detailed bibliography

- Anderson, R.B., The Fischer-Tropsch Synthesis, Academic Press, Nueva York, 1984.
- Cheng, W.H., Kung, H.H., Methanol, Production and Use, Marcel Dekker, Nueva York, 1994.
- Wender, I., Reaction of Synthesis Gas, Fuel Process. Technol., 48, 189 (1996).

Journals

Ind. Eng. Chem. Res., AIChE J., Energy and Fuels, Fuel, Fuel Proc. Technol., Chem. Eng. J., Energy Conv. Manage., Energy, Biomass Bioenergy, Bioresouce Technol., J. Catal., Appl. Catal., Catal. Today
Proceedings of specific congresses published by Elsevier and other publishers (Gas-fuel, Natural Gas Conversion, Energy from Biomass and Wastes, European Bioenergy Conference, International Conference on Greenhouse Gas Control Technology).

Web sites of interest

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 310 - Faculty of Science and Technology **Cycle** .

Degree INQUI901 - Chemical Engineering **Year** .

COURSE

504265 - Refinery and petrochemical technologies **Credits, ECTS:** 3

COURSE DESCRIPTION

In this course we study the refinery processes that allow obtaining fuels and chemicals(raw materials of the petrochemical industry and lubricants) from crude oil. Special emphasis is placed on the state of the art of current technology and the challenges in the medium and long term, based on two fundamental aspects: the quality of the products obtained and the environmental challenges of each stage. The course includes the visit to a industrial site and laboratory experiments.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Understand the current state of the standard technologies in industrial facilities of petroleum refining and petrochemical industries, pointing out the tendencies of processing of raw materials.
Manage bibliographic sources that allow access to scientific and technological advances, to international technology trends in the use raw materials. Studding data offered by specialized enterprises in the sector.
Knowing how to identify the best options among the technological proposals studied according to the context and the possibilities of each region.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Tras cursar la asignatura, el alumnado será capaz de:
- Identificar y describir las diferentes unidades existentes en la refinería y en la industria petroquímica, en base a las materias primas, productos, tecnologías, condiciones de operación y catalizadores.
- Caracterizar las principales propiedades del crudo y/o productos derivados (especialmente los combustibles y lubricantes).
- Investigar, a través de búsquedas en bases de datos, y comunicar de forma oral y/o escrita los avances tecnológicos de las diferentes unidades de la refinería y la industria petroquímica.
- Redactar informes técnicos sobre un proceso catalítico desarrollado en los laboratorios de investigación

Theoretical and Practical Contents

1. Introduction: Socio-economic perspective of the oil supply and the petrochemical industry. Properties of crude oil. General scheme of a refinery

2. Fractionation of crude oil: atmospheric distillation unit. Vacuum unit. Future trends: Progressive distillation unit

3. Catalytic reforming, Isomerization, Alkylation and Oligomerization: Catalytic reforming. Isomerization. Alkylation. Oligomerization

4. Fluidized Catalytic Cracking: Feedstock and products. The reactor (riser-downer). The regenerator. Process variables and optimization. Challenges of the FCC

5. Hydrocracking and Hydrotreatment: Processes. Feedstock and products. The reactor Process variables and optimization. Challenges

6. Thermal Conversion: Coking. Visbreaking. Future trends

7. Petrochemical: Light olefins. Aromatics

8. Lubricants: Lubricants. Tribology

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Visit to industrial sites	4	100 %
Groupwork	8	50 %
Expositive classes	18	100 %
Handling experimental equipment and facilities	20	20 %
Handling sources and resources	25	0 %

TYPES OF TEACHING

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

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	30 %	70 %
Practical tasks	30 %	70 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The ordinary call consists of the evaluation of two parts, weighted in the following way:
- Written exam, 60% of the note
- Individual practical work, 40% of the mark

In case of renouncing the ordinary call, the assessment will be carried out in the following way:
Written exam, 100% of the grade, containing additional questions to assess the knowledge evaluated in the "Individual practical work "

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The extraordinary exam consist of a written exam that accounts for 100% of the grade, containing additional questions to assess the knowledge evaluated in the "Individual practical work "

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

- Wauquier, J.P., El Refino del petróleo. Petróleo crudo, productos petrolíferos y esquemas de fabricación, Ed. Diaz de Santos, 2004
- Ramos Carpio, M. A., Refino del petróleo, gas natural y petroquímica; Ed. Fundación Fomento Innovación industrial, Madrid (1997).
- Leprince, P., Petroleum Refining. 3. Conversion Processes. Ed. Technip, 2001
- Matar, S. Hatch, L. F., Chemistry of Petrochemical Proceses, Elsevier, 2000
- Chauvel, A., Lefebvre, G., Petrochemical Processes. Technical and Economic Characteristics; Ed. Technip, Paris, 1989.

Detailed bibliography

- Meyers, R.A., Handbook of Petroleum Refining Processes, Ed. McGraw-Hill, 2003
- Parkash S., Refining Processes Handbook, Elsevier, 2003
- Speight, J.G., Petroleum Refining Processes (Chemical Industries), Ed. Marcel Dekker, 2002

Journals

Ind. Eng. Chem. Res., AIChE J., Energy and Fuels, Fuel, Fuel Proc. Technol., Chem. Eng. J., Energy Conv. Manage., Energy,...)

Web sites of interest

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 310 - Faculty of Science and Technology **Cycle** .

Degree INQUI15b - Master in Chemical Engineering **Year** .

COURSE

504267 - Catalytic technologies for air pollution control **Credits, ECTS:** 3

COURSE DESCRIPTION

Advantages of catalysis for gaseous pollutants removal.
Applications of catalytic systems for mobile exhaust gas control (automobile petrol engines, diesel and lean-burn engines, ozone decomposition in airplanes).
Catalytic technologies for stationary emissions (volatile organic compounds, nitrogen oxides, gas turbine emissions, small engines).
New and emerging technologies: environment air cleaning, emergent pollutants, CO2 capture and valorization).

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

To understand the importance of air quality and learn assessment methodology, identify how gaseous and particulate matter contribute to air pollution and discuss historical cases and control.
To discern between pollution prevention methods and post-treatment technologies. To know available pollution control technologies and be able to select the most appropriate for every pollutant or pollution source
Determinar qué tipo de tecnología de control se requiere y/o es la más apropiada para cada tipo de contaminante o fuente de contaminación del aire
To discuss and propose improved strategies and stablish new challenges for future air pollution control and management

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

After completing the course, students should be able to:
- Know the advantages of catalytic technologies for air pollutants control.
- Select the catalytic process most efficient for every pollutant and emission source.
- Analyze key variables in designing structured catalysts for environmental applications.
- Apply scientific-technological criteria for designing efficient catalysts for air pollutants emissions after treatment.

Theoretical and Practical Contents

Lesson 1. General discussion on plausible strategies and future challenges for atmospheric pollution management and control.
Lesson 2. General aspects of air pollution control.
Lesson 3. Particulate matter air pollution control.
Lesson 4. Mobile exhaust gas control: petrol engines.
Lesson 5. Mobile exhaust control: diesel and lean-burn engines.
Lesson 6. Stationary souces: volatile organic compounds control.
Lesson 7. Stationary sources: nitrogen oxides and sulphur oxides.
Lesson 8. Air pollution and global climate change.
Lesson 9. Other minor sources and pollutants.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Visit to industrial sites	3	100 %
Case analysis	6	50 %
Expositive classes	15	100 %
Groupwork	15	20 %
Handling sources and resources	16	0 %
Exercises	20	30 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15	6	6						3
Horas de Actividad No Presencial del Alumno/a	15	18	9						3

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	50 %	70 %
Presentations	15 %	35 %
Practical tasks	15 %	35 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Al finalizar cada uno de los temas, los estudintes deberán responder a un cuestionario teórico-práctico acerca de los contenidos del tema, que permita evaluar el nivel de comprensión y puesta en marcha de las tecnologías analizadas. La evaluación podrá realizarse tanto por los profesores de la asignatura como mediante evaluación por pares entre los propios estudiantes.
Algunos aspectos concretos de los temas serán preparados por los propios estudiantes para su exposición pública al resto de compañeros y debate colectivo. La participación activa en esta actividad será evaluada por los profesores.
Al final del curso, se realizará una prueba final de adquisición de conocimientos y competencias aprendidos al cursar la asignatura.

NOTA.- Si existieran condiciones de exigencia sanitaria, algunas de las actividades presenciales serán programadas para su realización a través de tecnologías telemáticas, que serán oportunamente comunicadas.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Los estudiantes que no superen la evaluación continua de la asignatura, basada en las actividades realizadas durante el curso y el exámen final ordinario, tendrán derecho a la realización de una nueva prueba en convocatoria extraordinaria. Esta prueba constará de tantas actividades, de naturaleza similar a las realizadas durante el curso, como sean necesarias para evaluar si el estudiante ha adqurido los conocimientos y competencias de la asignatura.

MANDATORY MATERIALS

Presentaciones y actividades disponibles en el aula virtual e-gela de la asignatura, a la que el alumno tendrá acceso tras la matrícula en el curso.

BIBLIOGRAPHY

Basic bibliography

- Ronald M. Heck, Robert J. Farrauto, Suresh T. Gulati, "Catalytic Air Pollution Control. Commercial Technology". 3ª edición, John Wiley & Sons, New Jersey, USA (2009).
- Noel de Nevers. "Air Pollution Control Engineering". 2nd edition, Weveland Press, Inc., Long Grove, IL, USA (2010).

Detailed bibliography

Reviews and scientific papers supplied by teachers for analysis and discussion.

Journals

Applied Catalysis B: Environmental
Catalysis Today
Chemosphere
Environmental Science and Technology
Topics in Catalysis
Industrial and Engineering Chemistry Research

Web sites of interest

http://www.epa.gov, Environmental Protection Agency.
http://www.eea.europa.eu/es. Agencia Europea del Medio Ambiente.
Other more specific will be supplied during lectures.

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 310 - Faculty of Science and Technology **Cycle** .

Degree INQUI15b - Master in Chemical Engineering **Year** .

COURSE

504270 - Waste valorisation **Credits, ECTS:** 3

COURSE DESCRIPTION

The Waste Valorization course deals with the analysis of the problems of industrial waste, as well as its characterization, and decision-making about its management. It deals with the evaluation of the state of the art and the development of the available technologies for waste valorization.
It considers the use of alternatives to waste minimization and valorization to solve practical problems and the application of waste valorization processes to practical cases of waste generation.
In order to expand training in energy and waste, it is recommended to study the optional subject of the university Master's Degree in Chemical Engineering "Remediation of Contaminated soils".

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Understand the problem of industrial waste, as well as, characterize it, and make decisions about its management.
Evaluate the state of the art and the development of available technologies for waste valorization.
Analyze alternatives to waste minimization and valorization to solve practical problems.
Apply waste valorization processes to practical cases of waste generation.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

After studying the subject, students will be able to:
- Analyze and interpret the application of current legislation on waste and characterization of industrial waste
- Identify and describe the main industrial waste valorization processes
- Select the most appropriate management among the alternatives for the minimization and valorization of specific waste in accordance with current legislation

Theoretical and Practical Contents

Topic 1. Urban and industrial waste. Current legislation on waste. Types of waste, management and waste treatment.
Topic 2. Valorization processes of waste biomass, industrial sludge and waste from polluted soil. Application of valorization processes.
Topic 3. Processes for valorization of waste plastics. Application of valorization processes.
Topic 4. Processes for valorization of end-of-life tyres. Application of valorization processes.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Expositive classes	13	100 %
Case analysis	15	40 %
Handling sources and resources	22	0 %
Exercises	25	44 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	13	6	5		6				
Horas de Actividad No Presencial del Alumno/a	18	9	9		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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Presentations	30 %	70 %
Practical tasks	30 %	70 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Abstracts, reports, and presentations tasks: 70-80%

Tasks of questions in a fixed time: 20-30%

The assessment guidelines in this subject are based on the documents: "Regulatory Regulations for Student Assessment in Official Undergraduate Degrees" and "Protocol on Academic Ethics and Prevention of Dishonest or Fraudulent Practices in Assessment Tests and Academic Papers at the UPV/EHU" (https://www.ehu.eus/es/web/estudiosdegrado-gradukoikasketak/akademia-araudiak)"

REQUESTING FOR FINAL ASSESSMENT SYSTEM
Students who want to be assessed by the final assessment system, regardless of their participation in the continuous assessment, will have to submit a written resignation to continuous evaluation, filling in the form available in egela of the VR subject and uploading the completed form through the VR subject in egela, for which they will have a period of 9 weeks (weeks 1 to 9 of the semester), according to the academic calendar of the center. (Art. 8.3 Text approved in the Degree Committee of May 16, 2019).
Resignations will NOT be accepted by other means, nor after the deadline.

RESIGNATION TO THE CALL
Both in the case of continuous and final assessment, since the weight of the final exam of the subject "Waste valorization" is greater than 40% of the subject's grade, it will be sufficient not to go to the final exam so that the final grade of the subject is << not presented >>. (Art. 12.2 Text approved in the Degree Committee of May 16, 2019 and applicable in 2019/20)

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

ASSESSMENT:
Assessment proof/final exam 100% of the total
The assessment guidelines in this subject are based on the documents: "Regulatory Regulations for Student Assessment in Official Undergraduate Degrees" and "Protocol on Academic Ethics and Prevention of Dishonest or Fraudulent Practices in Assessment Tests and academic papers at the UPV/EHU" (https://www.ehu.eus/es/web/estudiosdegrado-gradukoikasketak/akademia-araudiak)"

RESIGNATION TO THE CALL
RESIGNATION TO THE CALL
It is sufficient not to go to the extraordinary exam, so that the final grade of the subject is << not presented >>.

MANDATORY MATERIALS

Course notes and basic bibliography

BIBLIOGRAPHY

Basic bibliography

- LaGrega, M.D., Buckingham, P.L., Evans, J.C., 1996. Gestión de residuos tóxicos. Tratamiento, eliminación y recuperación de suelos. McGraw-Hill Interamericana.
- Marañon, E. Residuos industriales y suelos contaminados. 2000, Servicio de publicaciones, U Oviedo, Oviedo.

Detailed bibliography

Aguado, J., Serrado, D., Feedstock Recycling of Waste Plastics, Royal Society of Chemistry, 1999
California Integrated Waste Management Board, Environmental Factors of Waste Tire Pyrolysis, Gasification, and Liquefaction, 1995.
Curlee, T.R., Das, S., Plastic Wastes. Management, Control, Recycling, and Disposal, US Environmental Protection Agency, 1991.
Scheirs J. Kaminsky, W. Feedstock Recycling and Pyrolysis of Waste Plastics,, Wiley, 2006
Klass, D.L., Biomass for Renewable Energy, Fuels, and Chemicals, Academic Press, 1998.

Journals

Environmental Science and Technology, Chemical Engineering Science, Fuel, Energy and Fuels, Industrial and Engineering Chemistry Research, Waste Management, Energy Conversion and Management, ¿

Web sites of interest

www.epa.gov/osw/
http://www.ibet.pt/Industry/
Water_energy_and_the_environment/Waste_valorization.htm

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 310 - Faculty of Science and Technology **Cycle** .

Degree QAPLI902 - Synthetic and Industrial Chemistry **Year** .

COURSE

504304 - Advanced Chemical Synthesis **Credits, ECTS:** 3

COURSE DESCRIPTION

The course belongs to the common module of 12 ECTS of the Master involving compulsory courses and is taught during the first semester of the year. The four constituent courses of this module will provide students with essential advanced knowledge complementing that received in the Degree. This first semester is therefore basically theoretical and allows the students to complete their basic training and provides them with the basis for their Master's thesis.

The Advanced Chemical Synthesis is a course that is directly related to the compulsory subjects of the common module "Metals in Synthesis" and "Stereocontrolled Synthesis" of the first semester and to the optional subjects of the speciality modules "Advanced Organic Chemistry" of the first semester and "Design and Synthesis of Drugs" Synthesis in Solid Phase and Combinatorial Chemistry" taught in the second semester.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Planificar la síntesis de una molécula objetivo mediante el análisis retrosintético
Seleccionar y aplicar metodologías sintéticas eficientes a la síntesis de compuestos de interés
Identificar y discutir las etapas clave de una secuencia de síntesis,

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

Unit 1. Introduction to Organic Synthesis. General principles. Efficiency and selectivity in synthesis. Methodology and strategies. Design of synthesis processes. Retrosynthetic analysis.

Unit 2. Electrophilic synthons. Nucleophilic synthons: stabilized and unstabilized carbanions. Disconnection of monofunctional systems. Disconnection of difunctional systems. Synthetic examples

Unit 3. Protective groups and auxiliary groups in organic synthesis. Practical examples.

Unit 4. Formation of C-C and C-heteroatom bonds.

Unit 5. Synthesis by pericyclic reactions: Synthetic examples of cycloaddition reactions, electrocyclic reactions and sigmatropic transpositions.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Reading and practical analysis	4	100 %
Groupwork	5	0 %
Handling sources and resources	5	0 %
Expositive classes	16	100 %
Text analysis	20	0 %
Exercises	25	40 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	16	4	10						
Horas de Actividad No Presencial del Alumno/a	24	6	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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	40 %	70 %

Practical tasks	30 %	60 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Due to the Coronavirus pandemic, this evaluation method could suffer changes if the guidelines of the sanitary authorities require it so. The necessary modifications would be announced timely.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Due to the Coronavirus pandemic, this evaluation method could suffer changes if the guidelines of the sanitary authorities require it so. The necessary modifications would be announced timely.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

-"Modern Methods of Organic Synthesis", W. Carruthers, I. Coldham, 4th Ed., Cambridge University Press, 2004.
-"Organic Synthesis" M. B. Smith, 4th Ed., Academic Press, 2016.
-"Organic Synthesis: The Disconnection Approach", S. Warren, Jonh Wiley and Sons, 1983.
-"Diseño de Síntesis Orgánica: Introducción Programada al Método del Sintón", S. Warren, Ed. Alhambra, Madrid, 1983.
-"Análisis Retrosintético y Síntesis Orgánica", M. Carda, J. A. Marco, J. Murga, E. Falomir, Publications de la Universitat Jaume I, 2010.
-"Green Chemistry, an Introductory Text", Lancaster, M., 2nd ed., RSC Publishing, 2010 -"Cycloaddition Reactions in Organic Synthesis", Wiley-UCH, 2002, S. Kobayashi, K.A. Jorgensen.
-"Protecting Groups", Thieme, 2004, P.J. Kocienski.
-"Greene`s Protective Groups in Organic Synthesis, Wiley-VCH, 2007, P.G.H. Wuts, T.W. Greene.

Detailed bibliography

-"Advanced Organic Chemistry: Reactions, Mechanism and Structure", 5th Edition, J. March, M. B. Smith, J. Wiley, New York, 2001.
- "Organic Synthesis Highlights" Series, Varios, Wiley-VCH.

Journals

Web sites of interest

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 310 - Faculty of Science and Technology **Cycle** .

Degree QAPLI902 - Synthetic and Industrial Chemistry **Year** .

COURSE

504312 - Natural Products: Synthesis, Biosynthesis and Applications **Credits, ECTS:** 3

COURSE DESCRIPTION

COMPETENCIES/LEARNING RESULTS
Understanding of the structures of the Secondary Metabolism Natural Products, and how they are produced and interconverted in nature (35%)
Ability to propose reasonable biosynthetic pathways for given natural products (25%)
Ability to apply the principles of synthetic design to the synthesis of relevant natural products (40%)

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Conocer y entender las estructuras de los Productos Naturales del metabolismo secundario y cómo se sintetizan y se interconvierten en los seres vivos

Proponer rutas biosintéticas razonables para productos naturales
Aplicar los principios del diseño de síntesis a la síntesis de Productos Naturales de interés

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

secondary metabolism. Elucidating biosynthetic pathways. .
Chapter 2.. The Acetate pathway (I). Fatty acids and derivatives.. Polyketides: de from tetraketides to decaketides. Tetracyclines. Macrocyclic antibiotics. Polyketides of marine origin..
Chapter 3. The Acetate pathway (II). Terpenes. From monoterpenes to tetraterpenes. MVA and MEP pathways. Cannabinoids. Natural fragances. Carotenoids. Chemistry of vision.
Chapter 4. The Shikimate pathway. Aromatic aminoacids and phenylpropanoids. Secondary metabolites from the shikimate pathway : lignanes and lignin. Coumarines, Flavonoids. Pharmacological properties.
Chapter 5. Alkaloids. Pyrrolidine, piperidine and tropane alkaloids. Tobaco alkaloids. Isoquinoline alkaloids. Opium alkaloids. Indole alkaloids. Phramacological properties.
Chapter 6. Peptides and othe aminoacid derivatives.Peptides. beta-lactam antibiotics. Penicillins and cephalosporins. Macrocyclic peptides.
Chapter 7. Total synthesis. Design and synthetic strategies towards natural product synthesis..
Chapter 8. Recent advances in natural product synthesis. Selected examples

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Expositive classes	12	100 %
Text analysis	18	0 %
Groupwork	20	40 %
Exercises	25	40 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	12	8	10						
Horas de Actividad No Presencial del Alumno/a	18	12	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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	30 %	70 %
Practical tasks	30 %	70 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The final grade will be the result of the following parts:.

1. Written theory and practice exam: The exam will consist of theory and practice written exercises on the topics worked during the course. The appropriate approach to the exercises will be assessed, as well as the coherence and accuracy of the answers. The pass mark is 5/10.
2. Individual work. Set of exercises. Each student will be given a set of exercises that she/he will have to deliver at the end of the course. Bibliographic resources are allowed to solve these exercises. The appropriate approach to the exercises will be assessed, as well as the coherence and accuracy of the answers. The pass mark is 5/10.
Declining to sit implies not taking part in any of the above assessment parts.

This assessment system could be modified if required by the Sanitary authorities.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

1. Written theory and practice exam: The exam will consist of theory and practice written exercises on the topics worked during the course. The appropriate approach to the exercises will be assessed, as well as the coherence and accuracy of the answers. The pass mark is 5/10.
2. Individual work. Set of exercises. Each student will be given a set of exercises that she/he will have to deliver at the end of the course. Bibliographic resources are allowed to solve these exercises. The appropriate approach to the exercises will be assessed, as well as the coherence and accuracy of the answers. The pass mark is 5/10.

This assessment systems could be modified if required by the Sanitary authorities.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Dewick, P. M. "Medicinal Natural Products. A Biosynthetic Approach", 3ª ed.,Wiley, Chichester, 2009

Detailed bibliography

Mann, J.; Davidson, R. S.; Hobbs, J. B.; Banthorpe, D. V.; Harborne, J. B. . "Natural Products. Their chemistry and biological significance", Addison Wesley Longman, Essex 1996
Marco, J.A., "Química de los Productos Naturales", Ed. Síntesis, Madrid, 2006
Nicolau, K. C.; Sorensen, E. J. "Classics in Total Synthesis. Targets, Strategies, Methods". WCH, Weinheim, 1996.
Nicolau, K. C.; Snyder, S. A "Classics in Total Synthesis II.". Wiley-WCH, Weinheim, 2003

Journals

Web sites of interest

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty	321 - Faculty of Economics and Business	**Cycle**	.
Degree	DIREM18b - Business Management from an Innovation and Internationalizatio	**Year**	.

COURSE

502109 - Ecological Marketing: Research strategies and techniques for Sustainable development

Credits, ECTS: 3

COURSE DESCRIPTION

The deterioration of the environment is probably the most serious threat that the human species has faced during its existence. Environmental problems such as climate change, the destruction of remaining natural spaces, the mass extinction of species, and the accumulation of plastics in the environment require urgent actions for their deceleration and mitigation. Achieving the sustainability of economic and industrial activity is imperative for both current and future generations.

This course addresses corporate sustainability not as a burden imposed, but as an opportunity for the development of successful innovations in international markets through a sustainability marketing approach. The marketing of sustainable products and services offers companies significant opportunities for internationalization by meeting the needs of global market segments. The course also examines how sustainability can be an important driver of innovation and differentiation, as the sustainability dimension provides the opportunity to develop innovative products that are distinguished from conventional ones by their sustainability. For example, the course explores these aspects in the case of marketing organic products in international markets and the transition to a low-carbon economy through innovations that drive consumer demand for energy from renewable sources.

The course is approached with the United Nations' Sustainable Development Goals (SDGs), included in the 2030 Agenda of the United Nations Development Programme (UNDP), in mind.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Definir una metodología de trabajo e investigación, básica y aplicada, que permita al alumno identificar y desarrollar líneas de investigación orientadas a la mejora de la competitividad empresarial y del medio ambiente.
Perseguir de forma continuada la mejora en el conocimiento asumiendo un compromiso ético con el trabajo, la sociedad y el medio ambiente.
Elaborar y presentar cualquier informe (escrito u oral) sobre el ámbito de estudio, bien sea a un público especializado o no especializado, con claridad y coherencia.
Analizar y sintetizar información proveniente de diversas fuentes y con capacidad crítica, para emitir juicios razonados sobre temas relevantes de índole económico, social o científico.
Manejar bases de datos a disposición del alumnado, para discernir la información útil en la actividad investigadora.
Aprender a hacer una base de datos propia para el desarrollo de trabajos de investigación.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Reconocer un problema de investigaci¿e relevancia en el ¿a del marketing ecol¿o.

Saber dise¿un trabajo de investigaci¿corde a las necesidades del problema de investigaci¿ analizar, vinculado con aspectos del marketing ecol¿o.

Seleccionar y aplicar una metodolog¿de investigaci¿oherente con los objetivos de investigaci¿en el ¿a del marketing para la sostenibilidad).

Ser capaz de emitir juicios fundamentados sobre temas relevantes de ¿ole social a partir de la interpretaci¿e datos relacionados con su ¿a de conocimiento.

Identificar oportunidades y desaf¿ para un desarrollo m¿sostenible en el dise¿e acciones y estrategias vinculadas a un contexto determinado o campo de estudio en direcci¿mpresarial.

Dise¿un proyecto dentro de l¿tes realistas de car¿er econ¿o, ambiental, social, ¿co, de seguridad y sostenibilidad.

Theoretical and Practical Contents

MARKETING FOR GLOBAL SUSTAINABILITY

SUSTAINABLE CONSUMER BEHAVIOR FROM A GLOBAL PERSPECTIVE

PRODUCT AND SERVICE SUSTAINABILITY AS A STRATEGY FOR INNOVATION AND DIFFERENTIATION

DETERMINING FACTORS OF INTERNATIONAL DEMAND FOR ORGANIC AGRICULTURAL PRODUCTS

THE TRANSITION TO A LOW-CARBON ECONOMY: OPPORTUNITIES FOR INNOVATION AND INTERNATIONALIZATION

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Discussion	1	100 %
Group discussion	1	100 %
Handling sources and resources	4	25 %
Visit to industrial sites	4	100 %
Analysing and discussing papers	5	20 %
Groupwork	5	80 %
Reading and practical analysis	5	20 %
Case analysis	10	10 %
Drawing up reports and presentations	10	10 %
Student's personal work	15	0 %
Expositive classes	15	100 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15	15							
Horas de Actividad No Presencial del Alumno/a	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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Presentations	5 %	10 %
Oral defence of the final master's dissertation	5 %	10 %
Otros: Participación activa en clase (trabajo en equipo, respuesta a preguntas, planteamiento de dudas reflexivas, etc.)	10 %	20 %
Practical tasks	15 %	30 %
Written preparation of the final master's dissertation	15 %	30 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Apaolaza, V., Hartmann, P., Paredes, M. R., Trujillo, A., & D'Souza, C. (2022). What motivates consumers to buy fashion pet clothing? The role of attachment, pet anthropomorphism, and self-expansion. Journal of Business Research, 141, 367-379.

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Barrutia, J. M., Echebarria, C., Aguado-Moralejo, I., Apaolaza-Ibáñez, V., & Hartmann, P. (2022). Leading smart city projects: Government dynamic capabilities and public value creation. Technological Forecasting and Social Change, 179, 121679.

Apaolaza, V., Paredes, M. R., Hartmann, P., García-Merino, J. D., & Marcos, A. (2022). The effect of threat and fear of COVID-19 on booking intentions of full board hotels: The roles of perceived coping efficacy and present-hedonism orientation. International Journal of Hospitality Management, 105, 103255.

Apaolaza, V., Paredes, M. R., Hartmann, P., Barrutia, J. M., & Echebarria, C. (2022). How does mindfulness relate to proenvironmental behavior? The mediating influence of cognitive reappraisal and climate change awareness. Journal of Cleaner Production, 357, 131914.

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243-262). Springer, Singapore.
Policarpo, M. C., Aguiar, E. C., Marcos, A., Hartmann, P., & Apaolaza, V. (2022). The Role of Green Product Pricing in Conspicuous Green Consumption Behaviour—A Brazilian Perspective. In Environmental Sustainability in Emerging Markets (pp. 1-21). Springer, Singapore.
D’Souza, C., Taghian, M., Apaolaza, V., Hartmann, P., Brouwer, A., & Chowdhury, B. (2021). Consumer Self-Confidence in Green Foods: An Investigation of the Role of Ecolabels Using the Theory of Planned Behavior and Market Segmentation. Journal of International Food & Agribusiness Marketing, 1-31.
D'Souza, C., Apaolaza, V., Hartmann, P., Brouwer, A. R., & Nguyen, N. (2021). Consumer acceptance of irradiated food and information disclosure–A retail imperative. Journal of retailing and consumer services, 63, 102699.
Fernández, P., Hartmann, P., & Apaolaza, V. (2021). What drives CSR communication effectiveness on social media? A process-based theoretical framework and research agenda. International Journal of Advertising, 1-29.
D’Souza, C.; Apaolaza, V.; Hartmann, P.; Brouwer, A.R. (2020). Marketing for sustainability: Travellers’ intentions to stay in green hotels. Journal of Vacation Marketing, Published online December 4, https://doi.org/10.1177/1356766720975063.
Paredes, M. R., Apaolaza, V., Fernandez-Robin, C., Hartmann, P., & Yañez-Martinez, D. (2020). The impact of the COVID-19 pandemic on subjective mental well-being: The interplay of perceived threat, future anxiety and resilience. Personality and Individual Differences, 170, 110455.
Apaolaza, V., Paredes, M. R., Hartmann, P., & D’Souza, C. (2020). How does restaurant’s symbolic design affect photo-posting on instagram? The moderating role of community commitment and coolness. Journal of Hospitality Marketing & Management, 1-17. https://doi.org/10.1080/19368623.2020.1768195.
D'Souza, C., Apaolaza, V., Hartmann, P., & Gilmore, A. (2020). Fairtrade nexus between just-world beliefs and normative antecedents. Marketing Intelligence & Planning. Vol. 38 No. 7, pp. 991-1005. https://doi.org/10.1108/MIP-04-2020-0170.
Hartmann, P., Fernández, P., Apaolaza, V., Eisend, M., & D’Souza, C. (2020). Explaining Viral CSR Message Propagation in Social Media: The Role of Normative Influences. Journal of Business Ethics, 1-21.
Apaolaza, V., Hartmann, P., Fernández-Robin, C., & Yáñez, D. (2020). Natural plants in hospitality servicescapes: the role of perceived aesthetic value. International Journal of Contemporary Hospitality Management. Vol. 32 No. 2, pp. 665-682.
Apaolaza, V., Hartmann, P., D'Souza, C., & Gilsanz, A. (2019). Mindfulness, Compulsive Mobile Social Media Use, and Derived Stress: The Mediating Roles of Self-Esteem and Social Anxiety. Cyberpsychology, Behavior, and Social Networking. Published Online:7 Jun 2019 https://doi.org/10.1089/cyber.2018.0681.
Hartmann, P., Apaolaza, V., & D’Souza, C. (2018). The role of psychological empowerment in climate-protective consumer behaviour: An extension of the value-belief-norm framework. European Journal of Marketing, 52(1/2), 392-417.
Apaolaza, V., Hartmann, P., D'Souza, C., & López, C. M. (2018). Eat organic–Feel good? The relationship between organic food consumption, health concern and subjective wellbeing. Food quality and preference, 63, 51-62.

Detailed bibliography

Apaolaza, V., Paredes, M. R., Hartmann, P., Barrutia, J. M., & Echebarria, C. (2022). How does mindfulness relate to proenvironmental behavior? The mediating influence of cognitive reappraisal and climate change awareness. Journal of Cleaner Production, 357, 131914.
Policarpo, M. C., Aguiar, E. C., Marcos, A., Hartmann, P., & Apaolaza, V. (2022). The Role of Green Product Pricing in Conspicuous Green Consumption Behaviour. A Brazilian Perspective. In Environmental Sustainability in Emerging Markets (pp. 1-21). Springer, Singapore.
D’Souza, C., Taghian, M., Apaolaza, V., Hartmann, P., Brouwer, A., & Chowdhury, B. (2021). Consumer Self-Confidence in Green Foods: An Investigation of the Role of Ecolabels Using the Theory of Planned Behavior and Market Segmentation. Journal of International Food & Agribusiness Marketing, 1-31.
Fernández, P., Hartmann, P., & Apaolaza, V. (2021). What drives CSR communication effectiveness on social media? A process-based theoretical framework and research agenda. International Journal of Advertising, 1-29.
D’Souza, C.; Apaolaza, V.; Hartmann, P.; Brouwer, A.R. (2020). Marketing for sustainability: Travellers’ intentions to stay in green hotels. Journal of Vacation Marketing, Published online December 4, https://doi.org/10.1177/1356766720975063.
D'Souza, C., Apaolaza, V., Hartmann, P., & Gilmore, A. (2020). Fairtrade nexus between just-world beliefs and normative antecedents. Marketing Intelligence & Planning. Vol. 38 No. 7, pp. 991-1005.
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Apaolaza, V., Hartmann, P., Fernández-Robin, C., & Yáñez, D. (2020). Natural plants in hospitality servicescapes: the role of perceived aesthetic value. International Journal of Contemporary Hospitality Management. Vol. 32 No. 2.

Journals

Web sites of interest

HTTP://WWW.EUSKADI.NET/

WWW.IHOBE.NET/

WWW.EUSKADIKALITATEA.NET/

WWW.ICLEI.ORG/

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 321 - Faculty of Economics and Business **Cycle** .

Degree DIREM18b - Business Management from an Innovation and Internationalizatio **Year** .

COURSE

502110 - Consumer Behaviour and Brand Management: Research Methods **Credits, ECTS:** 3

COURSE DESCRIPTION

A successful marketing plan must begin with a deep understanding of the consumer. There is a vast amount of research and empirical evidence that supports the development of consumer behavior studies within the marketing discipline. At the same time, in recent decades, business practices have undergone significant changes, which have evolved alongside the increasing complexity of the market. This complexity has favored, in the context of marketing, the development of the strategic aspect of marketing, whose fundamental functions include the analysis and understanding of consumers.

Consequently, understanding and characterizing the consumer are the central themes upon which this course is built. From our discipline, we recognize the need to carry out a thorough analysis and deep understanding of consumer behavior, from the psychology of decision-making, allowing students to grasp how the rules governing human behavior can be applied in a marketing context. Therefore, consumer knowledge and behavior will be of great importance for companies in the development and implementation of their various marketing policies and, specifically, in the design and execution of their brand strategies.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Realizar investigación básica y aplicada en el campo del comportamiento del consumidor, con una base científica y metodológica sólida.
Perseguir de forma continuada la mejora en el conocimiento asumiendo un compromiso ético con el trabajo, la sociedad y el medio ambiente.
Elaborar y presentar cualquier informe (escrito u oral) sobre el ámbito de estudio, bien sea a un público especializado o no especializado, con claridad y coherencia.
Analizar y sintetizar información proveniente de diversas fuentes y con capacidad crítica, para emitir juicios razonados sobre temas relevantes de índole económico, social o científico.
Manejar bases de datos a disposición del alumnado, para discernir la información útil en la actividad investigadora.
Aprender a hacer una base de datos propia para el desarrollo de trabajos de investigación.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

¿ Comprensi¿ manejo de conceptos asociados al estudio del comportamiento del consumidor.
¿ Comprensi¿ manejo de conceptos asociados a la gesti¿e la imagen de marcas.
¿ Reconocer un problema de investigaci¿e relevancia en el ¿a del comportamiento del consumidor, y la direcci¿ gesti¿e marcas.
¿ Saber dise¿un plan de investigaci¿corde a las necesidades del problema de investigaci¿ analizar, vinculado a aspectos concreto del comportamiento del consumidor, y/o la direcci¿ gesti¿e marcas.
¿ Seleccionar y aplicar una metodolog¿de investigaci¿oherente con los objetivos de investigaci¿en el campo de estudio del comportamiento del consumidor, y/o la direcci¿ gesti¿e marcas).

Theoretical and Practical Contents

CONSUMER BEHAVIOR: INFLUENCING FACTORS

EMOTIONS AND THEIR INFLUENCE ON CONSUMER BEHAVIOR

EVOLUTIONARY PSYCHOLOGY: EVOLUTIONARY PATTERNS OF BEHAVIOR

BRAND MANAGEMENT: DETERMINING ITS ATTRIBUTES AND BENEFITS

CONSUMER SATISFACTION AND LOYALTY TOWARD BRANDS

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Group discussion	5	100 %
Handling sources and resources	5	20 %
Presentations and Papers	5,5	100 %
Student's personal work	10	30 %
Readings	10	0 %

Groupwork	10,5	48 %
Expositive classes	14	100 %
Drawing up reports and presentations	15	10 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15	15							
Horas de Actividad No Presencial del Alumno/a	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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Attendance and participation	10 %	20 %
Critical debate in the classroom	10 %	20 %
Presentations	30 %	40 %
Otros: Redacción del trabajo en grupo o individual	50 %	60 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Apaolaza, V., Hartmann, P., Paredes, M. R., Trujillo, A., & D'Souza, C. (2022). What motivates consumers to buy fashion pet clothing? The role of attachment, pet anthropomorphism, and self-expansion. Journal of Business Research, 141, 367-379.

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Barrutia, J. M., Echebarria, C., Aguado-Moralejo, I., Apaolaza-Ibáñez, V., & Hartmann, P. (2022). Leading smart city projects: Government dynamic capabilities and public value creation. Technological Forecasting and Social Change, 179, 121679.

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Journals

Web sites of interest

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 321 - Faculty of Economics and Business **Cycle** .

Degree DIREM401 - Master in Business Management From An Innovation and Interna **Year** .

COURSE

502120 - Family Business Governance and Control **Credits, ECTS:** 3

COURSE DESCRIPTION

DESCRIPTION AND CONTEXTUALIZATION OF THE COURSE

Family firms account for two thirds of all businesses around the world, generate around 70-90 percent of annual global GDP, and create 50-80 percent of jobs in the majority of countries worldwide, playing a significant role in economic growth and territorial development. Common denominators of such firms include family involvement in the enterprise and a desire to maintain family control over the business in future generations.

The particular nature of such enterprises and the interaction between family and firm significantly influences ownership, governance and management, clearly marking them out from non-family businesses. These distinctive features add greater complexity to firms management and it is important to understand the relationships arising out of the relationship between family and firm and the particular elements they bring to governance and management.

Aims of the course

This course is oriented towards management of family businesses. Its main purpose is therefore to provide students with tools for understanding family firms’ behaviour. The course will examine specific features of family firms including setting objectives (economic and noneconomic), generational succession, governing bodies, relationships between firm and family and internal behavior. In addition, their relationships and their influence on entrepreneurship, innovation and the internationalization strategy, among other aspects, are also analyzed.

COMPETENCIES AND LEARNING OUTCOMES

The expected learning outcomes can be summarised as follows:

-Knowing and understanding the specific nature of the family business and the implications of such circumstances for governance and management.

-Understanding the challenges and dynamics of family firms throughout their lifecycles and their continuity over time.

-Identifying the strengths and weaknesses of family businesses, enabling the acquisition of skills for managing business and family systems.

-Understanding the concept of corporate governance in a broad sense, and its application in the context of the family firm.

-Identifying the governance structures of the family business and the business family, as well as the mechanisms for channelling the relationships between these structures.

-Being able to understand the influence of economic and non-economic aspects derived from the family nature in the strategic decision-making of the business, especially in relation to the entrepreneurship, the innovation and the internationalization of the family business.

-Developing management skills that promote growth and internationalisation of the family firm.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Conocer el peso de la empresa familiar en la economía
Conocer las características que diferencian a la empresa familiar de la no familiar
Ser capaz de identificar el control familiar en distintos estructuras empresariales: de propiedad concentrada y de propiedad dispersa
Comprender las relaciones de agencia en el seno de la empresa familiar
Identificar los conflictos de interés entre los distintos agentes vinculados a la empresa familiar
Ser capaz de comprender la influencia del altruismo en los costes de agencia

Comprender el concepto de gobierno corporativo en un sentido amplio, y la razón de la existencia de Códigos de Buen Gobierno
Ser capaz de trasladar el concepto de gobierno corporativo a la peculiaridad de la empresa familiar
Identificar las estructuras de gobierno de la empresa familiar y de la familia empresaria, así como los mecanismos para encauzar las relaciones entre dichas estructuras

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

- Distinguir los elementos que permiten identificar una empresa de carácter familiar.

- Determinar características singulares de la empresa familiar que pueden ser fuente de ventaja competitiva.

- Determinar características singulares de la empresa familiar que pueden ser fuente de conflictos.

- Explicar las relaciones entre propiedad, dirección y familia desde una perspectiva generacional.

- Aplicar los conceptos de gobierno corporativo a la empresa familiar y a la familia empresaria.

- Sintetizar y determinar los mecanismos que canalizan las relaciones entre la familia y la empresa.

- Comprender las paradojas que pueden plantearse en el gobierno y dirección de la empresa familiar: tradición, innovación e internacionalización.

Theoretical and Practical Contents

1. FAMILY FIRM: CULTURE AND VALUES.

2. DESIGN OF GOVERNMENT STRUCTURES OF THE FAMILY FIRM.

3. TRANSGENERATIONAL CONTINUITY OF THE FAMILY FIRM.

4. INNOVATION, ENTREPRENEURSHIP, AND INTERNATIONALIZATION OF THE FAMILY FIRM.

5. UNIQUENESS IN THE FINANCIAL ASPECTS OF THE FAMILY FIRM.

The course contents is complemented with a series of seminars and conferences given by staff and executives from family businesses. This activity is organised by the Family Business Chair at the University of the Basque Country, in collaboration with the Provincial Government of Bizkaia, Bilbao Chamber of Commerce, CEBEK (the Businesses Confederation of Bizkaia) and AEFAME (Association of Family Firms of the Basque Country).

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Groupwork	3	0 %
Group discussion	4	100 %
Discussion	4	100 %
Information presentation	4	100 %
Handling sources and resources	4	50 %
Tutorials	4	50 %
Presentation and defence of projects	6	100 %
Student's personal work	8	0 %
Case studies	8	100 %
Drawing up reports and presentations	10	0 %
Expositive classes	20	100 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15	15							
Horas de Actividad No Presencial del Alumno/a	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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Attendance and participation	20 %	40 %
Critical debate in the classroom	20 %	40 %
Continuous evaluation	10 %	30 %
Presentations	20 %	40 %
Practical tasks	10 %	30 %
Written preparation of the final master's dissertation	20 %	40 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

ORGANIZATION OF THE SUBJECT, ASSESSMENT PROCEDURES AND THE STUDENT'S LEARNING TASKS

Overall assessment will take into account the achievement of objectives, acquisition of skills and assimilation of the course contents. This will include attendance at classes and active participation in the classroom, as well as attendance at proposed activities and the submission of assignments.

Assignments may be submitted in either of the two official languages of the Basque Autonomous Country (Spanish and Basque) or in English. Likewise, if pupils are interested in carrying out their final assignment in English, lecturers will ensure proper monitoring and tutoring.

The weight of each of the activities in the final grade is as follows: 20% attendance at classes with active participation in them, 10% attendance at conferences, colloquia or other activity offered by teachers and 70% with tests and proposed tasks.

To pass the subject, it is compulsory to attend at least 80% of the face-to-face classes and take the tests and proposed tasks. In addition, the score achieved, after applying the planned weightings, must reach, at least, the threshold of 5. The tasks will be carried out as the course is developed, and will be presented on the dates determined and communicated by the teaching staff.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY CALL: GUIDELINES AND WAIVER

In the extraordinary call, the evaluation of the subject will be carried out through a final test with all the theoretical-practical contents that have been addressed during the course.

The final test will comprise 100% of the grade for the course.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Detailed bibliography

Journals

EUROPEAN JOURNAL FAMILY BUSINESS
http://www.revistas.uma.es/index.php/ejfb

FAMILY BUSINESS REVIEW
https://journals.sagepub.com/home/fbr

JOURNAL OF FAMILY BUSINESS MANAGEMENT
https://www.emerald.com/insight/publication/issn/2043-6238

JOURNAL OF FAMILY BUSINESS STRATEGY
https://www.journals.elsevier.com/journal-of-family-business-strategy

Web sites of interest

Chair in SMEs and Family Business of UPV/EHU: http://www.ehu.eus/es/web/catedra-empresa-familiar

Spanish Family Business Institute: http://www.iefamiliar.com/

International Family Enterprise Research Academy (IFERA): https://ifera.org/

Family Firm Institute: https://www.ffi.org/

Institute for Family Business: https://www.ifb.org.uk/

Universidad del País Vasco Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 321 - Faculty of Economics and Business **Cycle** .

Degree DIREM401 - Master in Business Management From An Innovation and Interna **Year** .

COURSE

502122 - Globalisation and financial management **Credits, ECTS:** 3

COURSE DESCRIPTION

This course is optional and is taught in the first semester of the first year of the University Master in Business Management from Innovation and Internationalization. This subject is generally taken by students who come from different grades, such as: business administration and management, economics, engineering, law, advertising and communication, etc.
The students in this master must acquire the ability to have a critical and rational vision and, also a synthetic ability about readings, academicals articles and data around Business Management. It will explain and practice communicate skills, both with their peers / and with the academic community and with society in the fields of financial economics, market research and marketing, and Business Management. Thus, the main objective is that students become familiar with financial management from a perspective of financial globalization. Financial decisions in the company must be made efficiently and for them new technologies are an important instrument, but it is also important to make them understand the integration of ethical and sustainable commitment as essential components in their decisions. Students generally come with financial knowledge, as they have taken subjects such as Financial Management: Financing (2nd year of ADE and 4th GADEDE) or Management of Financial Markets (4th year). In the case of students who have not completed finance subjects in their grades, they are provided with supplementary materials so that they can monitor the classes efficiently.
In particular, this subject includes a large part of the topics that are considered basic for the initial training of financial and management chief positions that require financial advisory skills. In this subject, in addition to the concepts of economic-financial globalization, financial management, treasury management, topics related to ethical behavior are included, or the inclusion of sustainable and / or ethical finance to instill students towards the fulfillment of the SDGs , specifically, the Sustainable Economy (SDG 8).
The starting point is the definition of the different financial entities and the framework in which they are developed. Subsequently, their management tasks are analyzed, focusing on those related to the sources of financing, investment and operations in the financial markets, as well as the adequate management of the risks assumed. It ends with a global vision, studying the different strategic lines followed by credit institutions.
The teachers who explain this subject promote academic ethics by encouraging sensitivity and perception of the ethical aspects of students, both in their attitude within the classroom and in the performance of individual or team work and various tasks and practices throughout the course.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Potenciar la capacidad investigadora en finanzas: desarrollar las habilidades para identificar, analizar, estudiar y dar solución a los problemas científicos en finanzas
Comprender el nuevo entorno financiero que rodea a las empresas
Aprender a identificar los posibles efectos derivados de fenómenos aún emergentes
Desarrollar la capacidad de adaptación al nuevo entorno empresarial
Comprender los fundamentos de la gestión de tesorería
Aprender a identificar los efectos de una modificación de la política de dividendos sobre el valor de la empresa
Aprender a identificar la metodología de investigación empírica que se ajusta al objetivo de un trabajo.
Aprender a identificar y valorar los problemas éticos en las finanzas

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

1.- Comprensión de los aspectos que le permite interrelacionar los diferentes conceptos en un entorno globalizado y considerando la sostenibilidad como criterio inclusivo.
2.- Analizar los factores de la globalización económica y financiera que afectan a la gestión financiera, y a la gestión de tesorería en particular.
3.- Identificar, comprender y analizar los conceptos éticos y los factores que propician y condicionan las finanzas.
4.- Identificar y comprender las funciones, responsabilidades y decisiones del gestor financiero en una economía sostenible.
5.- Comunicar de forma comprensiva los resultados de un caso de estudio relacionado con la materia con fluidez oral y escrita.

Theoretical and Practical Contents

Contents:
Part I: Research in Finance
-The purpose of the research in finance: problem and research questions
-The publication in international high quality journals
-Empirical studies in Corporate Finance

Part II: Cash Management
- Treasury Management vs. Cash Management
- Treasury Management: a financial culture
- Information and Communication Technologies in cash management
-New technologies
Part III: Ethics in Finance
-New perspectives of finance: from benefit to values
-Sustainability Finance
-The case of ethics in trade credit and cash holding
-Ethical banks and Social efficiency of banking
Part IV: Economical and Financial Globalisation
- Concept and origin of economic and financial globalization
- The development context of the economic and financial globalization process
- Level achieved in economic and financial globalization
- Positive effects and negative effects of globalization
Part V: Adaptation of business financial management to financial globalization
- Adaptation of the financial function
- Adaptation of the tasks to be performed by the financial function
-Country risk

Note: At the beginning of the semester the students will receive (through the web) a detailed schedule of the different topics. Exercises and notes will be uploaded to the web system for the students to work on them. The basic bibliography will be provided using university platform.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Readings	10	0 %
Student's personal work	15	0 %
Group discussion	20	40 %
Expositive classes	30	100 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15	15							
Horas de Actividad No Presencial del Alumno/a	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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Attendance and participation	15 %	35 %
Evaluation by means of the presentation of projects	10 %	25 %
Presentations	15 %	35 %
Questions to discuss	10 %	30 %
Writing up the teamwork	15 %	35 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

1. A compulsory written test (10% of the final grade), which will consist of various questions of theoretical and practical content.
2. Carrying out activities - classroom practices and group work - (40% of the final grade):
i. Task 1: use of ICTs to detect ethical problems in the area of finance and their defense in written and oral form (with recording) (15% of the final grade).
ii. Task 2: critical reflection of current articles on financial globalization (25% of the final grade).
b. The development of activities (individual or in group) of a participatory and compulsory nature in the classroom will allow obtaining the remaining 5 points (50% of the final grade). In total, various practices will be carried out (depending on the academic year-see on eGela):
i. Practice 1: search, read and comment on articles and information related to financial globalization.
ii. Practice 2: search for information and presentation on ethical concepts
iii. Practice 3: analysis using Excel of financial decisions
iv. Practice 4: feedback between the students and the exhibitions. Opinions.

Teaching will be done in person (or bimodally, if the size of the group does not make it possible for all the students to attend the classroom in person). If for health reasons classroom attendance is not allowed in the classroom, it will go to online teaching and assessment. All information will be upload in eGela.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Same that ordinary.
Teaching will be done in person (or bimodally, if the size of the group does not make it possible for all the students to attend the classroom in person). If for health reasons classroom attendance is not allowed in the classroom, it will go to online teaching and assessment. All information will be upload in eGela.

MANDATORY MATERIALS

There is no mandatory manual, but the students will gest resources upload and share by the professor (slides and articles). It will reduce the taking of notes during classrooms. This material will be available in the eGela. If someone needs for any reason the materials can be provided via mail / wetransfer or give more materials about it.

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Detailed bibliography

Bibliografía complementaria
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EICHENGREEN, B. y M.D. BORDO (2002): ¿Crises now and then: what lessons from the last era of financial globalization?¿. National Bureau of Economic Research (NBER) Working Paper, nº 8716, Cambridge, pp. 55.
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GUITIÁN, M. y F. VARELA (2000): Sistemas financieros ante la globalización. Pirámide, Madrid.
HARDOUVELIS, G.; D. MALLIAROPULUS y R. PRIESTLEY (2003): ¿The impact of globalization on the equity cost of capital¿. Social Science Research Network (SSRN) Working Paper, febrero, pp. 42.
ITURRALDE, I.; MASEDA, A. & SAN-JOSE, L. (2004): ¿Cash Management: análisis empírico de una cultura financiera¿, Revista Iberoamericana de Contabilidad y Gestion, II (1), 151-175.
MASIH, A.M. y R. MASIH (2002): ¿Propagative causal price transmission among international stock markets: evidence from the pre- and post globalization period¿. Global Finance Journal, vol. 13, nº 1, pp. 63-91

Journals

- Estrategia financiera: http://www.estrategiafinanciera.es/
- Inversión y finanzas.
- Finanzas.com: http://www.finanzas.com/
- Diario expansión: http://www.expansion.com/
- El economista: http://www.eleconomista.es/
- El confidencial: http. //www.elconfidencial.com
-Corresponsables: https://www.corresponsables.com

Monográficos
ARESTIS, P. y S. BASU (2003): ¿Financial globalization and regulation¿. The Levy Economics Institute of Bard College Working Paper, nº 397, pp. 19.
BANCO MUNDIAL (2000): ¿¿Qué es la globalización?¿. PREM Grupo de políticas económicas y Grupo de economía para el desarrollo, abril.

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PRASAD, E.; K. ROGOFF, S. WEI y M.A. KOSE (2003): ¿Effects of financial globalization on developing countries: some empirical evidence¿. International Monetary Fund (IMF) Occasional Paper, nº 220, septiembre, pp. 86.

Web sites of interest

Direcciones web de utilidad
ASSET. TESOREROS DE ESPAÑA: https://asset.es/
BANCA ÉTICA: http://bancaetica.cat/es/
BANCO CENTRAL EUROPEO: http://www.ecb.int/ecb/html/index.es.html
BANCO DE ESPAÑA: http://www.bde.es
COMISIÓN NACIONAL DEL MERCADO DE VALORES: http://www.cnmv.es
ECONOMYWEB: http://www.economyweb.com
EUROPEAN BUSSINESS ETHICS NETWORK: https://www.eben-spain.org/
EUROPEAN FINANCE ASSOCIATION: http://european-finance.org/r/home
FINANZAS PARA TODOS: http://www.finanzasparatodos.es/
INSTITUTO SUPERIOR TECNICAS/PRACTICAS BANCA: http://www.iberfinanzas.com
POLITICAS DE LA UNION EUROPEA: http://europa.eu.int/scadplus/leg/es/l00000.htm
UNIÓN EUROPEA: http://www.europa.eu.int/index-es.htm

BLOGS…
http://www.loyolaandnews.es/seccion/blogs-tematicos/etica-y-finanzas/
https://blog.iese.edu/antonioargandona/
http://blog.cristianismeijusticia.net/2012/03/16/hacia-unas-finanzas-eticas-al-servicio-de-los-pueblos-por-jordi-mari

Universidad del País Vasco Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 321 - Faculty of Economics and Business **Cycle** .

Degree ECONO802 - Master in Economics: Economic Analysis Tools **Year** .

COURSE

503485 - Econometrics **Credits, ECTS:** 4

COURSE DESCRIPTION

Econometrics is a compulsory subject in the Interuniversity Master's Degree in Economics: Tools of Economic Analysis. It is taught simultaneously and in a coordinated way in the three universities that offer this program.

The work developed in this course allows students to use the linear regression model to analyze the behavior of economic variables using the data available (cross-sectional, time series and panel). The regression model will be studied in depth, with special emphasis on the alternative estimators used in the case of non-compliance with the assumptions.

Knowledge of descriptive statistics and probability theory as well as statistical inference is necessary to follow this Econometrics course properly. In addition, it is necessary to know how to use linear and matrix algebra at a basic level.

The linear regression model is a useful model to apply in those subjects that require the analysis of economic models for decision making.

Specific Competences

To acquire a solid knowledge of modern statistical-econometric methods for the quantification of economic relations, the comparison of theories and the evaluation of public policies.

To know and use the different sources of microeconomic and macroeconomic data relevant for the evaluation of the labour market situation: labour force survey, salary structure survey.

To understand the logic of modelling and econometric methods for the analysis of time series and cross-section data, as well as their usefulness in economic forecasting.

Carry out empirical work, selecting the appropriate statistical-econometric methods according to the nature of the data and the problem to be analyzed and using specialized computer programs.
To interpret and transmit the results of a quantitative analysis and to prepare reports.

In addition to the basic competencies of this course, the following Transversal Competencies are worked on throughout the course:

CT1692 - Managing information and communication technologies in your professional and research performance in the field of economic analysis.
CT1702 - Planning tasks, organizing resources and managing time efficiently.
CT1709 - To identify and solve specific problems by developing the capacity for analysis and synthesis.
CT1711 - Communicate fluently, both orally and in writing in Spanish, and read, understand and write texts in English.

The learning outcomes of this course, related to the specific competences are

- To apply economic theory to represent real-life situations.

- To interpret in economic terms the mathematical results of formal models.

- To know how to look for information relevant to evaluate the economic situation both at a territorial level and in the different markets of interest: labour, financial, ..., using different sources of microeconomic and macroeconomic data

- To understand the logic of econometric modelling for the analysis of time series. cross-section and panel data.

- To acquire solid knowledge of modern statistical-econometric methods for the quantification of economic relations, the contrast of theories and prediction.

- To apply the econometric-statistical methods for the analysis and evaluation of economic policies, whether at the public or private, local, national or international level.

- To carry out empirical work, selecting the appropriate statistical-econometric methods according to the nature of the

data and the problem to be analysed and using specialised computer programmes.

- To interpret and transmit the results of a quantitative analysis and prepare reports.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Manejar los métodos estadístico-econométricos diseñados para el análisis y evaluación de políticas públicas.
Conocer y utilizar las distintas fuentes de datos microeconómicos y macroeconómicos relevantes para evaluar la situación del mercado de trabajo: encuesta de población activa, encuesta de estructura salarial.
Conocer los procedimientos para estimar y contrastar las consecuencias de la unión económica, con especial atención a la evaluación de las políticas económicas europeas actuales destinadas al logro de la convergencia.
Conocer y utilizar las fuentes de datos estadísticos y las herramientas econométricas que permiten contrastar las teorías económicas relativas a la Economía industrial.
Comprender la lógica de la modelización y los métodos econométricos para el análisis de datos de series temporales y de sección cruzada, así como su utilidad en la predicción económica.
Adquirir conocimientos sólidos de los métodos estadístico-econométricos modernos para la cuantificación de las relaciones económicas, el contraste de teorías y la evaluación de políticas públicas.
Realizar trabajos empíricos, seleccionando los métodos estadístico-econométricos apropiados según la naturaleza de los datos y el problema a analizar y utilizando los programas informáticos especializados.
Interpretar y transmitir los resultados de un análisis cuantitativo y elaborar informes.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

demás de las competencias básicas de la asignatura recogidas en la memoria de la titulación, a lo largo del curso se trabajan las siguientes Competencias Transversales:

CT1692 - Manejar las tecnologías de la información y comunicación en su desempeño profesional e investigador en el campo del análisis económico.
CT1702 - Planificar tareas, organizar recursos y gestionar de forma eficiente el tiempo.
CT1709 - Identificar y resolver problemas concretos desarrollando la capacidad de análisis y de síntesis.
CT1711 - Comunicarse de forma fluida, tanto de forma oral como escrita en castellano, así como leer, comprender y redactar textos en inglés.
CT- Compromiso social (comprensión crítica de la problemática socio-ambiental global)

Los resultados de Aprendizaje de esta asignatura, relacionados con las competencias específicas de la asignatura son:

- Aplicar la teoría económica para representar situaciones reales.
- Interpretar en términos económicos los resultados matemáticos de modelos formales.
- Saber buscar información en las distintas fuentes de datos microeconómicos y macroeconómicos relevantes para evaluar la situación económico tanto a nivel territorial como de los distintos mercados de interés: laboral, financiero, ...
- Comprender la lógica de la modelización econométrica para el análisis de datos de series temporales y de sección cruzada.
- Adquirir conocimientos sólidos de los métodos estadístico-econométricos modernos para la cuantificación de las relaciones económicas, el contraste de teorías y la predicción.
- Aplicar los métodos estadístico-econométricos para el análisis y evaluación de políticas económicas, tanto a nivel público como privado, local, nacional o internacional.
- Realizar trabajos empíricos, seleccionando los métodos estadístico-econométricos apropiados según la naturaleza de los datos y el problema a analizar y utilizando los programas informáticos especializados.
- Interpretar y transmitir los resultados de un análisis cuantitativo y elaborar informes.
- Emitir juicios fundamentados sobre temas relevantes de índole socio-económico y ambiental a partir de la interpretación de datos y utilizando los modelos econométricos apropiados.

Theoretical and Practical Contents

1. Review of the basic concepts of probability, distribution functions and mathematical statistics necessary for this course.

2. Specification, estimation and inference of the general linear regression model under the linear regression assumptions.

3. Generalization of the linear regression model and presentation of a general estimation method that allows working under different sets of assumptions.

4. Study of the specific problems raised by time series data: violation of the assumptions of stationarity and absence of autocorrelation.

5. An introduction to panel data models, both fixed and random effects.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Theory	2,5	100 %
Seminars	8,5	50 %
Classroom practicals	12	50 %
Computer practicals	21,4	33 %
Lectures	55,6	36 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	20	4,5	6		7			2,5	
Horas de Actividad No Presencial del Alumno/a	35,6	4	6		14,4			0	

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	40 %	60 %
Presentations	20 %	40 %
Questions to discuss	10 %	30 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The ordinary assessment session is structured as follows:

50% of the grade for the subject is obtained by answering exercises, case studies and problems individually and in groups.

50% of the grade for the subject is obtained by means of an individual written exam in which students must answer theoretical questions and solve problems related to the theoretical and practical contents taught on the subject. This exam is the same in the three universities that offer this programme.

Students may decline to take part in the ordinary assessment session by merely notifying the faculty in writing up to one week before the official exam date.

The faculty who teach this subject reserve the right to modify the evaluation system because of causes of major force. Any change will be announced on the e-gela platform in good time and in an appropriate manner.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary assessment session assessment consists of an individual exam (which accounts for the entire grade awarded) covering all the learning outcomes for the subject. It will take place on the date set on the offical course calendar.

Students may decline to take part in the extraordinary assessment session by merely notifying the faculty in writing up to one week before the official exam date.

The faculty who teach this subject reserve the right to modify the evaluation system because of causes of major force. Any change will be announced on the e-gela platform in good time and in an appropriate manner.

MANDATORY MATERIALS

Egela platform

Econometric software Gretl

BIBLIOGRAPHY

Basic bibliography

Stock, J. y M. Watson (2003). Introduction to Econometrics. Ed. Pearson Education.

Wooldridge, J.M. (2003). Introducción a la Econometría. Ed. Thomson Learning. 2ª edición.

Detailed bibliography

Heij, C, P. de Boer, P.H. Franses, T. Kloek y H. van Dijk (2004). Econometric Methods with applications in Business and Economics. Oxford Unversity Press.

Ramanathan, R. (2002). Introductory Econometrics with Applications. Ed. Thomson Learning, 5ª edición.

Verbeek, M. (2004) Guide to modern econometrics. Ed. Wiley.

Journals

Journals (Spanish)
http://www.revecap.com Revista de Economía Aplicada
http://www.revistaestudiosregionales.com Revista de Estudios Regionales
http://www.funep.es/invecon/sp/sie.asp Investigaciones Económicas
http://www1.euskadi.net/ekonomiaz Ekonomiaz

Journals (English)
Computational Economics
Econometrica
Econometric Reviews
Econometric Theory
Empirical Economics Journal
International Journal of Forecasting
Journal of Applied Econometrics
Journal of Business and Economic Statistics
Journal of Econometrics
Journal of Economic Dynamics and Control
Journal of Forecasting
Oxford Bulletin of Economics and Statistics
Review of Economics and Statistics
Review of Economic Studies
Studies in Nonlinear Dynamics and Econometrics

Web sites of interest

Software

http://gretl.sourceforge.net GRETL. Paquete econométrico, Manual para el usuario y Datos (versión en castellano).

Institutions
http://www.eustat.es EUSTAT
http://www.ogasun.ejgv.euskadi.net. Departamento de Economía y Hacienda. Gobierno Vasco. Bases de datos: Ikerbide, Udalmap, ¿
http://www.ine.es INE
http://www.meh.es Ministerio de Economía y Hacienda
http://www.bde.es Banco de España.
http://ec.europa.eu/eurostat EUROSTAT
http://www.ecb.int/ Banco Central Europeo
http://www.oecd.org OECD
http://www.imf.org Fondo Monetario Internacional.
http://www.worldbank.org Banco Mundial.

Datos
http://www.nber.org/data_index.html
http://www.estadief.minhac.es/
http://fisher.osu.edu/fin/osudown.htm
http://econ.queensu.ca/jae/
http://www.psidonline.isr.umich.edu/data/

http://www.census.gov/

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 321 - Faculty of Economics and Business **Cycle** .

Degree ECONO802 - Master in Economics: Economic Analysis Tools **Year** .

COURSE

503486 - Methods of Statistical Inference **Credits, ECTS:** 3

COURSE DESCRIPTION

This is a course on Statistical Inference based on a Decision Theory perspective. In this course the student will be introduced to the required statistical tools that will allow him/her to be able to state and make formal statements about statistical inference processes within an economical framework. The course includes an initial introduction to Statistics viewed from the Theory of Decision perspective, so that specific criteria for selecting optimal statistical procedures can be stated. These criteria will allow the student to be able to study topics on parameter estimation methods and their specific properties, as well as on convergence and hypothesis testing.

The main objective of this course is that the students become familiar and are able to efficiently use all of the provided elements from basic and advanced statistical inference from a Bayesian perspective: point and interval estimation, properties of estimators, and hypothesis testing, which will require a previous study of some of the most commonly used and necessary probability distributions in Statistics. The material included in this course will allow the student to be able to state and solve specific problems in statistical inference, required for any data analysis process, as well as to carry out any quantitative analysis or study related to the student's specific field.

SPECIFIC SKILLS:
- Identify and be able to select the most appropriate characteristics of the different theoretical probability models (discrete and continuous) for each case and, thus, be able to assess their utility and applicability in the specific professional field under study.
- Assess the different problems in statistical inference to be able to appropriately select the best alternative of analysis.
- Be able to apply the available statistical methods to take the most adequate decision on the basis of professional and methodological criteria.
- Select the most appropriate source of information to be able to study the specific problem of interest and, in addition, be able to analyze data sets using the most adequate statistical technique under each setting.
- Be able to interpret and communicate the results of the different analyses, using clear and concise statements, as well as tools from the up-tp-date technologies of information (TICs).

CROSS SECTIONAL SKILLS:
- Be able to state motivated judgements based on the results obtained from the different data analyses.
- Be able to fluently communicate in an oral and written form.
- Be able to participate in team-work, with responsability and showing respect for others, as well as displaying initiative and leadership within the group.
- Be able to carry out analytical judgements and critical statements on given settings within the specific fields of study.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Aplicar los criterios y la metodología del análisis económico para obtener procedimientos generales de diseño y análisis de políticas públicas: estructuración de problemas, pronóstico, recomendación y evaluación.
Manejar los métodos estadístico-econométricos diseñados para el análisis y evaluación de políticas públicas.
Conocer los principios del análisis económico más relevante en la gestión óptima de los recursos naturales, teniendo en cuenta que la incertidumbre y la irreversibilidad juegan un papel muy importante.
Manejar los modelos y las técnicas microeconométricas, así como los programas informáticos habituales en el análisis empírico del mercado de trabajo.
Realizar tareas de consultoría y asesoramiento en el diseño de estrategias empresariales y de políticas económicas locales adaptadas a las condiciones de integración económica.
Realizar trabajos empíricos, seleccionando los métodos estadístico-econométricos apropiados según la naturaleza de los datos y el problema a analizar y utilizando los programas informáticos especializados.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

Chapter 1. STATISTICS AND DECISION THEORY.
Definition of statistical procedures. Theory of Decision's perspective: States of Nature, decision space, sample space, loss function. Expected loss. Bayes risk. Admissible Procedures.
Recommended References: Kiefer (1983) Chap.1, 2 and 3. Berger (1985) Chap.2. Lehmann (1983) Chap.1, Sec.1.

Bickel-Doksum (1977) Chap. 10. Ferguson (1967) Chap. 1 and 2.

Chapter 2. SELECTION CRITERIA FOR STATISTICAL PROCEDURES (I).
Bayes criterion. Randomization of statistical procedures. Complete classes. Minimax criterion: characterization. Characterization of admissible procedures. Least favorable distributions. Computing minimax procedures. Relation between minimax and Bayes procedures.
Recommended references: Kiefer (1983) Chap.4. Lehmann(1983) Chap. 4. Bickel-Doksum (1977) Chap. 10. Ferguson (1967) Chap. 1 and 2.

Chapter 3. SELECTION CRITERIA FOR STATISTICAL PROCEDURES (II).
What to do if we do not have a specific loss function? Unbiased estimation. Maximum likelihood estimation method. Method of moments estimation method. Frequency substitution estimation method. Least squares estimation method.
Recommended references: Kiefer (1983) Chap. 4. Bickel-Doksum (1977) Chap. 3.

Chapter 4. SUFFICIENCY.
Characterizacion of sufficiency. Families of distributions. Exponential family. Sufficient statistics and the exponential family. Sufficient statistics and Bayes solutions. Characterization of the minimal sufficiency. Complete statistics.
Recommended references: Kiefer (1983) Chap.4. Lehmann (1983) Chap.1 Sec. 5. Cox-Hinkley (1974) Chap. 2 Sec. 2. Cox-Hinkley (1978). Ferguson (1967) Chap. 3.

Chapter 5. POINT ESTIMATION. SOME BASIC RESULTS.
The condition of unbiasedness. Convex functions. UMVU estimators. Rao-Blackwell's Theorem. Lehmann-Scheffé's Theorem. Cramér-Frechet-Rao's inequality. Chapman-Robbins-Kiefer's inequality. Efficiency and asymptotic efficiency. Equivariance (or "invariance"). Hunt-Stein's Theorem.
Recommended references: Kiefer (1983) Cap. 7. Lehmann (1983) Chap. 2 and 3. Bickel-Doksum (1977) Chap. 4. Rohatgi (1976) Chap. 8.

Chapter 6. STOCHASTIC CONVERGENCE AND ASYMPTOTIC PROPERTIES.
Sequences of random variables. Types of convergence. Law of large numbers. Central limit theorem. Weakly and strongly consistent estimation sequences. Rates of consistency. The median as location estimator. Asymptotic distribution of method of moments estimators.
Recommended readings: Kiefer (1983) Chap. 7. Rao (1965) Sec. 2.c. Lehmann (1983) Chap. 5. Cox-Hinkley (1974) Appendix A.

Chapter 7. POINT ESTIMATION. THE MAXIMUM LIKELIHOOD METHOD.
Maximum likelihood estimation and sufficient statistics. Asymptotic properties: consistency (Wald's Theorem), asymptotic normality, asymptotic efficiency. B.A.N. estimators ("normally asymptotically optimal").
Recommended readings: Kiefer (1983) Chap. 7. Lehmann (1983) Chap. 6. Cox-Hinkley (1974) Chap.8 and 9. Cox-Hinkley (1978).

Chaoter 8. HYPOTHESIS TESTING.
Test statistics and their null distribution. Decision theory perspective on hypothesis testing. Simple hypothesis testing. Composite hypothesis testing. Discarding nuisance parameters. Pure, simple and composite tests of hypothesis. Randomized tests. Most powerful tests: Neyman-Pearson's Theorem. Uniformly most powerful tests. Uniformly most powerful unbiased tests. Most powerful and unbiased local tests. Equivariant tests. Generalized maximum likelihood ratio tests.
Recommended readings: Kiefer (1983) Chap. 8. Cox-Hinkley (1974) Chap. 3 and 5. Lehmann (1959) Chap. 3. Ferguson (1967) Chap. 5. Bickel-Doksum (1977) Chap. 5 and 6.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Theory	5	100 %
Seminars	7	0 %
Computer practicals	8	0 %
Classroom practicals	15	66 %
Lectures	40	37 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15	0	10		0			5	
Horas de Actividad No Presencial del Alumno/a	25	7	5		8			0	

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Continuous assessment through class attendance	20 %	20 %
Evaluation of assignments by topic (educational and summative evaluation).	80 %	80 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Grading in this course is based on take-home homework assgined to students along the course, as well as on the active students' participation, both individually and as a team, and in the discussion resulting from the real problems' solutions related to the material included in the practical sessions about the specific contents in the course program. The solution to exercises and problems in the practical sessions, in the seminars, and in the lecture sessions will be part of the students' on-going evaluation grades.

Class participation in class: 20% of the final grade
Regular take-home homework: 80% of the final grade

Students not handling all of the assigned homework will have a "Failing" grade. Students handling no homework at all will have an "Absent" grade. Homework: The work submitted by the students must be their own work and must have been written completely by themselves. The students must identify and include the source of all facts, ideas, opinions and viewpoints of others through in-text referencing and the relevant sources should all be included in the list of references at the end of their work. Direct quotations from books, journal articles, internet sources or any other source must be acknowledged and the sources cited must be identified in the list of references.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The second call grade will be solely based on a final exam. The final exam will include all of the material included in the course program. The use of mobile or electronic devices, notes, books is not allowed in this exam.

MANDATORY MATERIALS

COMPULSORY REFERENCES:

Lehmann, E.L. (1959). Testing Statistical Hypothesis. New York: Wiley.
Lehmann, E.L. (1983). Theory of Point Estimation. New York: Wiley.

BIBLIOGRAPHY

Basic bibliography

RECOMMENDED ADDITIONAL REFERENCES:

Ferguson, T.S. (1967). Mathematical Statistics: A Decision Theoretic Approach. Academic Press: New York.

Lehmann, E.L. (1959). Testing Statistical Hypothesis. Wiley: New York.

Lehmann, E.L. (1983). Theory of Point Estimation. Wiley: New York.

Detailed bibliography

ADDITIONAL REFERENCES:

Berger, J.O. (1985). Statistical Decision Theory and Bayesian Analysis. Springer Verlag: New York.

Bickel, P.J. y Doksum, K.A. (1977). Mathematical Statistics. Holden-Day, Inc.: Oakland.

Cox, D.R. y Hinkley, D.V. (1974). Theoretical Statistics. Chapman and Hall: London.

Cox, D.R. y Hinkley, D.V. (1978). Problems and Solutions in Theoretical Statistics. Chapman and Hall: London.

Garthwaite, P.H., Jolliffe, I.T. y Jones, B. (1995). Statistical Inference. Prentice Hall: London.

Kiefer, J.C. (1983). Introduction to Statistical Inference. Springer Verlag: New York.

Lindley, D.W. (1969). Introduction to Probability and Statistics from a Bayesian Viewpoint. Cambridge University Press: Cambridge.

Migon, H.S. y Gammerman, D. (1999). Statistical Inference. An Integrated Approach. Arnold: London.

Peña, D. (2001). Fundamentos de Estadística. Alianza Editorial: Madrid.

Rao, C.R. (1965). Linear Statistical Inference and its Applications. Wiley: New York.

Journals

JOURNALS:

Applied Statistics
Applied Stochastic Models in Business and Industry
Biometrics
Biometrika
Biostatistics
Communications in Statistics ¿ Computation and Simulation
Communications in Statistics ¿ Theory and Methods
Journal of Applied Statistics
Journal of the American Statistical Association
Journal of the Royal Statistical Society ¿ Series B
Journal of Statistical Computation and Simulation
Journal of Statistical Planning and Inference
Methodology ¿ European Journal of of Research Methods for the Behavioral and Social Sciences
Statistics in Medicine
Statistical Methods in Medical Research
Statistical Modelling
The American Statistician

Web sites of interest

WEBSITES:

American Statistical Association (http://www.amstat.org/)
Biostatnet (http://eio.usc.es/pub/biostatnet/)
International Statistical Institute (http://www.isi-web.org/)
International Biometric Society (http://www.biometricsociety.org/)
Royal Statistical Society (http://www.rss.org.uk/)
Sociedad Española de Estadística e Investigación Operativa (http://www.seio.es/)
Sociedad Española de Biometría (http://biometricsociety.net/)

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 321 - Faculty of Economics and Business **Cycle** .

Degree ECONO802 - Master in Economics: Economic Analysis Tools **Year** .

COURSE

503487 - Basic Time Series Analysis **Credits, ECTS:** 3

COURSE DESCRIPTION

This course offers an introduction to the analysis of data that evolve over time, which requires specific techniques. Basic methods and techniques are presented, with special application to economic series. The aim is for the student to learn the simplest time series modelling schemes, their limitations and possibilities of application in practice. Likewise, the aim is for the student to acquire the basic theoretical foundations of the subject that will allow them to further delve into the subject in advanced time series analysis courses.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Conocer los procedimientos para estimar y contrastar las consecuencias de la unión económica, con especial atención a la evaluación de las políticas económicas europeas actuales destinadas al logro de la convergencia.
Realizar tareas de consultoría y asesoramiento en el diseño de estrategias empresariales y de políticas económicas locales adaptadas a las condiciones de integración económica.
Comprender la lógica de la modelización y los métodos econométricos para el análisis de datos de series temporales y de sección cruzada, así como su utilidad en la predicción económica.
Adquirir conocimientos sólidos de los métodos estadístico-econométricos modernos para la cuantificación de las relaciones económicas, el contraste de teorías y la evaluación de políticas públicas.
Identificar, buscar, organizar y sistematizar la información estadística relevante para ayudar a explicar las cuestiones económicas de interés, tanto a nivel microeconómico como macroeconómico.
Realizar trabajos empíricos, seleccionando los métodos estadístico-econométricos apropiados según la naturaleza de los datos y el problema a analizar y utilizando los programas informáticos especializados.
Interpretar y transmitir los resultados de un análisis cuantitativo y elaborar informes.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

Lesson 1: Introduction to Time Series Analysis. Nature and structure of time series. Basic operators. Stochastic processes and properties. Definition of stochastic process. Autocorrelation functions (fac and facp). Stationary processes.
Lesson 2: Stationary probabilistic models: AR1, AR2 and ARp processes. White noise. AR processes: fac and properties. The stationarity condition.
Lesson 3: Stationary probabilistic models: mixed MA and ARMA processes. MA processes: fac and properties. The invertibility condition. Validation and Prediction.
Lesson 4: Non-stationary and seasonal processes: Box-Jenkins methodology. ARIMA models. Heteroscedasticity and lack of stationarity. Treatment of seasonality.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Theory	5	100 %
Classroom practicals	10	50 %
Computer practicals	20	25 %
Lectures	40	37 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15		5		5			5	
Horas de Actividad No Presencial del Alumno/a	25		5		15			0	

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	40 %	60 %
Questions to discuss	40 %	60 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

All the above-mentioned competencies will be assessed through different activities.
The final grade will be obtained from: - Activities carried out in class, solving individual and/or group exercises and virtual activities: 50% of the final grade. - Written test (on the official date): 50% of the final grade.

Those students who are assessed through continuous assessment will receive the grade of "Not Presented" if they do not attend the final test. In accordance with the current permanence regulations, the grade of "Not Presented" implies the voluntary resignation from the corresponding call.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The assessment for those students who take the first call and then the second call of each academic year will, in any case, be a final test that will determine 100% of the grade. This test will assess all the skills and content developed in the activities of the teaching period of the subject.

MANDATORY MATERIALS

Fernández-Macho (2010), Análisis Básico de Series Temporales, notas de clase, Noviembre 2010.
Fernández-Macho (2012), Introducción al AST con Gretl. v 1.2es-abst, Febrero 2012.

BIBLIOGRAPHY

Basic bibliography

Harvey, A. (1993), Time Series Models, 2 edn, Pearson ed.

Detailed bibliography

Box, G. , Jenkins, G. y Reinsel, G (1994), Time Series Analysis: Forecasting and Control, 3 edn, Holden-Day, San Francisco.
Chatfield, C. (1996), The Analysis of Time Series: An Introduction, 5 edn, Chapman and Hall, London.
Hamilton, J. (1994), Time Series, Princeton U.P., Princeton, NJ.
Harvey, A. (1990), The Econometric Analysis of Time Series, 2 edn, MIT Press, Cambridge, Mass.

Journals

Computational Economics
Econometrica
Econometric Reviews
Econometric Theory
Empirical Economics Journal
International Journal of Forecasting
Journal of Applied Econometrics
Journal of Business and Economic Statistics
Journal of Econometrics
Journal of Economic Dynamics and Control
Journal of Forecasting
Oxford Bulletin of Economics and Statistics
Review of Economics and Statistics
Review of Economic Studies
Studies in Nonlinear Dynamics and Econometrics

Web sites of interest

Software:
http://gretl.sourceforge.net. Gretl: Free and open source econometric software (versions in Spanish, Basque and English), user manual and data.
Institutional links:
http://www.eustat.es. EUSTAT
http://www.ine.es. INE
http://www.bde.es. Banco de España
http://ec.europa.eu/eurostat. EUROSTAT
http://www.oecd.org OCDE
http://www.imf.org. International Monetary Fund
http://www.worldbank.org. World Bank
http://www.bolsamadrid.es Madrid Stock Market

Data:

http://www.nber.org/data_index.html
http://www.estadief.minhac.es/
http://fisher.osu.edu/fin/osudown.htm
http://econ.queensu.ca/jae/
http://www.psidonline.isr.umich.edu/data/
http://www.census.gov/

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 321 - Faculty of Economics and Business **Cycle** .

Degree ECONO802 - Master in Economics: Economic Analysis Tools **Year** .

COURSE

503488 - Statistics and Time Series Topics **Credits, ECTS:** 6

COURSE DESCRIPTION

This course allows the student to deepen in the different techniques used in the analysis of economic time series and its statistical treatment, putting special emphasis in the analysis in the frequency domain and dynamic volatility models. The aim is to enable students to carry out quality research in the field of economic analysis by applying advanced statistical and econometric instruments and knowledge. At the end of the course the student should know how to extract information from an economic series, use different statistical and econometric packages, and master both semi-parametric and non-parametric statistical models. Likewise, the student must know the characteristics and utilities of the integrated and fractional processes and of the changing volatility models, especially important in financial series.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Comprender la lógica de la modelización y los métodos econométricos para el análisis de datos de series temporales y de sección cruzada, así como su utilidad en la predicción económica.
Adquirir conocimientos sólidos de los métodos estadístico-econométricos modernos para la cuantificación de las relaciones económicas, el contraste de teorías y la evaluación de políticas públicas.
Identificar, buscar, organizar y sistematizar la información estadística relevante para ayudar a explicar las cuestiones económicas de interés, tanto a nivel microeconómico como macroeconómico.
Realizar trabajos empíricos, seleccionando los métodos estadístico-econométricos apropiados según la naturaleza de los datos y el problema a analizar y utilizando los programas informáticos especializados.
Interpretar y transmitir los resultados de un análisis cuantitativo y elaborar informes.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

First part of the course is devoted to the Time series volatility analysis. The tools needed to perform a detailed time series analysis in the frequency domain, alternative to the traditional time domain, are presented and described. The concepts of cycle, distribution, spectral density, linear filters, the periodgram and estimators of spectral density functions are introduced.
The second part of the course is devoted to the Time series analysis in the frequency domain. It is focused on basic concepts of frequency domain, Fourier analysis, estimation in the frequency domain and fractional integration Several financial models for dynamic heterocedasticity, both within the ARCH and Stochastic Volatility approaches are described.
The third part of the course is focused on non-linearities in Econometrics. It aims at maximum likelihood estimation,, numerical optimization methods, non-linear regression, identifiability and specification tests.
The last fourth part is devoted to the software package R for statistical and graphical analysis that has a dual nature of program and programming language. R has many functions for statistical and graphical analysis

A. Time series volatility analysis

1. Introduction: Statistical characteristics of the financial series
2. ARCH models and extensions
3. Stochastic volatility models

B. Time series analysis in the frequency domain

1. Basic concepts of frequency domain
   2. Fourier analysis
3. Estimation in the frequency domain
4. Long memory in time series: Fractional integration

C. Non-linearity in Econometrics

1. Maximum likelihood
2. Numerical optimization methods
3. Non-linear regression: Numerical calculation algorithms
4. Maximum likelihood estimation: Numerical calculation algorithms
5. Identifiability
6. Specification tests

D. Programming in R

1. Introduction
2. Basic commands
3. Linear regression
4. Time Series Analysis: Box-Jenkins Methodology
5. Non-linearity in the estimation by Maximum Likelihood

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Exams, evaluation tests	5	100 %
Presentation and defence of exercises	10	100 %
Computer practicals	10	33 %
Theory	20	100 %
Preparation and presentation of work	20	10 %
Classroom practicals	20	50 %
Lectures	65	37 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	5	10		10			5	
Horas de Actividad No Presencial del Alumno/a	50	10	10		20			0	

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	10 %	60 %
Exhibition of work, readings...	0 %	50 %
Questions to discuss	40 %	60 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The final grade is composed of the qualification obtained from subjects A and B (50%) and topics C and D (50%).

Grading of topics A and B will be based on individual problems and a final exam. Grading of topics C and D will be based on the assignments students will have to do throughout the school term. There are a total of 6 assignments in topics C and D. Each assignment will have the following weight in the grading of topics C and D:

Task 1: 10%
Task 2: 10%
Task 3: 10%
Task 4: 10%.
Task 5: 10%
Task 6: 50%

The evaluation will preferably be in-classroom. If this is not possible, the final exam will be taken using the services available at Egela. The student will have a limited time to download the final exam form from Egela and upload the solution to that platform (preferably in pdf and in any case in a perfectly legible format to enable evaluation). This exam is individual, so in order to guarantee it the teaching team of the course might request an oral interview of verification of the answers after the correction of the exam with an individualized conversation with the student.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Evaluation by means of a final written test.

MANDATORY MATERIALS

Andersen, T.G., Davis, R.A., Kreib. J.P. and Mikosch, T. (2009). Handbook of Financial Time Series. Springer-Verlag Berlin.

Beran, J. (1994) Statistics for Long-Memory Processes. Chapman & Hall.

Fomby, T., Hill, C. & Johnoson, S. (1984), Advanced Econometric Methods, Needham, MA, Springer-Verlag.

Greene, W. H. (1993), Econometric Analysis, Macmillan Publishing Company, New York.

Fox, J. (2005), An R and S-plus companion to applied regression, Sage Publications, Thousand Oaks, California.

BIBLIOGRAPHY

Basic bibliography

Bollerslev, T., Engle, R.F. and Nelson, D.B. (1994). ARCH Models. Handbook of Econometrics, Vol. IV, Engle R.F and McFadden D.L., eds., 2959-3038.

Brockwell, P.J. and Davis, R.A. (1991) Time Series: Theory and Methods. Springer-Verlag New York, Inc.

Harvey, A.C. (1993) Time Series Models. Harvester Wheatsheaf.

Cramer, J. (1986), Econometric Applications of Maximum Likelihood methods, Cambridge University Press, Cambridge.

Faraway, J. (2005), Linear models with R, Chapman & Hall/CR, Boca Raton.

Fox, J. (2005), An R and S-plus companion to applied regression, Sage Publications, Thousand Oaks, California.

Detailed bibliography

Bollerslev, T., Engle, R.F. and Nelson, D.B. (1994), ARCH Models. Handbook of Econometrics, Vol. IV, Engle R.F and McFadden D.L., eds., 2959-3038.

Brockwell, P.J. and Davis, R.A. (1991), Time Series: Theory and Methods. Springer-Verlag New York, Inc.

Horowitz, J. L. (1998), Semiparametric methods in econometrics. Lecture Notes in Statistics, 131. Springer-Verlag, New York.

Pagan, A. and A. Ullah (1999), Nonparametric econometrics. Themes in Modern Econometrics. Cambridge University Press, Cambridge.

Priestley, M.B. (1992), Spectral Analysis and Time Series. Academic Press LTD.

Rossiter, D.G. (2006), Introduction to the R Project for statistical computing for use at ITC, Internacional Institute for Geo-information Science & Earth Observation, Enschede (http://cran.es.r-project.org/doc/contrib/Rossiter-RIntro-ITC.pdf).

Venables, B., Smith, D., Gentleman R., Ihaka, R. and Mächler M. (1997), Notas sobre R: Un entorno de programación para Análisis de Datos y Gráficos, University of Auckland. (http://cran.r-project.org/doc/contrib/R-intro-1.1.0-espanol.1.pdf).

Verzani J. (2002), simpleR ¿ Using R for Introductory Statistics, CSI Math department (www.math.csi.cuny.edu/Statistics/R/simpleR).

Journals

R Journal

Web sites of interest

http://www.r-project.org/
www.tutorialr.es/

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 321 - Faculty of Economics and Business **Cycle** .

Degree ECONO802 - Master in Economics: Economic Analysis Tools **Year** .

COURSE

503501 - Environmental Economics **Credits, ECTS:** 3

COURSE DESCRIPTION

The Environmental Economics course is an optional subject offered by the University of the Basque Country (Master in Economics: Economics Analysis Tools). This course explores the relationship between the economy and the environment. We show the tools that economic analysis provides for the study of the main environmental problems like local pollution, climate change, biodiversity loss or depletion of natural resources. Basic economic concepts to follow this course are offered by the compulsory subjects taken by the master’s students during the first part of the semester. At the same time, this course offers useful concepts and tools that will be used in different optional subjects that the students can take during the second and third semester (Natural Resource Economics and Environmental Policy, Regulation and Competition Policy, Analysis of Public Choice or Evaluation of Transport and Network Policies).
In case legal imperatives or safety reasons ban face to face interaction then teaching will be online.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Conocer los principios del análisis económico más relevante en la gestión óptima de los recursos naturales, teniendo en cuenta que la incertidumbre y la irreversibilidad juegan un papel muy importante.
Analizar el comportamiento de los mercados y de los agentes económicos para la correcta modelización de los problemas ambientales.
Identificar los objetivos y los requisitos que deben satisfacer las políticas medioambientales cuya finalidad sea la utilización eficiente de los activos ambientales y el desarrollo sostenible.
Conocer de forma precisa la legislación vigente, los acuerdos internacionales y la actuación de los organismos públicos en materia medioambiental.
Realizar labores de estudio, asesoramiento y diseño de políticas medioambientales que garanticen el desarrollo sostenible.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

Environmental Economics explore the relationship between economics and the environment. Microeconomic analysis is used to analyze and explain environmental problems as market failures due to external effects, public goods or the absence of property rights. We present different economic instruments and environmental policies that are used to solve environmental problems with special emphasis in the case of Climate Change. Finally, we present the main methods and concepts used to value environmental assets and services.

Table of contents
Tema 1. Economics and the environment: Introduction
Tema 2. Economic instruments and environmental policy
Tema 3. Economic growth, the environment and Sustainable Development Goals
Tema 4. The Economics of Climate Change
Tema 5. Environmental Valuation: concepts and methods

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Seminars	5	0 %
Theory	5	100 %
Classroom practicals	22,5	44 %
Lectures	42,5	35 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15	0	10					5	
Horas de Actividad No Presencial del Alumno/a	27,5	5	12,5					0	

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	50 %	70 %
Presentations	10 %	30 %
Questions to discuss	10 %	30 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Class attendance is mandatory to follow continuous evaluation based on
(i) individual tasks;
(ii) active participation in roleplaying games on Climate Change;
(iii) oral presentation of individual work;
(iv) group assignments and class participation;

A final written exam will be mandatory for those students who fail the continuous evaluation. Any student who does not show up for the final exam will have "Not Submitted" as final grade.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Evaluation system on second round: there will be a single final written exam that counts 100% of the final grade.
It will comprise problems and long essays regarding the main issues discussed along the course.

MANDATORY MATERIALS

Relevant documentation and study material (lecture slides and readings) will be posted on the course website. EGELA is the virtual classroom to support face-to-face teaching.

BIBLIOGRAPHY

Basic bibliography

- R. Perman, Y. Ma, M. Common, D. Madison, J. McGilvray, 2011, Natural Resource and Environmental Economics, Pearson Education-Addison Wesley, 4ª ed.
- P. Riera, D. García, B. Kriström y R. Bränlund. Manual de Economía Ambiental y de los Recursos Naturales, Thomson Editores, 2005 (3º reimpresión 2011).
- Stavins Robert N. (ed.), 2019 (7º ed.) Economics of the Environment. Selected Readings, W.W. Norton and Company.

Detailed bibliography

- Baumol W. J. y W. E. Oates, The Theory of environmental policy, Cambridge University Press, 1988.
- Field Barry & Martha K. Field: Economía Ambiental, McGraw-Hill, 2003.

Journals

Ecological Economics
Review of Environmental Economics and Policy
Journal of Environmental Economics and Management
Environmental and Resource Economics
Resource and Energy Economics
Energy Economics
Land Economics
American Economic Review
Journal of Political Economy

Web sites of interest

NEP (New Economic Papers) (http://nep.repec.org/)
The Economics of Ecosystem and Biodiversity (http://www.teebweb.org/)
Pew Center on Global Climate Change (USA) (http://www.c2es.org/)
BC3 (Basque Center for Climate Change) (http://www.bc3research.org/)

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 321 - Faculty of Economics and Business **Cycle** .

Degree ECONO802 - Master in Economics: Economic Analysis Tools **Year** .

COURSE

503504 - Economics of Natural Resources and Environmental Policy **Credits, ECTS:** 6

COURSE DESCRIPTION

"Economics of Natural Resources and Environmental Policy" is an elective subject (6 ECTS) of the Master in Economics: Economic Analysis Tools. This one year Master program (60 ECTS) extends over three trimesters and is jointly offered by the Universities of Cantabria, Oviedo and the UPV/EHU. This subject, being elective, is taught only at the UPV/EHU, being the students who move to take it. For this reason, teaching is concentrated in one day, on Wednesdays during the 9 weeks of the second trimester.
The main objective of this course is to explain how natural resources such as fishery resources, forest resources or non-renewable resources are managed / should be managed.
Regardless of the initial training of the master's students, the basic concepts for this subject are covered in the compulsory subjects of the Master. Additionally, the introductory topic will deepen into certain mathematical and computational tools that will be used extensively in this subject: the analysis of the qualitative behavior of discrete dynamic systems and dynamic optimization in discrete time.
In turn, this subject provides basic concepts for other elective subjects of the Master that are offered in the second and third trimesters such as: "Regulation and Competition Policy", "Analysis of Public Decisions" and "Evaluation of Transport and Network Policies "
The development of the subject is proposed according to the double track of the Master: professional and research oriented. Thus, the course presents the student with a range of tools of economic analysis for the solution of natural resource management problems that will be of interest to both collaborating companies and institutions, where they can carry out placements, and to carry out a research project (Master Thesis) that may lead to the future completion of a Doctoral Thesis.

In addition to the specific competences of the subject collected in the memory of the degree, throughout the course the following transversal competences are worked:
CT1692- Managing information and communication technologies in professional and research activities in the field of economic analysis.

CT1702 - Planning tasks, organizing resources and efficiently managing time.

CT1709- Identifying and solving specific problems developing the capacity for analysis and synthesis.

CT1711- Communicating fluently, both orally and in writing in Spanish, as well as reading, understanding and writing texts in English.

The learning results of the subject are the following:

R1- To have a basic knowledge of natural resource economics.
R2- To know and understand the economic models used to study natural resource management problems.
R3- To apply the economic models studied to specific natural resource management problems (local, regional or international).
R4- To plan tasks properly and efficiently manage time.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Conocer los principios del análisis económico más relevante en la gestión óptima de los recursos naturales, teniendo en cuenta que la incertidumbre y la irreversibilidad juegan un papel muy importante.
Analizar el comportamiento de los mercados y de los agentes económicos para la correcta modelización de los problemas ambientales.
Identificar los objetivos y los requisitos que deben satisfacer las políticas medioambientales cuya finalidad sea la utilización eficiente de los activos ambientales y el desarrollo sostenible.
Conocer de forma precisa la legislación vigente, los acuerdos internacionales y la actuación de los organismos públicos en materia medioambiental.
Realizar labores de estudio, asesoramiento y diseño de políticas medioambientales que garanticen el desarrollo sostenible.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

The introductory topic covers (1) the main methods of qualitative analysis of the behavior of discrete dynamic systems, (2) some methods for dynamic discrete time optimization and (3) the use of Excel, and specifically some routines such as "Solver", to carry out optimization and simulation exercises. The aim of the introductory topic is to get acquainted with the most basic mathematical and computational instruments that allow operating, through very simple numerical problems, the most common theoretical concepts in Natural Resource Economics and build bridges towards the empirical analysis of this type of problems.
The second topic focuses in the economic theory that underlies the optimal exploitation of fishery resources. It starts analyzing separately the biological aspects (dynamics of fishing stocks) and the economic aspects (fishery production functions) of a fishery. Next, the overexploitation that occurs in fisheries exploited under an open-access regime is analyzed, both through a static and a dynamic model. Subsequently, open - access exploitation levels are compared with those that are produce in a context where property regimes are well defined and this is also analysed in both an static and a dynamic context. Finally, different fisheries management policies proposed in the literature are analyzed, with special emphasis on total allowable catches, individual transferable quotas and marine reserves.
The third topic analyzes another renewable resource, forests, whose management has some interesting peculiarities. As with other renewable resources, optimal forest management will result from the combination of information from biological origin and certain economic variables. Therefore, the topic begins by analyzing the functions of forest resource growth (volume of marketable wood), to later incorporate economic variables (prices, costs and discount rates) in order to define optimal forest rotation in two contexts: a single rotation or an indefinite succession of rotations. Finally, a link is established with the following topic, that of the non-renewable resources, analyzing the determination of the optimal stock of natural forests (old growth forests).
The fourth and final topic analyzes how to exploit resources that are not renewed on a time scale of economic relevance. It aims at answering the following questions: What is the proper rate of extraction of a non-renewable resource? It is always optimal to exhaust a non-renewable resource? Can it ever be optimal to leave a field of non-renewable resources with positive reserves? Is the rate of exploitation of a renewable resource different when exploiting it under a regime of perfect competition instead of doing it under a monopoly? If you can increase the resource base to exploit through the search for new reserves, what is the right investment in searching for these new reserves? Finally, the appropriate measure of scarcity of non-renewable resources is discussed.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Theory	5	100 %
Seminars	15	33 %
Classroom practicals	45	44 %
Lectures	85	35 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	5	10		10			5	
Horas de Actividad No Presencial del Alumno/a	50	10	10		20			0	

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	50 %	70 %
Presentations	10 %	30 %
Questions to discuss	10 %	30 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Class attendance guarantees that the evaluation of the subject can be a continuous evaluation based on:

(i) individual tasks, and
(ii) oral presentation of an individual work.

If a student does not pass the subject through this continuous assessment system, they may choose a final exam, which will consist of a written test with exercises to solve and questions to be developed related to the topics of the program and the required readings.

To renounce the ordinary call, it will be enough not to sit the final exam and it will be reflected in the Transcript of Records

as NOT PRESENTED.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The extraordinary call will consist of a written test with exercises to solve and questions to be developed related to the topics of the program and the compulsory readings. This test will be 100% of the grade and will take place on the date set in the official exam calendar.

To renounce the extraordinary call, it will be enough not to sit the exam. It will be reflected in the Transcript of Records as NOT PRESENTED.

MANDATORY MATERIALS

Conrad, J.M. (2010), "Resource Economics" (Second Edition), Cambridge University Press.

Conrad, J.M. and C.W. Clark (1987), "Natural Resource Economics: Notes and Problems", Cambridge University Press.

Perman, R. , Y. Ma, J. McGilvray and M. Common (2003), ¿Natural Resource and Environmental Economics¿ (Third Edition), Pearson Education-Addison Wesley.

Riera, P., D. García, B. Kriström y R. Brännlund (2005), ¿Manual de Economía Ambiental y de los Recursos Naturales¿, Thomson.

BIBLIOGRAPHY

Basic bibliography

Bárcena- Ruiz J. C. and Garzón M. B., (2003). Strategic Environmental Standards, Wage Incomes and the Location of Polluting Firms. Environmental and Resource Economics 24, 121-139.
Bárcena-Ruiz J. C., (2006). Environmental Taxes and First-mover Advantages. Environmental and Resource Economics, forthcoming.
Conrad, J.M. y C.W. Clark (1994), ¿Natural resource economics: Notes and problems¿, Cambridge University Press, Cambridge.
Meadows, D.; Randers, J., Meadows, D. 2005. Limits to Growth. The 30-years update. Earthscan, London. 338 pp.
Millennium Ecosystem Assessment. 2005. Ecosystems and Human Well-Being, a framework for assessment. Island Press, 245 pp.
European Environment Agency, (2000). Environmental Taxes: Recent Developments in Tools for Integration. Environmental Issues Series Nº 18.
Kennedy, P., (1994). Equilibrium Pollution Taxes in Open Economies with Imperfect Competition. Journal of Environmental Economics and Management 27, 49-63.
Ulph, A., (1996). Environmental Policy and International Trade when Governments and Producers Act Strategically. Journal of Environmental Economics and Management 30, 256-281.
Perman, R., Y. Ma, J. McGilvray y Michael Common: ¿Natural Resource and Environmental Economics¿, Pearson Education-Addison Wesley, 3rd edition 2003.

Detailed bibliography

Azqueta, D. y A. Ferreiro (eds), ¿Análisis económico y gestión de recursos naturales¿, Alianza Editorial, Madrid, 1994.
Baumol W. J. y W. E. Oates, ¿The Theory of environmental policy¿, Cambridge University Press, 1988..
Hartwick, J.M. y N. Olewiler, ¿The Economics of Natural Resource Use¿, segunda edición, Addison-Wesley Longman Ltd, New York, 1997.
Haab T. y K.E. McConnell, ¿Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation¿.
P. Riera, D. García, B. Kriström y R. Bränlund. ¿Manual de Economía Ambiental y de los Recursos Naturales¿, Thomson Editores, 2005.
Stavins Robert N. (ed.), ¿Economics of the Environment. Selected Readings¿, W.W. Norton and Company, 5ª ed., 2005.

Journals

Web sites of interest

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 321 - Faculty of Economics and Business **Cycle** .

Degree ECONO802 - Master in Economics: Economic Analysis Tools **Year** .

COURSE

503506 - Game Theory **Credits, ECTS:** 3

COURSE DESCRIPTION

The course of Game Theory consists of an introduction to both Game Theory as well as an introduction to Experimental Economics and Behavioral Economics.
The first part of the course focuses on the core concepts of Game Theory (both cooperative and non-cooperative): definition of a game in normal and extensive-form, coalitions and different solution concepts.
The second part of the course focuses on revising the core assumptions made in Microeconomic Theory and Game Theory in light of empirical evidence gathered using experimental methods.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Conocer los principios del análisis económico más relevante en la gestión óptima de los recursos naturales, teniendo en cuenta que la incertidumbre y la irreversibilidad juegan un papel muy importante.
Analizar el comportamiento de los mercados y de los agentes económicos para la correcta modelización de los problemas ambientales.
Identificar los objetivos y los requisitos que deben satisfacer las políticas medioambientales cuya finalidad sea la utilización eficiente de los activos ambientales y el desarrollo sostenible.
Analizar el comportamiento de los agentes económicos en la toma de decisiones con el fin de entender cómo funcionan los mercados, especialmente en condiciones de competencia e información imperfecta.
Comprender el papel de las instituciones públicas en la economía industrial, tanto desde la perspectiva de la regulación de mercados como de la implementación de políticas microeconómicas.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

Core concepts in the definition of strategic environments: games, players, actions and strategies, information sets and order in decision making, and finally, payoffs.
Core concepts in the definition of a cooperative game: players, coalitions, characteristic function, axioms.
Core concepts and their assumptions in different solution concepts: Nash equilibrium, rationalizability, subgame perfect Nash equilibrium, Bayesian Nash equilibrium, core, Shapley value, stability.
Core concepts in the use of experimental methods: randomized experiments, subjects, recruitment, treatments, incentives, instructions.
Main findings of behavioral and experimental economics regarding social preferences and non- equilibrium play.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Theory	5	100 %
Seminars	7	0 %
Computer practicals	8	0 %
Classroom practicals	15	66 %
Lectures	40	37 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15	0	10		0			5	
Horas de Actividad No Presencial del Alumno/a	25	7	5		8			0	

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima

Written examination	50 %	70 %
Presentations	10 %	30 %
Questions to discuss	10 %	30 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

La evaluación consistirá en un examen final que contará el 100% de la nota final.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

La evaluación consistirá en un examen final que contará el 100% de la nota final.

MANDATORY MATERIALS

Todo el material necesario será impartido en las notas de clase así como en las transparencias utilizadas durante las clases magistrales.

BIBLIOGRAPHY

Basic bibliography

Aumann R. J.: Nash equilibria are not self-enforcing, Economic decision making: Games, econometrics and optimization. North-Holland, 1990.
Gibbons, R. (1993): Un primer curso de teoría de juegos, Antoni Bosch Editor.
Kreps, D. (1995): Curso de Teoría Microeconómica, McGraw-Hill.
Binmore, K. (1994): Teoría de Juegos, McGraw-Hill.

Gardner R (1996): Juegos para empresarios y economistas, Antoni Bosch editor.

Rasmusen, E. (1996): Juegos e información. Una introducción a la teoría de los juegos. Fondo de cultura económica. Mexico. Primera edición en inglés, 1989, Basil Blackwell, Cambridge, Massachussets y Oxford.

Tirole, J. (1990): La teoría de la Organización Industrial. Ariel Economía.

Detailed bibliography

Binmore, K. (1994): ¿Teoría de Juegos¿, McGraw-Hill.
Gardner R (1996): ¿Juegos para empresarios y economistas¿, Antoni Bosch editor.
Rasmusen, E. (1996): ¿Juegos e información. Una introducción a la teoría de los juegos¿. Fondo de cultura económica. Mexico. Primera edición en inglés, 1989, Basil Blackwell, Cambridge, Massachussets y Oxford.
Tirole, J. (1990): ¿La teoría de la Organización Industrial¿, capítulo 11. Ariel Economía.

Journals

Web sites of interest

https://www.coursera.org/course/gametheory
http://www.springerlink.com/content/101791/
http://www.sapub.org/journal/aimsandscope.aspx?journalid=1021

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree INTEL902 - Master in Telecommunication Engineering **Year** First year

COURSE

504005 - Electronic Communications Systems **Credits, ECTS:** 9

COURSE DESCRIPTION

The subject belongs to the first year of the Master's degree in telecommunication engineering.
It studies and expands knowledge about design of electronic instrumentation and electronic communications systems with emphasis on RF systems. Electronic circuits and systems for signal conditioning, acquisition, processing and transmission of signals generated by sensors, transducers and telecommunication systems are studied. It requires knowledge and skills with design, verification and circuit manufacturing tools.
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.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Ability to use programmable logic devices, as well as to design advanced electronic systems, both analog and digital.
Ability to design communications components such as routers, switches, hubs, transmitters and receivers in different bands.
Ability to develop electronic instrumentation, as well as transducers, actuators and sensors.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

Theory
- Components and devices in electronic instrumentation.
- Electronic instrumentation systems for signal acquisition, control and processing.
- Components and devices in telecommunications systems.
- Electronic systems and signal conditioning in telecommunications.
- Treatment and acquisition of signals. Modulation-demodulation and A/D-D/A converters.
- Interference signals, treatment and electromagnetic compatibility.

- Design and specifications of RF systems. Link Budget.
- Discrete passive and active RF components. Transmission lines and adaptation networks.
- Active and Passive Filters
- RF Small Signal Amplifiers.
- Oscillators and frequency synthesizers.
- Mixers and phase circuits.
- RF power amplifiers.

Lab practices:
The laboratory sessions develop the concepts adquire in theory through practical circuits that the student must design and assemble.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Classroom practicals	15	40 %
Laboratory practicals	75	40 %
Lectures	135	40 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	54		6	30					
Horas de Actividad No Presencial del Alumno/a	81		9	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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	60 %	60 %
Practical tasks	40 %	40 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

To pass the subject is mandatory to pass each and every one of the parts individually.
- Theoretical part: It is necessary to individually pass all the examinations of the ordinary call.
- Practical part: Attendance to laboratory sessions is mandatory to pass the practical part.
It is necessary to individually pass each of the parts of the laboratory.
The resignation procedure will be the one included in the corresponding regulations. The student who resigns continuous evaluation will be assessed for the 100% of the subject by means of a test that includes both the theoretical and the practice part.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Same criteria as in the ordinary call.
Scores in either of the two parts (theory and practices) will only be kept until the extraordinary examination sitting of the same academic year

MANDATORY MATERIALS

KICAD,Orcad, PSpice, LTspice, Keysight ADS or equivalent CAD/CAE software.

BIBLIOGRAPHY

Basic bibliography

Practical Design Techniques for Sensor Signal Conditioning. Analogue Devices, 1999.
Electronic Instrumentation. H .S. Kalsi. 2010.
Instrumentación Electrónica. M. A. Perez, J, C. Alvarez, Thompson Paraninfo 2003.
RF Circuit Design, Christopher Bowick, 2nd Edition, Newnes-Elsevier 2008.
Microwave Engineering, David M Pozar, 4Ed, Wiley, 2012.
Solid State Radio Engineering, Herbert L. Krauss and Charles W. Bostian, John Wiley & Sons. 1980

Detailed bibliography

Measurement, Instrumentation and Sensors Handbook. 2nd Edition. CRC Press, 2014.
Principles of Electronic Communication Systems. Louis E. Frenzel (Jan 26, 2007).
Electronic Instrumentation. U.A.Bakshi, A.V.Bakshi. 2009.
Design and development of medical electronic instrumentation. David Prutchi, Michael Norris. 2005.
Electronics Measurements And Instrumentation. U.A.Bakshi, A.V.Bakshi - 2009
Modern Electronic Communication (9th Edition) by Jeff Beasley and Gary M. Miller (May 6, 2007)
Electromagnetics Explained: A Handbook for Wireless/ RF, EMC, and High-Speed Electronics (EDN Series for Design Engineers) by Ron Schmitt (May 27, 2002)
RF Circuit Design. Theory and Applications. Reinhold Ludwing, G. Bogdanov. 2nd Edition, Perarson Prentice Hall, 2009.
Analog-Digital Conversión. Analog Devices.

Journals

http://www.electronics-eetimes.com/en/magazine/magazine-eetimes.html
Microwaves & RF [news@news.mwrf.com]
Microwaves Journal
Microwave Engineering Europe [microwave@electronics-eetimes.com]
analog@electronics-eetimes.com

Web sites of interest

http://www.cadence.com/products/orcad/pages/default.aspx
http://web.awrcorp.com/Usa/Products/Microwave-Office/
http://www.ni.com/labview/
http://www.electronics-eetimes.com/en/magazine/magazine-eetimes.html
Microwaves & RF [news@news.mwrf.com]
Microwaves Journal
Microwave Engineering Europe [microwave@electronics-eetimes.com]
analog@electronics-eetimes.com

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree INTEL902 - Master in Telecommunication Engineering **Year** First year

COURSE

504007 - Microelectronics **Credits, ECTS:** 4,5

COURSE DESCRIPTION

Basic knowledge about active electronic components, manufacturing processes and technologies in integrated circuits, as well as the use of design tools, mathematical models, analysis and simulation of electronic circuits.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Ability to design and manufacture integrated circuits.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

1. INTRODUCTION TO THE INTEGRATED CIRCUITS.
1.1 Historical evolution of integrated circuits.
1.2 Classification of integrated circuits.

2. MANUFACTURING PROCESSES OF INTEGRATED CIRCUITS.
2.1 Manufacture of integrated circuits.
2.2 Semiconductor substrates. Obtaining monocrystalline silicon.
2.3 Growth of monocrystals. Preparation of the substrate.
2.4 Epitaxial growth. Diffusion of impurities. Ionic implantation.
2.5 Oxidation, deposition of insulators and polysilicon.
2.6 Lithography techniques. Metallization. Encapsulated

3. MOS TECHNOLOGY
3.1 NMOS logic.
3.2 CMOS logic.
3.3 Input and output circuits. Verification.
3.4 Advanced circuits in MOS technology.
3.5 Fundamentals of circuits with switched capacities.
3.6 CMOS logic gate circuits.

4. BIPOLAR TECHNOLOGY.
4.1 Manufacturing process of bipolar integrated circuits.
4.2 Diodes and transistors in bipolar integrated circuits.
4.3 Passive components in integrated circuits.
4.4 Bipolar Logics: TTL, ECL and I2L.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Classroom practicals	7,5	40 %
Computer practicals	37,5	40 %
Lectures	67,5	40 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	27		3		15				
Horas de Actividad No Presencial del Alumno/a	40,5		4,5		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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	70 %	70 %

Practical tasks	30 %	30 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation is composed of two parts:
A theory exam for the 70% of the final grade.
A practical laboratory exercise for the 30% of the final grade.
The subject is passed only provided that both parts have been passed separatly (Theory >35%, Laboratory > 15%).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The same that in the ordinary call.

MANDATORY MATERIALS

De Diego, J.M. y Jiménez, J., Circuitos Integrados. Notas docentes. Publicaciones ETSI
Software installed in the computer rooms(both, for classes and open access) DSCH v2.7f and Microwind v2.6k

BIBLIOGRAPHY

Basic bibliography

Rabaey, J.M.; Chandrakasan, A.; Nikolic, B. Circuitos Integrados Digitales; Pearson Educación S.A.. 2004.

Detailed bibliography

Neil H.E.; Weste and Kamran Esharaghina Principles of CMOS VLSI Design; Addison Wesley; 1993.
Paul R. Gray and Robert G. Meyer; Análisis y Diseño de Circuitos Integrados Analógicos; 3rd edition; Prentice Hall; 1993.
David A. Hodges and Horace G. Jackson; Analysis and Design of Digital Integrated Circuits; 2nd edition; MacGraw-Hill; 1988

Journals

Electron Devices, IEEE Transactions on (ISSN: 0018-9383) Electron Device Letters, IEEE ISSN: 0741-3106

Web sites of interest

http://bwrc.eecs.berkeley.edu/classes/icbook/spice www.microwind.org
www.cadence.com

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree INTEL902 - Master in Telecommunication Engineering **Year** First year

COURSE

504010 - Convergence and Integration on Core and Access networks **Credits, ECTS:** 4,5

COURSE DESCRIPTION

This course examines the provision models and procedures for the management and operation of access and backbone networks.

After this course students should have general knowledge on how to solve the convergence, interoperability and design of heterogeneous networks.

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.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Capacidad para resolver la convergencia, interoperabilidad y diseño de redes heterogéneas con redes locales, de acceso y troncales, así como la integración de servicios de telefonía, datos, televisión e interactivos.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

1. INTRODUCTION
2.- ACCESS NETWORKS
Provision models, procedures for the management and operation of heterogeneous access networks.
3.- BACKBONE NETWORKS
Transport models based on packages.
Models for optical transport.
4.- CONTROL PLANE
Control architectures in Next Generation Networks.
5.- INTEGRATION OF ACCESS, BACKBONE AND CONTROL PLANE IN NGN
Models and integrative architectures in Next Generation Networks

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Seminars	10	40 %
Seminars	10	40 %
Laboratory practicals	37,5	40 %
Lectures	65	40 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	26	4		15					
Horas de Actividad No Presencial del Alumno/a	39	6		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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	25 %	60 %
Presentations	10 %	40 %
Practical tasks	20 %	50 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation of the course is designed to be done through continuous evaluation.

The final grade of the subject (with the continuous assessment) will be developed with the next grading formula:

*Lectures: 50% of the grade
Based on written exams
*Presentations: 10% of the grade
10% assigments developed in seminars

*Practical Tasks: 40% of the grade
*30% group reports
*10% continuous assesment in practical tasks

To pass the course, it is COMPULSORY to attend ALL continuous assessment classes (laboratory classes and seminars).

The student wishing to renounce the continuous evaluation will have to do so by submitting an email to the professor responsible for the asignature: eva.ibarrola@ehu.eus in 8 weeks from the beginning of the semester.

A minimum grade of 4 both is needed both in the theoretical part and in the practical part to pass the course.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The practical and theoretical contents will be evaluated through a final exam that will be 100% of the grade of the subject.

MANDATORY MATERIALS

Official web site of the subject: https://egela.ehu.es/

BIBLIOGRAPHY

Basic bibliography

- PETER TOMSU, CHRISTIAN SCHMUTZER, "NEXT GENERATION OPTICAL NETWORKS", ED. PRENTICE HALL, 2002
- C. HELLBERG, D. GREENE, AND T. BOYES, "BROADBAND NETWORK ARCHITECTURES: DESIGNING AND DEPLOYING TRIPLE-PLAY SERVICES", PRENTICE HALL PTR UPPER SADDLE RIVER, NJ, USA, 2007.
- A. KASIM AND P. ADHIKARI, "DELIVERING CARRIER ETHERNET: EXTENDING ETHERNET BEYOND THE LAN", MCGRAW-HILL OSBORNE MEDIA, 2007
- A. FARREL AND I. BRYSKIN, "GMPLS: ARCHITECTURE AND APPLICATIONS", MORGAN KAUFMANN, 2006.
- I. MINEI AND J. LUCEK, "MPLS-ENABLED APPLICATIONS: EMERGING DEVELOPMENTS AND NEW TECHNOLOGIES", WILEY, 2008.
- REDES CONVERGENTES, Manual ITU-T 2010.
- CONVERGING NETWORKS, Manual ITU-T 2010.
- CHRIS HELLBERG, DBROADBAND NETWORK ARCHITECTURES: DESIGNING AND DEPLOYING TRIPLE-PLAY SERVICES¿, PRENTICE-HALL 2007.
- JORDI PALET, IPv6 PARA ESPAÑA, CONSULINTEL 2011.
- A. FARREL E I. BRYSKIN, GMPLS: ARCHITECTURE AND APPLICATIONS, MORGAN KAUFMANN, 2006.
- KARTALOPOULOS, STAMATIOS, NEXT GENERATION INTELLIGENT OPTICAL NETWORKS: FROM ACCESS TO BACKBONE, SPRINGER, 2008.
- MIIKKA POIKSELKÄ, GEORG MAYER, THE IMS: IP MULTIMEDIA CONCEPTS AND SERVICES, WILEY, 2009.
- GONZALO CAMARILLO, MIGUEL-ANGEL GARCÍA-MARTÍN, THE 3G IP MULTIMEDIA SUBSYSTEM (IMS): MERGING THE INTERNET AND THE CELLULAR WORLD, 3ª EDICIÓN, WILEY 2008

Detailed bibliography

- Broadband Network Architectures: Designing and Deploying Triple-Play Services; Naoaki Yamanaka, Kohei Shiomoto , Eiji Oki; Prentice Hall
- GMPLS Technologies: Broadband Backbone Networks and Systems (Optical Science and Engineering); Chris Hellberg, Dylan Greene, Truman Boyes ;CRC Press.
- Broadband Cable Access Networks: The HFC Plant (The Morgan Kaufmann Series in Networking), David Large and James Farmer, Morgan Kaufmann.

Journals

IEEE Network: The Magazine of Global Internetworking, IEEE PRESS.

Web sites of interest

Broad Band Forum: http://www.broadband-forum.org/
TeleManagementForum: http://www.tmforum.org/

UIT-T Recommendations: http://www.itu.int/en/publications/ITU-T/Pages/default.aspx

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree INTEL902 - Master in Telecommunication Engineering **Year** First year

COURSE

504014 - Digital Circuit Laboratory **Credits, ECTS:** 4,5

COURSE DESCRIPTION

Laboratory of digital circuits is a subject of the course 1 semester 2 within the "Master's Degree in Telecommunication Engineering". The teaching is done in the School of Engineering. In this subject the field programmable circuits (FPGA) are worked on and in particular the devices that combine a programmable part and microprocessor (SoPC). It provides the knowledge and tools to analyze, design and use programmable circuits: characteristics, technological evolution, programmable logic devices, circuit description in VHDL and programming in C. The postgraduate course is supported (mainly) in the following subjects of the degree in telecommunication engineering:

* Course 2: Digital Electronics
* Course 3: Digital Systems
* Course 4: Digital circuits laboratory (optional)

The concepts, technologies and processes studied in this subject serve as support for subjects such as:

* Electronic communications systems
* Advanced signal processing
* Design and management of telecommunication networks and services
* Processing of biomedical signals

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

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Knowledge of hardware description languages for highly complex circuits.
Ability to use programmable logic devices, as well as to design advanced electronic systems, both analog and digital.
Ability to design communications components such as routers, switches, hubs, transmitters and receivers in different bands.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

Classroom:
During the classes in the classroom, we will see different coding techniques as well as the problems that may arise in the advanced design of FPGAs. The content of the theory must be applied in the IP cores that will be designed in the laboratory:

* Class Intro and 7 Series Architecture Overview
* FPGA Design Methodology and HDL Coding Techniques
* Synchronous Design Techniques and Reset Methodology
* Synchronization Circuits
* FPGA Design Techniques and Timing Exceptions
* Zynq Architecture
* Introduction to AXI and Zynq PS-PL AXI Ports

Laboratory
* FPGA Design Flow using Vivado
These practices will provide students with an introduction to the design flow using the Vivado® Design software suite for the Xilinx All Programmable devices.
The documentation for this course can be found on the Xilinx University Program website as well as on the subject page.

* Embedded System Design Flow on Zynq using Vivado
This course provides students with an introduction to the design of Zynq embedded systems using a Zedboard and Vivado board.
The documentation for this course can be found on the Xilinx University Program website as well as on the subject page.

* IP core design
Realization of free final practice. Creation of an IP core with interconnection using standard buses for real-time audio processing configurable using software.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Lectures	30	50 %
Laboratory practicals	82,5	36 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15			30					
Horas de Actividad No Presencial del Alumno/a	15			52,5					

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	25 %	50 %
Presentations	25 %	25 %
Otros	25 %	25 %
Practical tasks	50 %	75 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

One or more exams whose weighted average corresponds to 100% of the written test grade.
Final project for 100% of the part corresponding to the project.
The resignation must be done following the current regulations.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Project for 100% of the grade.

MANDATORY MATERIALS

* L. H. Crockett, R. Elliot, M. Enderwitz. "The Zynq Book: Embedded Processing with the Arm Cortex-A9 on the Xilinx Zynq-7000 All Programmable Soc".ISBN 9780992978709. Strathclyde Academic Media. http://www.zynqbook.com/
* Surviving the SOC revolution : a guide to platform-based design. Chang, Henry, Kluwer Academic, 1999.
* Winning the SoC revolution : experiences in real design. Martin, Grant, Kluwer Academic, 2003.
* Xilinx University Program: http://www.xilinx.com/support/university/students.html
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* L. H. Crockett, R. Elliot, M. Enderwitz. "The Zynq Book Tutorials for Zybo and ZedBoard". ISBN 9780992978730, Strathclyde Academic Media
* J. L. Martín (coordinador), P. Ibáñez, A. Zuloaga, U. Bidarte, J. Arias y J. Lázaro. "Electrónica digital". ISBN 84-96477-44-4. 2006, Delta Publicaciones, Madrid.
* E. Mandado, J. L. Martín. "Sistemas electrónicos digitales". ISBN 9788426721983, Ediciones Marcombo

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Volnei A. Pedroni. "Circuit Design with VHDL". Ed. MIT Press, 2004.
Sunggu Lee. "Advanced Digital Logic Design Using VHDL, State Machines, and Synthesis for FPGA's". Ed. Thomson-Engineering, 2005.

Journals

Web sites of interest

http://www.xilinx.com
http://www.digilentinc.com
http://www.ehu.es/Electronica_EUITI/vhdl/pagina/inicio.htm
http://www.vhdl-online.de/tutorial/
http://esd.cs.ucr.edu/labs/tutorial/

Universidad del País Vasco Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree INTEL902 - Master in Telecommunication Engineering **Year** First year

COURSE

504018 - Advanced Radio Communications Design **Credits, ECTS:** 7,5

COURSE DESCRIPTION

This course focuses on the design and planning of several radio communication systems such as: backbone and access networks, mobile communications networks, satellite communications, radar systems and radionavigation systems.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Capacidad para desarrollar sistemas de radiocomunicaciones: diseño de antenas, equipos y subsistemas, modelado de canales, cálculo de enlaces y planificación.
Capacidad para implementar sistemas por cable, línea, satélite en entornos de comunicaciones fijas y móviles.
Capacidad para diseñar y dimensionar redes de transporte, difusión y distribución de señales multimedia.
Capacidad para diseñar sistemas de radionavegación y de posicionamiento, así como los sistemas radar.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

COMPETENCES:
Ability to develop radio communication systems: antenna design, equipment and subsystems, channel modeling, link calculation, and planning.
Ability to implement systems via cable, line, and satellite in fixed and mobile communication environments.
Ability to design and dimension networks for the transport, broadcasting, and distribution of multimedia signals.
Ability to design navigation and positioning systems, as well as radar systems

SYLLABUS
Lectures and seminars.

- Topic 1. Advanced propagation theory. Review of free space propagation and radiant systems. Channel models and propagation models. Problems.

- Topic 2. Radiocommunications for fixed services. Review of radio links. Short review of SDH and PDH. Canalization. Unavailability and error characteristic issues. Problems.

- Topic 3. Mobile radiocommunications. Review of fundamentals of mobile communications. LTE case study: beamforming, MIMO and spectral efficiency. Problems.

- Topic 4. Satellite radiocommunications. Review of satellite communications fundamentals. Mobile satellite services, satellite broadcasting. Problems.

- Topic 5. Radar and radionavigation systems. Review of fundamentals and design of radar systems. Geolocation services. Problems.

Laboratory projects.

- Project 1. Introduction to simulation SW. Antenna design Case study: design and simulation of microstrip antennas. Result presentation.

- Project 2. Measurements automation. Introduction to the SW for equipment remote control. Development of a control software to carry out a measurement campaign and subsequent analysis. Result presentation.

- Project 3. Measurement of RF signals and characterization of circuits using the S parameters. Propagation models and introduction to basic channel modeling. Measurement of channel impulse and frequency response; propagation speed. Planning and execution of indoor measurement campaign; Data processing and conclusions about the radio channel. Result presentation.

- Project 4. LTE network simulation. Tutorial and general coverage objectives for the development of the network. Result

presentation.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Lectures	37,5	40 %
Analytical problems - working groups (report)	37,5	40 %
Seminars	37,5	40 %
Laboratory practicals	112,5	40 %

TYPES OF TEACHING

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

Denominación	Ponderación mínima	Ponderación máxima
Written examination	40 %	40 %
Presentations	30 %	30 %
Multiple-choice examination	30 %	30 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Mid-course exam: NO.

Clarification of the assessment system:

1) On-going assessment.
The 40% of the final grade of the course, which corresponds to the contents of lectures and seminars is distribuited into two parts:
i) Tests carried out along the teaching period (up to a 20% of the final grade of he course). The amount and contents covered by these tests will be decided by the teaching staff according to the observed learning progression of the students. It may be possible to discard some of the worst grades obtained in these tests to obtain the corresponding score for this subsection.
ii) Written exam the day of the first official call regarding the contents of the lectures and the seminars, worth between 20% an 40% of the total grade of the subject. In every case the overall grade of parts i) and ii) will add up to a 40% of the total, and a minimum grade of 3.5 points over 10 will be required to pass the course. Should this requirement not be fulfilled, the final grade will be the grade obtained in this part i) + ii). 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.

The remaining 60% is assigned to the laboratory projects. The skills to be acquired in these projects are assessed following two procedures:

a) There will be oral presentations by the working groups of the laboratory about the work carried out in the projects with a weight of 30% of the final grade of the course. Each project will be given a 0-to-10 grade, and each grade will determine a 7.5% of the final grade of the course, so that, being 4 projects, the overall grade provided by this assessment procedure will be the mentioned 30%.
More specifically, half of the groups will present projects 1 and 3, while the other half will present projects 2 and 4. 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, might be used for this evaluation.
The working groups that are not to do the oral presentation in a certain project will have to develop a presentation-format report from the scratch for that project. However, they will be allowed to take information from the document already

presented by other group and amend it or improve it, taking into consideration the questions and comments arisen in the question time. This document will be used for the evaluation of this project for each non-presenting group.
For this procedure to work properly, the composition of the working groups should be kept constant along the course.

b) Test exam regarding the laboratory projects with 3 to 5 questions corresponding to each project for an overall number of 20 questions. The weight of this exam will be 30% of the final grade of the course.

2) Not on-ongoing assessment.
In order to relinquish the on-going assessment, a letter must be sent to the subject coordinator following the procedure and within the time limits defined by the University regulations. As a consequence, it will be possible to obtain the maximum grade by means of the written exam of the contents of the lectures, the seminars and the laboratory projects, with the following distribution: lectures and seminars will have a weight of 40% of the final grade of the course, while laboratory projects will be assigned the remaining 60%. In the first part, the one corresponding to lectures and seminars, a minimum grade of 3.5 points over 10 will be required to pass the course. Should this requirement not be fulfilled, the final grade will be the grade obtained in this part. The laboratory part will be a 30-question test with there being no minimum.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

There are two modifications with respect to the evaluation format of the first call. In the second call:
-In the 40% of the grade corresponding to master classes and seminars, the tests throughout the training period will not be taken into account and, therefore, 40% of master classes and seminars will be evaluated through the written test to be taken on the day of the official call. The rest is maintained, including the minimum grade requirement of 3.5 out of 10 in that part of master classes and seminars. If this requirement is not verified, the grade obtained in this part will be taken as the final grade.
-The laboratory test will consist of 20 questions in any case.

MANDATORY MATERIALS

- Course slides and exercises based on practical scenarios to be solved, available on the online platform (eGela)
- Guides of the Laboratory Projects (also available on eGela) and reference material.

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- ITU-R Recommendations. Radiocommunication Sector, Series: F, M, PI, PN, S, SF, SM, V. International Telecommunication Union. Geneva 2008.
- John S. Seybold. Introduction to RF propagation. John Wiley & Sons, Inc. 2005.
- Robert K. Crane. Propagation handbook for wireless communication system design. CRC Press LLC, 2003.
- Satellite Communications Systems Engineering. Louis J. Ippolito, Jr. Ed. John Wiley & Sons Ltd, 2008

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Cellular Radio Performance Engineering. A. Mehrotra. Ed. Artech House 1994.
Understanding UMTS RADIO NETWORK, Modelling, Planning and Automated Optimisation. John Wiley and Sons, 2006.
Radio Network Planning and Optimisation for UMTS. Jaana Laiho y Achim Wacker. Ed. John Wiley & Sons Ltd, 2006
OFDM for Wireless Multimedia Communications. R Van Nee, R Prasad , 2000.
Synchronization and Channel Estimation in OFDM Systems. JJ van de Beek , 1998.
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Introduction to Radar Systems, M.I. Skolnik, McGraw-Hill Book Co., Singapur, 1980
Radar System Analysis and Modeling, D. K. Barton, Artech House , 2005
A software-defined GPS and Galileo Receiver - A single-frequency approach, K. Borre, D.M. Akos, N. Bertelsen, P. Rinder, S.H. Jensen, Birkhäuser , 2007

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IEEE Transactions on Communications
IEEE Transactions on Vehicular Technology
IEEE Transactions on Broadcasting

IEEE Antennas and Wireless Propagation Letters

Web sites of interest

http://www.itu.int
http://www.ebu.ch
http://www.etsi.org
http://www.dvb.org
http://www.umts-forum.org
http://www.3gpp.org
http://ieeexlpore.ieee.org
http://www.esa.int/esaNA/galileo.html
http://www.gps.gov

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree INTEL902 - Master in Telecommunication Engineering **Year** First year

COURSE

504022 - Research Management and Methodology **Credits, ECTS:** 3

COURSE DESCRIPTION

This subject seeks to introduce the student to the research methodology, providing the conceptual and practical tools necessary to achieve effective development of their research tasks.
This subject covers the basis of the scientific method and the main activities to carry out by a person who intends to develop scientific and / or technological research and work in the field of R + D + i in any of its aspects. With this aim, the following topics are studied: scientific publications, doctoral theses, congresses and technical conferences, patents, spinoffs and incubators, the transfer of scientific and technological knowledge to the production environment, the information search, the preparation of proposals for research projects, certification of R + D + i projects and oral communications. Other issues such as fraud, error, bias, philosophy of science, and research ethics are also addressed.
This subject allows the student to acquire not only technical knowledge about the described specific topics, but by carrying out practical work that reproduces real activities, the student acquires the skills and knowledge required to carry out R & D & i activities in a company, university or research center.

This subject is part of the educational innovation projectnamed HBP/PIE i3lab24-17 (UZTATU) "INtegración de las tecnologías de Telecomunicación en la EDUcación: aprendizaje con enfoque investigador e interdisciplinar entre la ingeniería y la educación para la adquisición de las competencias transversales del Máster Universitario en Ingeniería de Telecomunicación (INTELEDU)" of the HPB/PIE i3lab (2024-2025) call.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Capacidad para la integración de tecnologías y sistemas propios de la Ingeniería de Telecomunicación, con carácter generalista, y en contextos más amplios y multidisciplinares como por ejemplo en bioingeniería, conversión fotovoltaica, nanotecnología, telemedicina.
Capacity for the elaboration, direction, coordination, and technical and economic management of projects on: systems, networks, infrastructures and telecommunication services, including the supervision and coordination of the partial projects of its attached work; common telecommunication infrastructures in buildings or residential centers, including digital home projects; telecommunication infrastructures in transport and environment; with its corresponding power supply facilities and evaluation of electromagnetic emissions and electromagnetic compatibility.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

At the end of the subject, students must have acquired the skills described, as well as the expected learning outcomes. These learning outcomes are as follows:
- Develop a project working as a team.
- Ability to carry out tasks of preparing requests for research projects developing the fundamental knowledge of the research methodology.
- Understand the procedures and basic techniques to carry out research work.

Theoretical and Practical Contents

1. Fundamental concepts about scientific research: The researcher and the research process. The cientific method.
2. Scientific publications and documentation.
3. The doctoral thesis.
4. Research projects: calls and regional, state and European research plans. Proposal and evaluation of research projects. Development and monitoring.
5. Information search. Scientific databases.
6. Patents. Incubators for technology-based companies and spinoffs.
7. Transfer of knowledge to the productive environment. Policies and indicators.
8. Research Ethics. Fraud.
9. Introduction to the philosophy of science. Racism, sexism and other impostures.
10. Certification of research projects in companies. Scholarships and grants. Research career.
11. Science, technology and religion. Historical evolution and current situation.
12. Uncertainty, measurements and metrology.
13. Oral communication, congresses and conferences. Practical cases.
14. Presentation of research project proposals. Evaluation of research projects. Practical cases.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Computer practicals	37,5	40 %
Lectures	37,5	40 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15				15				
Horas de Actividad No Presencial del Alumno/a	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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Continuous evaluation	20 %	40 %
Written examination	20 %	40 %
Practical tasks	60 %	80 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the regular exam schedule, the evaluation system consists of two parts: written exam of the contents or the whole subject (35% of the grade) and 2 practical works (65% of the grade).

The distribution of 65% of the grade related to practical works in the different activities carried out in the subject is detailed below:

- Writing and presenting a research project proposal: 35%
- Creating and presenting an informative video about general telecommunication concepts: 30%

The evaluation process includes both individual and group work evaluation.

To pass the subject in the regular exam schedule following the described evaluation method, it is necessary that the weighted average of the grades of the sections described above is greater than 5 points and that in any case, the mark of the written exam is greater than or equal to 4 points out of 10.

Attending seminars is obligatory.

Students who do not wish to take continuous assessment must present their withdrawal from continuous assessment according to the procedure and deadlines established in Article 8.3 of the UPV / EHU Student Assessment Regulations.

NOTE: if health reasons do not allow a teaching activity or evaluation task to take place face-to-face, a not face-to-face modality will be used and students will be informed punctually.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the special exam schedule, the assessment will consist of a final exam, the score obtained in this exam being 100% of the subject’s grade.
Withdrawals will be carried out according to applicable regulations.

MANDATORY MATERIALS

S. Ramón y Cajal: Reglas y consejos sobre la investigación científica. 1935.
J. R. Taylor: An introduction to error analysis. University Science Books, 1982.
C. Ascheron and Angela Kitkuth, "Make your mark in Science", Wiley, 2005
E. E. Glavich, R. R. Ibáñez, M. R. Lorenzo, H. A. Palma: Notas introductorias a la filosofía de la ciencia. Eudeba, 1998.
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Alan Chalmers, "La ciencia y cómo se elabora", Siglo XXI, 1992
Horace Freeland, Anatomía del fraude científico, Drakontos, 2006

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F. Di Trocchio: Las mentiras de la ciencia. Alianza editorial, 1769, 1995.
F. Di Trocchio: El genio incomprendido. Alianza editorial, CT 2501, 1999.
R. P. Feynman: ¿Qué significa todo eso?. Editorial Crítica, 1999.
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J. Losee: Introducción histórica a la filosofía de la ciencia. Alianza editorial, AU I65, 1985.
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How to Survive Your Viva - Rowena Murray, 2009

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Davis, P. "La mente de Dios", McGraw Hill, 1993.
Francis S. Collins, "Cómo habla Dios", Temas de Hoy, Planeta, 2007.
Leonard Susskind, "El paisaje cósmico", Drakontos, 2007.
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S. Pérez: Cómo elaborar y presentar un trabajo escrito. Edición Deusto, S.A.,1993.
E. Currás: Documentación y metodologías de la investigación científica. Cuadernos de trabajo. Editorial Paraninfo,1995.
R. J. Freund and W. J. Wilson: Statistical methods. Academic Press Limited, 1997.
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A. Fernández-Rañada: Los científicos y Dios. Ediciones Nobel, 2000.
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INTERNATIONAL JOURNAL OF SOCIAL RESEARCH METHODOLOGY BY ROUTLEDGE
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INTERNATIONAL JOURNAL OF RESEARCH & METHOD IN EDUCATION BY ROUTLEDGE
COMPUTERS & OPERATIONS RESEARCH BY ELSEVIER
NATURE
SCIENCE

Web sites of interest

Magazine "El Escéptico", edita ARP- Sociedad para el avance del pensamiento crítico:
http://www.arp-sapc.org
Página del Ministerio de Educación: www.mec.es.
Página del Centro Español de Metrología: www.cem.es.
Servicio de Información Comunitario sobre Investigación y Desarrollo:
http://cordis.europa.eu.int/es/home.html.
FECYT http://www.accesowok.fecyt.es/cursos/online.html
On being a scientist; a guide to responsible conduct in research,The national Academic of Science, The national Academic of Engineering and the Institue of Medicine (USA); http://www.nap.edu/catalog.php?record_id=12192
Nature Journal, http://www.nature.com/nature/index.html
Science magazine, http://www.sciencemag.org/

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree INTEL902 - Master in Telecommunication Engineering **Year** Second year

COURSE

504023 - Security and Distributed Systems **Credits, ECTS:** 4,5

COURSE DESCRIPTION

Students will acquire a complete and practical vision of the concepts and technologies used for the design of telematic applications, services and infrastructures with specific security and audit requirements and the related regulations.
This subject addresses the protocols, methodologies and tools for the specification, design, implementation and validation of secure networks, systems, services and applications. The applicable legislation in this field is also analyzed.
In the event that health conditions prevent carrying the teaching activity and/or face-to-face evaluation, a non-face-to-face modality will be activated, of which the students will be promptly informed.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Conocimiento de conceptos de seguridad, criptografía y diseño de protocolos de seguridad, que permitirán diseñar y validar soluciones telemáticas que tengan las necesidades de seguridad adaptadas a cada escenario.
Conocimiento de los procedimientos conducentes a validar el correcto desempeño de los mecanismos de seguridad de acuerdo a la legislación vigente.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

In general, the learning outcome pursued in the course is as follows:
Broad and consistent knowledge in the area of security in distributed systems covering the entire service chain: from the authentication of terminals or users to the verification of systems.

In detail:

RA1: Ability to define, implement and validate security protocols at different levels using the usual tools used by engineering professionals in their professional performance.

RA2: Knowledge of the securization of telematic systems, services and applications, such as telematic voting, electronic commerce and the securization of transactions and data exchange in general.

RA3: Ability to define, implement and verify access control systems to information systems, password management and digital identities in distributed systems, including problems associated with mobile environments and user mobility in general.

RA4: Ability to define, implement and validate security policies in distributed systems, carry out risk analysis using specific tools and methods, as well as perform security audits on systems in operation.

RA5: Knowledge of the applicable legal framework and current legislation regarding security in information systems, as well as its implications in the design, implementation and operation of distributed systems.

Theoretical and Practical Contents

C11 Block
Topic 1. Basic security concepts:
- 1.1 Introduction and review of security concepts.

Topic 2. Concepts of cryptography and protocol design:
- 2.1 Encryption Algorithms.
- 2.2 Blind signature. Application in payment and voting services.
- 2.3 Protection of digital content.
- 2.4 Formal verification of security protocols.

C12 Block
Topic 3. Authentication and authorization architectures and protocols:
- 3.1 Authentication systems.
- 3.2 Access control systems.
- 3.3 Identity Management.

Topic 4. Design and security auditing of distributed systems:
- 4.1 Security Policies. Multilevel and multilateral security.
- 4.2 Methodologies for the design of secure systems, security assessment and risk analysis
- 4.3 Audit and security analysis.

Topic 5. Related legislation:
5.1 Applicable Law.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Computer, laboratory, hands-on field practice	0	0 %
Computer work practice, laboratory, site visits, field trips, external visits	0	0 %
Individual work and/or group work	0	0 %
Seminars	10	40 %
Seminars	10	40 %
Laboratory practicals	37,5	40 %
Lectures	65	40 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	26	4		15					
Horas de Actividad No Presencial del Alumno/a	39	6		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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Drawing up reports and presentations	5 %	25 %
Realización de prácticas (ejercicios, casos o problemas)	40 %	70 %
Team work (problem solving, project design).	25 %	35 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation of the subject in the ordinary call is based on continuous evaluation and will be carried out according to the following criteria:

- 60% - Completion of laboratory practices and preparation of reports (covering the contents of units 1, 2 and 3)
- 30% - Solving a complex problem (covering the contents of unit 4) using the PBL methodology (problem-based learning). Evaluation of the deliverables defined in the PBL proposal.
- 10% - Completion and delivery of a short research paper (related to the contents of unit 5)

To pass the subject in the ordinary call following the continuous assessment method, it is necessary that the weighted average of the qualifications of the sections described above is greater than 5 points.

In this case of not following the continuous evaluation method, on the official date assigned to the ordinary call, a test will be carried out for 100% of the grade that should cover the evaluation of the theoretical, practical and complex problem-solving knowledge.

Students who wish to waive continuous assessment must do so in accordance with the procedure and deadlines established in Article 8.3 of the UPV/EHU Student Assessment Regulations.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

A test will be carried out for 100% of the grade that should cover the evaluation of the theoretical, practical and complex problem-solving knowledge.

MANDATORY MATERIALS

R. Anderson: Security engineering. John Wiley & Sons Inc. 2001.
J. Carracedo: Seguridad en Redes Telemáticas. Mc Graw Hill. 2004

BIBLIOGRAPHY

Basic bibliography

D. Gollman: Computer security. 1st Edition, John Wiley & Sons Inc. 1999.
B. Schneier: Applied Cryptography. 2nd Edition. John Wiley & Sons Inc. 1996.
S. Garfinkel, G. Spafford: Practical Unix and Internet Security. 2nd Edition. O'Reilly. 1996

Detailed bibliography

J. Viega, G. McGraw: Building secure software. Addison-Wesley Professional Computing Series. 2002
W. Chewick, S. Bellovin, A Rubin: Firewalls and Internet Security: Repelling the Willy Hacker. Addison-Wesley Professional Computing Series. 2003
R. Housley, T. Polk: Planning for PKI. John Wiley & Sons. 2001
S. Barman: Writing Information Security Policies. New Riders Publishing. 2002
M. Bishop: Computer Security: Art and Science. 2002 by Addison-Wesley Professional. 2002

Journals

Revista de Seguridad en Informática y Comunicaciones: http://www.revistasic.com/
IEEE Security and Privacy: http://www.computer.org/security

Web sites of interest

Red temática Iberoamericana de Criptografía y Seguridad de la Información: http://www.criptored.upm.es
Herramienta Cryptool: http://www.cryptool.com
Herramienta Span: http://www.irisa.fr/celtique/genet/span/
Agencia Vasca de Protección de datos: http://www.avpd.es
Agencia Española de Protección de Datos: http://www.agpd.es

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree INTEL902 - Master in Telecommunication Engineering **Year** Second year

COURSE

504026 - Speech Technologies **Credits, ECTS:** 4,5

COURSE DESCRIPTION

The subject is a general introduction to speech technologies and its goal is to qualify the student to work in this area. This includes both the research profiles and the professional profiles devoted to the design, development and commercialization of dialogue, speech synthesis and recognition systems, biometric security systems, etc. In this subject, basic concepts of signal processing taught in the in the Telecommunication Technology Engineering degree, mainly in the subject of Signal Treatment and also in Multimedia Signal Processing, where basic techniques to process audio and speech signals are studied. Besides, knowledge in advanced signal statistical processing is required. This topic is studied in Advanced Signal Processing, in the first course of the master.
In the event that the sanitary conditions prevent the realization of teaching activities and/or face-to-face evaluations, an online modality will be activated and the students will be informed promptly.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Describe the processes of generation and perception of the voice signal.
Demonstrate knowledge about the time and frequency representation of the voice signal and the techniques used for its analysis.
Demonstrate understanding of problems related to speech acoustic modeling, language modeling, automatic speech and speaker recognition, and voice synthesis systems, as well as about the techniques used to evaluate them.
Measure and interpret the main parameters that characterize the speech signal.
Implement a perceptual voice encoder.
Develop a basic speech recognition system.

Theoretical and Practical Contents

Lesson 1 Introduction to speech technologies
Lesson 2 Speech generation and perception
Lesson 3 Speech signal digital processing techniques
Lesson 4 Speech coding
Lesson 5 Introduction to speech and speaker recognition
Lesson 6 Text to speech conversion

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad

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					
Horas de Actividad No Presencial del Alumno/a	33,75			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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation is divided in three independent parts: master lessons, lab practices and a group work.
- The knowledge about the master lessons will be proven with a multiple choice 20 question test (40%).
- The lab practices will be evaluated by the reports and the work developed at the lab (45%).
- The group work will be evaluated by means of a group grade that will take into account the development and presentation of the work (15%).

In the regular evaluation, the exam must be passed with at least a 4 over 10 and to succeed in the subject the final grade of 5 over 10 must be achieved, once the grades gotten in the three parts are added up. The three parts are independent and once a part is passed, the grade is kept for future calls.

The students unable to follow the combined evaluation must justify their reasons with proper documentation sent to the subject lecturers, according to the procedure established by the current regulation in the first two weeks of the course. They also should inform the faculty at least a month before the exam period starts. These students will be able to prove the achievement of the learning results by means of a final evaluation consisting of: a written exam (40%), a laboratory exam (45%) and the developemnt and presentation of a work (15%).

By not showing to the final written exam, the student refuses to take part in the call.

In the event that the sanitary conditions prevent performing a teaching activity and/or face-to-face evaluation, a non-face-to-face modality will be activated. Students will be informed on time about it.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the resit attempt, two different tests will be made: an exam for the master classes and another one for the lab practices. Each exam will represent the 50% of the final note and both of them must be passed with at least a 5 over 10.

The students that have presented the written justification to elude the continuous evaluation must prove they have correctly completed the lab practices.

In the event that the sanitary conditions prevent performing a teaching activity and/or face-to-face evaluation, a non-face-to-face modality will be activated. Students will be informed on time about it.

MANDATORY MATERIALS

The students will have available at eGela (http://egela.ehu.eus/) the following materials, needed to correctly follow the course:
- Slides with the theoretical content of the course
- Guide for lab practices, a file for each practice with the corresponding theoretical introduction
- Necessary signals, matlab programs, linux scripts and other tools needed to complete the lab practices
- Guide for the development of the group research work

BIBLIOGRAPHY

Basic bibliography

- J. G. Proakis, D. G. Manolakis. Digital signal processing. Principles, algorithms and applications (4th edition). Pearson Prentice Hall, 2007. (ISBN: 978-0131873742)
- L. R. Rabiner, R. W. Schafer. Digital processing of speech signal. Prentice-Hall, 1978. (ISBN: 978-0132136037)
- X. Huang, A. Acero, H. Hon. Spoken Language Processing: A Guide to Theory, Algorithm and System Development. Prentice Hall, 2001. (ISBN: 978-0130226167)
- A. V. Oppenheim, R. W. Schafer. Discrete-Time signal processing (3rd edition). Pearson Prentice Hall, 2009. (ISBN: 978-0131988422)
- D. Jurafsky, J. H. Martin. Speech and Language Processing (2nd edition). Prentice Hall, 2008. (ISBN: 978-0131873216)

Detailed bibliography

- P. Taylor. Text-to-Speech Synthesis. Cambridge University Press, 2009. (ISBN: 978-0521899277)
- L. Rabiner, B. H. Juang. Fundamentals of Speech Recognition. CRC Press, 1993. (ISBN: 978-0130151575)
- D. Yu, L. Deng. Automatic Speech Recognition: A Deep Learning Approach. Springer, 2015. (ISBN: 978-1447157786)
- W. C. Chu. Speech Coding Algorithms: Foundation and Evolution of Standardized Coders. Wiley-Interscience, 2003. (ISBN: 978-0471373124)

Journals

Computer Speech and Language
Speech Communication
IEEE Transactions on Audio, Speech & Language Processing
IEEE Transactions on Systems, Man and Cybernetics-Part B
IEEE Transactions on Multimedia
Journal of the Acoustical Society of America

Web sites of interest

- Speech Technologies
http://www.speech.cs.cmu.edu/
http://festvox.org/
- Review of Speech Synthesis Technology
http://www.acoustics.hut.fi/publications/files/theses/lemmetty_mst/contents.html
- Smithsonian Speech Synthesis History Project (SSSHP)
https://amhistory.si.edu/archives/speechsynthesis/ss_home.htm
- TTS demos
https://www.acapela-group.com/demos/
http://www.nuance.com/landing-pages/playground/Vocalizer_Demo2/vocaLizer_modal.html?demo=true
http://www.cepstral.com/en/demos
https://cloud.google.com/text-to-speech
http://aholab.ehu.eus/tts
- ASR demos
https://www.ibm.com/demos/live/speech-to-text/self-service/home
https://www.google.com/intl/en/chrome/demos/speech.html
https://huggingface.co/spaces/HiTZ/Demo_Basque_ASR

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree INTEL902 - Master in Telecommunication Engineering **Year** Second year

COURSE

504027 - Biomedical Signal Processing **Credits, ECTS:** 4,5

COURSE DESCRIPTION

BIOMEDICAL SIGNAL PROCESSING

DESCRIPTION AND CONTEXTUALIZATION

The subject is an introduction to the analysis and digital processing of biomedical signals of different nature. Typical one-dimensional signals such as the electrocardiogram (ECG), the electroencephalogram (EEG) and the electromyogram (EMG), and multidimensional signals, such as biomedical images, are introduced.

The student will learn to interpret the physiological phenomenon represented by the signals, the acquisition and conditioning techniques that allow the digital storage of the signals, as well as techniques aimed to characterize these signals in the time and in the frequency domains. Typical applications of biomedical signal processing, mainly oriented to diagnosis, will be developed during the laboratory sessions.

The subject is conceived as a general introduction to the biomedical engineering discipline. Thus, it introduces the professional skills required for a biomedical engineer, such as maintenance, design and commercialization of electromedical equipment, diagnostic devices, and medical image systems. The subject also introduces some topics related to research in biomedical engineering.
This subject requires prior advanced knowledge on statistical signal processing, design of digital filters, signal representation in the time and frequency domain, and signal acquisition and conditioning.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Capacidad para analizar, interpretar y procesar digitalmente señales biomédicas

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

SYLLABUS:

TOPIC 1 - Introduction to biomedical signals
TOPIC 2 - Biomedical signal aquisition and conditioning
TOPIC 3 - Characterization of unidimensional biomedical signals
TOPIC 4 - Applications of biomedical signal processing of unidimensional signals
TOPIC 5 - Analysis and processing off biomedical images

LAB SESSION:
SESSION 1 - Aquisition of biomedical signals
SESSION 2 - Basic ECG processing
SESSION 3 - Respiratory component: tachogram and pressure signal
SESSION 4 - Detection of shockable rhythms: session I
SESSION 5 - Detection of shockable rhythms: session II
SESSION 6 - The electromiogram
SESSION 7 - The encephalogram
SESSION 8 - Segmentation of medical images
SESSION 9 - 3-D reconstruction of medical images

Details of the syllabus, laboratory sessions, and the description of the subject methodology are available in the eGela learning platform.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Expository presentation of the contents and discussion	0	0 %
Presentations and Papers	2	100 %
Individual work and/or group work	9,25	0 %
Computer work practice, laboratory, site visits, field trips, external visits	22,5	100 %
Lectures	22,5	100 %
Laboratory practicals	56,25	40 %

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					
Horas de Actividad No Presencial del Alumno/a	33,75			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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Practical Examination	30 %	30 %
Written examination (theory)	30 %	30 %
Internship Report/Summary	25 %	25 %
Team work (problem solving, project design).	15 %	15 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

ORDINARY CALL

The Evaluation systems comprises three independent parts: theory sessions (MAG), laboratory sessions (LAB), and a research work (TI). The MAG part is graded individually and the other two will be assigned a group grade.

The MAG part will be evaluated through an individual written exam based on short questions (30%).
The LAB part will be evaluated with a group grade, considering the reviewed LAB session reports (25%), and an individual exam consisting of two software programs closely related to those developed for the LAB session reports (30%).

The TI part will be evaluated with a group grade, and the works will be publicly presented in a collective session (15%).

The MAG individual part and the LAB individual part require a minimum grade of 5/10, and the overall grade must be above 5/10, once all the parts are aggregated. MAG, LAB and TI are independent and once the minimum grade (5/10) is achieved in one part, this grade will be kept for the following calls.

RESIGNATION:

The students unable to follow the combined evaluation must justify their reasons with proper documentation sent to the subject lecturers, according to the procedure established by the current regulation. They will be able to prove the achievement of the learning results by means of a final evaluation consisting of: (1) a written exam (30%), a laboratory exam (55%) and (3) the work (15%).

If the student does not attend the final written exam and the laboratory exam (both), the resignation will be assumed automatically.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY CALL

The extraordinary call will consist of two exams, corresponding to the MAG and to the LAB parts, respectively. Each exam comprises 50% of the final grade. Both exams require a minimum grade of 5/10.
The students failing to provide an appropriate written documentation to justify their combined evaluation resignation, must prove the adequate development of a work related to biomedical signal processing.

MANDATORY MATERIALS

MATERIALS

Materials for the MAG and the LAB sessions, as well as for the development of the work are available in the eGela platform.

BIBLIOGRAPHY

Basic bibliography

BASIC BIBLIOGRAPHY:

JG Proakis and DG Manolakis. Digital signal processing. Principles, algorithms and applications. Pearson Prentice Hall. 2007.
L Sörnmo and P Laguna. Bioelectrical signal processing in cardiac and neurological applications. Elsevier, Academic Press. 2005.
W Birkfellner. Applied Medical Image Processing: A Basic Course. CRC Press 2014.

Detailed bibliography

ADVANCED BIBLIOGRAPHY:

K.K. Najarian. Biomedical signal and image processing, CRC Press, 2006.
J.D. Bronzino. The biomedical engineering handbook, Vol1 y Vol2, CRC Press, 2000.
TM Deserno. Biomedical Image Processing. Springer-Verlag Berlin Heidelberg. 2011.

Journals

JOURNALS:

IEEE Transactions on Biomedical engineering.
Physiological Measurement.

Web sites of interest

INTERNET LINKS:

http://www.physionet.org/, PhysioBank: a big repository with annotated databases of biomedical signals, including tutorials on signal processing and other software tools for visualization and processing.

NBIA (National Biomedical Image Archive): Biomedical images repository
URL: https://imaging.nci.nih.gov/ncia/login.jsf

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree ININD902 - Master in Industrial Engineering **Year** Second year

COURSE

503302 - Design and Product Development **Credits, ECTS:** 4,5

COURSE DESCRIPTION

Product Design and Development.

The main objectives of the course are:
- To understand the process of design and development of an industrial product.
- To learn, using current tools and methods, applying and sharing existing knowledge, developing group work and improving communication skills.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Knowledge and ability to project, design and develop industrial products.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

They are specified in:
- Knowledge and ability to project and design industrial products.
- Knowledge of product design methodologies according to its life cycle.

The student who passes the course should be able to:
- Generate conceptual designs and develop the technical specifications of industrial products.
- Design product models in a concurrent engineering environment.
- Manage the product design and development process, taking into account its life cycle, in a collaborative engineering environment.

Theoretical and Practical Contents

The fundamental theoretical contents correspond to the stages of a generic process of design and development of an industrial product:

- Nature of the design of new products.
- Stages and methods of the design process.
- Needs and technical specifications.
- Generation of conceptual solutions.
- Concept testing.
- Comparison and selection of alternatives.
- Ergonomic and aesthetic aspects.
- Materials and manufacturing processes.
- Environmental criteria.
- Design process management.
- Integrated industrial design project in a collaborative environment.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Lectures	37,5	40 %
Laboratory practicals	75	40 %

TYPES OF TEACHING

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

Denominación	Ponderación mínima	Ponderación máxima
Attendance and participation	10 %	30 %
Written examination	5 %	50 %
Presentations	10 %	15 %
Otros	30 %	50 %
Practical tasks	20 %	65 %
Questions to discuss	5 %	15 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

A good performance in the course reflected in the collaborative work, carried out sequentially throughout the four-month period, and its final defense, together with the complementary exercises developed in class, may mean that the final exam is unnecessary or has little weight. The student who dispenses with the follow-up of the course will always be able to take the final exam, in this case, with a weight of 100%.

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 students will be promptly informed.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

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 students will be promptly informed.

MANDATORY MATERIALS

The use of the materials provided in the eGela is recommended.

BIBLIOGRAPHY

Basic bibliography

- Product Design and Development. < K.T. Ulrich and S.D. Eppinger >
- El Proceso de Diseño en Ingeniería. < C.L. Dym and P. Little >.
- Engineering Design Methods. < Nigel Cross >.
- Metodología del Diseño Industrial. < M. García; V. Cloquell; T. Gómez >
- The Mechanical Design Process. < David G. Ullman >
- Diseño Industrial. Desarrollo de Producto. < F. Sanz y J. Lafargue >.
- Metodología del Diseño Industrial. < F. Aguayo y V.M. Soltero >
- Manual práctico de Ecodiseño. Operativa de Implantación en 7 pasos. < IHOBE >
- Breve Historia del Diseño Industrial. < J. Heskett >.
- Diseño Industrial I y II. <Danielle Quarante>.

The following book is highly recommended:
- Product Design and Development. < K.T. Ulrich and S.D. Eppinger >, whose fifth edition is translated into Spanish.

Detailed bibliography

- ¿Cómo nacen los objetos? Apuntes para un metodología proyectual < Bruno Munari >.
- Diseño. Historia, teoría y práctica del diseño industrial. < B.E. Bürdek >
- Estrategias para la Creatividad. <G.A. Davis and J.A. Scott>.
- El Diseño Tridimensional. Del Boceto a la Pantalla. <Alan Pipes>.
- Color. <Frans Gerritsen>.
- Ergonomía. <Mc. Cormick, Ernest>.
- Las Dimensiones Humanas en los Espacios Interiores. < J. Panero y M. Zelnik >.
- Materials Selection in Mechanical Design. < Michael F. Ashby >
- Plastic Part Design for Injection Molding. < Robert A. Malloy >
- Ingeniería de Diseño (I, II y III). < P. Orlov >.
- Diseño en Ingeniería Mecánica. < J.E. Shigley and C.R. Mischke >.
- Historia del Diseño Industrial. < R. Torrent y J.M. Marín >.

(*) The books in this category can be used occasionally as a complement in some subjects.

Journals

Web sites of interest

Universidad del País Vasco
Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao
Cycle .

Degree ININD902 - Master in Industrial Engineering
Year First year

COURSE

503905 - Integrated Manufacturing Systems
Credits, ECTS: 3

COURSE DESCRIPTION

The subject "Integrated Manufacturing Systems" is taught in the 1st Course of the Master's Degree in Mechanical Engineering and is the only compulsory subject directly related to processes and technologies for mechanical manufacturing.
The subject focuses on the study of manufacturing systems from the point of view of their necessary interaction with mechanical manufacturing processes. After having studied the fundamental description of the processes in the Degree of Industrial Technologies, the student is in a position to analyze the equipment, machinery and tools, as well as the technology necessary for the manufacture of a component. It is a subject that contributes fundamentally to the acquisition of the competences related to project, calculate and design integrated manufacturing and dimensional control systems.
The subject has been designed in a way that integrates and interacts with subjects related to materials, calculation of machine elements and production automation. On the other hand, the subject prepares the student to address, if he/she wishes to configure his/her curriculum, the proposed intensifications of Product Design and Manufacturing, and of Mechanical Design. Their programs have been coordinated with the contents of Integrated Manufacturing Systems.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

SLC ¿ Knowledge and ability to project, calculate and design integrated manufacturing systems.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

RA-1 A deep knowledge and understanding of the principles of their specialty.
RA-2 Critical awareness of the vanguard knowledge of their specialty.
RA-3 The ability to solve problems outside the standard guidelines of their engineering branch, defined incompletely or with inconsistent specifications.
RA-4 The ability to formulate and solve problems in new emerging areas of their specialty.
RA-5 The ability to use their knowledge and sufficient understanding to conceive models, systems and engineering processes.
RA-6 The ability to identify, find and obtain data.
RA-7 The ability to design and carry out research based on analysis, modeling and experimental data.
RA-8 The ability to critically analyze the data and reach conclusions.
RA-9 The ability to investigate the application of new technologies in its engineering branch.
RA-10 The ability to use their knowledge and understanding to provide solutions to problems that require knowledge beyond those of their discipline.
RA-11 The creative capacity to develop new and original ideas and methods.
RA-12 The ability to use its technical sense to work with incomplete and complex information; and with technical uncertainty.
RA-13 The ability to integrate knowledge from different fields and manage its complexity.
RA-14 A comprehensive knowledge of applicable methods and techniques and their limitations.
RA-15 Knowledge of all the implications of the practical application of engineering.
RA-16 Demonstrate the generic competences of first-cycle graduates at a higher level characteristic f the master's level.

Theoretical and Practical Contents

Unit 1. General aspects - The interaction between system and mechanical manufacturing process
1. Introduction
2. General rules for manufacturing design (DFM)
3. Automotive sector
4. White line sector
5. Aeronautical sector
6. Other sectors: energy, sport, electronics, ...

Unit 2. Sheet metal forming: material characterization
1. Introduction. Case study: manufacturing a car brake pedal
2. Advanced design of sheet forming operations:
- Materials characterization
- Experimental calculation of stamping operations
- Equipment for sheet metal forming

Unit 3. The machine tool: functions, types and architecture
1. Introduction
2. Main functions of machine tools
3. Types and architectures of machine tools

Unit 4. The machine tool: structural elements and guidance systems
1. Introduction
2. Structural elements
3. Guidance systems
4. Feed drive systems
5. Main spindle drive systems
6. Measuring systems

Unit 5. Multitasking machines and hybrid machines
1. Introduction
2. Milling machine evolution
3. Evolution of the lathe
4. Multitasking machines
5. Hybrid or multi-process machines

Unit 6. Flexible manufacturing systems and transfer machines
1. Definition of Flexible Manufacturing System (FMS)
2. Advantages and disadvantages of FMS
3. Definition of families of parts and compound parts
4. Elements present in a Flexible Manufacturing System
5. Other aspects related to FMS
6. Transfer machines and custom manufacturing systems

Unit 7. Coordinate measuring machines
1. Concept and applications
2. Architectures and choice factors
3. The probe
5. Other components
6. Measurement process

Unit 8. Optical and opto-electronic instruments applied to metrology
1. Optical probes
2. Laser radar
3. Tomography

Unit 9. Measurement by interferometry
1. Fundamentals
2. Machine calibration
3. Sources of error
4. The laser tracker
5. The laser tracer

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Workshop practices - working groups (questionnaire)	12,5	32 %
Analytical problems - working groups (report)	12,5	48 %
Computer practicals	12,5	40 %
Computer practices - working groups (report)	12,5	40 %
Seminars	12,5	40 %
Theory	37,5	40 %
Lectures	37,5	40 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15	6			5			4	
Horas de Actividad No Presencial del Alumno/a	22,5	6,5			7,5			8,5	

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	25 %	50 %
Presentations	10 %	25 %
Practical tasks	35 %	50 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation of the theoretical part is carried out by means of a single eliminatory exam. The weight of the final mark of the exam is 50%.

The evaluation of work derived from computer sessions and from the seminars:

The performance of these works is considered mandatory for those students who opt for continuous evaluation. As a whole, the work of the computer sessions together with a two process sheets that the students must deliver will have a relative weight of 40% of the total.

Evaluation of the industrial workshop practices

The positive evaluation of the industrial workshop practices goes through the realization of the two proposed practices. In case of doing them, the total of 10% of the final grade will be available. In each practical session the student must complete some scripts provided by the teacher and some activities in eGela.

The following table summarizes the options available to students to carry out their evaluation.

	Option 1 Non-continuous evaluation	Option 2 Continuous evaluation
Exam	100%	50%
Workshop (*)	-	10%
PamStamp project	20%	
Seminars	-	20%

(*)You must attend all the Industrial Workshop sessions.

The minimum grade in each block of option 2 must be 5 to be able to average. In the written exam (option 1 and 2), you will be asked separately to have a minimum grade of 3.5 both in theory and in the numerical problem.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In this case, the student can save the marks related to the practices and group-works.

The evaluation of the theoretical part is carried out by means of a single eliminatory exam. The weight of the final mark of the exam is 50%.

The evaluation of work derived from computer sessions and from the seminars:

The performance of these works is considered mandatory for those students who opt for continuous evaluation. As a whole, the work of the computer sessions together with a two process sheets that the students must deliver will have a relative weight of 40% of the total.

Evaluation of the industrial workshop practices

The positive evaluation of the industrial workshop practices goes through the realization of the two proposed practices. In case of doing them, the total of 10% of the final grade will be available. In each practical session the student must complete some scripts provided by the teacher and some activities in eGela.

The following table summarizes the options available to students to carry out their evaluation.

	Option 1 Non-continuous evaluation	Option 2 Continuous evaluation
Exam	100%	50%
Workshop (*)	-	10%
PamStamp project	20%	
Seminars	-	20%

(*)You must attend all the Industrial Workshop sessions.

The minimum grade in each block of option 2 must be 5 to be able to average. In the written exam (option 1 and 2), you will be asked separately to have a minimum grade of 3.5 both in theory and in the numerical problem.

MANDATORY MATERIALS

Slides projected by the lecturers are available in E-gela platform.

BIBLIOGRAPHY

Basic bibliography

Tool and Manufacturing Engineers Handbook
Society of Manufacturing Engineers
Varios volúmenes

Fundamentals of machining and machine tools
G. Boothroyd, W.A. Knight
CRC Taylor and Francis
2006

Detailed bibliography

Mecanizado de Alto Rendimiento
L.N. López de Lacalle, J.A. Sánchez, A. Lamikiz
Ediciones Técnicas Izaro
2004

Machine Tools for High Performance Machining
L.N. López de Lacalle, A. Lamikiz
Springer
2009

Mecanizado de Alta Velocidad y Gran Precisión
Arnone, M.
Editorial: El Mercado técnico SL
2000

Manufacturing Automation: Metal Cutting Mechanics, Machine Tool Vibrations, and CNC Design
Y. Altintas
Editorial: Cambridge University Press Date Published
2000

Journals

Información de Máquina-Herramienta Española (IMHE)
Ediciones Técnicas Izaro

European Tool and Mould Making

Web sites of interest

www.afm.es
www.cem.es
http://machinedesign.com/channel/motion-control-mechatronics

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree ININD902 - Master in Industrial Engineering **Year** Second year

COURSE

503915 - Project Management **Credits, ECTS:** 6

COURSE DESCRIPTION

The course focuses on giving an integrated vision of project management, from its genesis to its implementation, contemplating the processes of planning, organization, coordination and control of the project.

In addition to working on the technical skills that a Project Director must have, the subject presents concepts related to personal skills, such as leadership or stakeholder management. Therefore, the subject is understood as an extension of the Grade subject "Engineering Projects".

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

G6. Skills for work organization and human resources management. Knowledge of occupational risk prevention.
G7. Knowledge and skills for integrated project management.
G8. Ability to manage research, development and technological innovation.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

a) Reinforce general concepts of Project Management.
b) Develop the ability to evaluate the success and performance of a project through metrics.
c) To know the capabilities and leadership styles that a Project Manager must have.
d) To know and put into practice techniques for the control and monitoring of projects.
e) To know aspects of R+D+i management and the different financing structures.
f) To develop skills to define, plan, control, etc. a project integrating all the knowledge acquired throughout the degree and the subject.

Theoretical and Practical Contents

GENERAL AGENDA:
1. Project management.
2. The director of the project. The organization of the project. Functional, matrix, mixed organization charts.
3. Management of resources and stakeholders.
4. Economic and financial aspects of the project
5. Project planning.
6. Project control and monitoring
7. Leadership. Teamwork
8. Analysis of the environmental and social impact of the project
9. Legislation
10. How to present a teamwork

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Lectures	30	33 %
Computer practicals	30	66 %
Seminars	90	33 %
Seminars	90	33 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	10	30			20				
Horas de Actividad No Presencial del Alumno/a	20	60			10				

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	15 %	25 %

Presentations	15 %	25 %
Practical tasks	60 %	80 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation of the subject is carried out continuously throughout the course.
The following factors are taken into account in the grading of the course:
Exam (20%): As in the certification exams of the associations of project management professionals, the exam will be in the form of a test with several answer options. In order to pass the course, the exam must have obtained a grade higher than 5 out of 10.
Seminar (50%): At the beginning of the course, students will be assigned to work teams of 4 to 6 people. Each team will have to deliver a work designated at the beginning of the course. The work will be delivered by uploading it to egela within the defined deadlines. The work will also be defended orally. In order to pass the course, the work must have obtained a grade higher than 5 out of 10.
Laboratory practices (30%): The students will have to carry out the indicated practices and deliver the corresponding report. The work will be delivered by uploading it to egela within the defined deadlines. In order to pass the course, the work must have obtained a grade higher than 5 out of 10.
The grade of the course will be obtained by applying to each of the factors (exam, seminar, laboratory practices) its corresponding weight.
If the exam grade is lower than 5.0, the final grade for the course will be that corresponding to the exam grade.
If any of the other two parts (seminar or laboratory practices) has not passed the established cut-off mark, the final grade of the course will be that corresponding to the grade of the part not passed.
If the student decides to waive the Continuous Evaluation of this subject, he/she must communicate it in writing before the deadline for the presentation of the individual work. This date can be found in the Student Guide handed out in class and available in the eGela platform.
In this case, in order to pass the course, the student will be evaluated through a written exam that may contain additional questions to those posed in the exam to which continuously evaluated students are submitted and that will include all the contents studied throughout the four-month period corresponding to the exam. This evaluation will be completed with an oral exam that will take place on the same day of the written exam, prior appointment to the students enrolled in that call.
In the oral exam the students will be asked about the contents studied in the classroom, as well as about the activities carried out during the corresponding four-month period. The student, in order to pass the course, must pass both tests.
In the event that health 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 students will be promptly informed (applicable to all the calls: ordinary, extraordinary and advance).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Those who must submit to the extraordinary call will do so in the same way in which they presented themselves in the ordinary call. That is to say, those who underwent the continuous evaluation, will complete the tests (exam, seminar, laboratory practices) that they did not pass in the ordinary call.
The grade for the course will be obtained by applying the corresponding weight to each of the factors (exam, seminar, laboratory practices).
If the exam grade is lower than 5.0, the final grade of the course will be the one corresponding to the exam grade.
If any of the other two parts (seminar or laboratory practices) has not passed the established cut-off mark, the final grade for the course will be that corresponding to the grade of the part not passed.
Those who waived the continuous evaluation, will be submitted to a written and oral exam as described in the previous section (Ordinary call: orientations and waiver).

MANDATORY MATERIALS

1.- PMI, Project Management Body of Knowledge 6th edition, Project Management Institute, 2017
2.- IPMA, National Competence Baselines ICB4, 2015

BIBLIOGRAPHY

Basic bibliography

Kerzner H., PhD. "Project Management. A systems approach to planning, scheduling and control" 10th edition, Wiley & Sons, 2009
PMI Standards Committee, "A guide to the Project Management Body of Knowledge (PMBOK guide)", 6th edition, 2017
IPMA, IPMA Competence Baselines ICB4, 2015
Fleming Q., Koppelman J., "Earned Value Project Management (Fourth Edition)", Project Management Institute, 2010
Burke R., "Project Management. Planning and Control techniques", Wiley & Sons, 2003
Anbari, F. "Earned value method and extensions" Project Management Journal, vol.34(4), pp. 12‐23, 2003
Burke R., Barron S., "Project Management Leadership: Building Creative Teams", Wiley, 2014
Grisham T., "International Project Management: Leadership in Complex Environments", Wiley, 2010
Klippenborg T., Shriberg A., Venkatram J. "Project Leadership (The Project Management Essential Library)", Management Concepts, 2003

Kerzner H., "R&D project management", Wiley, 2015

Detailed bibliography

Turner J.R., "The handbook of Project-based Management", McGraw-Hill, 2012
Vanhoucke M., "Integrated Project Management Sourcebook", A Technical Guide to Project Scheduling, Risk and Control, Springer, 2016
Kerzner H., "Project Management Metrics, KPIs, and Dashboards. A Guide to Measuring and Monitoring Project Performance", Wiley, 2013
Practice Standard for Earned Value Management, PMI, 2005
National Defense Industrial Association (NDIA) Program Management Systems Committee (PMSC), ANSI/EIA-748-A Standard for Earned Value Management Systems Intent Guide, 2005
Lipke W., Schedule is different, The Measurable News Summer, 31-34, 2003

Journals

International Journal of Project Management
Project Management Journal
R&D Management

Web sites of interest

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

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree ININD902 - Master in Industrial Engineering **Year** First year

COURSE

503922 - Parametric Modelling and Design **Credits, ECTS:** 4,5

COURSE DESCRIPTION

Computer Aided Design Techniques for industrial design. Computational geometry. Curves, surfaces and solids. Parametric modelling. Virtual simulation. Engineering standards. Industrial applications of CAD systems.

In case health conditions prevent a teaching activity or face-to-face evaluation, non-presential options will be enabled and students will be informed immediately.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Knowledge and skills to design and calculate integrated manufacturing systems.
Skills to design and test machines.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

Unit 1. Introduction to industrial graphics. Graphic treatment of information.
Unit 2. CAD Methodology and techniques applied to industrial design.
Unit 3. Fundamentals of Computational Geometry. Treatment of curves, surfaces and volumes with the computer.
Unit 4. Parametric and variational modelling.
Unit 5. Virtual simulations.
Unit 6. Obtaining perspectives and realistic images.
Unit 7. Standardized representation in engineering. Standardization and dimensioning with the computer.
Unit 8. Fulfillment of an industrial design project.
Unit 9.- Industrial applications of CAD systems. Associations with close technological environments (CAM, CAE, GIS, etc.).

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Lectures	37,5	40 %
Laboratory practicals	75	40 %

TYPES OF TEACHING

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

Denominación	Ponderación mínima	Ponderación máxima
Written examination	15 %	40 %
Otros	15 %	40 %
Practical tasks	40 %	70 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

1.- Fundamentos de Dibujo. <W.J. Luzadder>.
2.- El dibujo industrial. <A. Chevalier>.
3.- Dibujo Técnico. <A. Bachman>.
4.- Dibujo Industrial. <J..Félez y M.L. Martínez>.
5.- CAD-CAM. <Barry Hawkes>.
6.- CAD/CAM Theory and Practice. <Ibrahim Zeid>.
7.- Fundamental of interactive Computer Graphics. <J.D. Foley y A..Van Dam>.
8.- Computational Geometry for Design and Manufacture. <I.D. Faux y M.J. Pratt>.
9.- Geometric Modeling. <M.E. Mortenson>.
10.- Parametric and Feature Based CAD/CAM. <J. Shah y M. Mäntylä>.
11.- Manual de Normas: UNE/ISO/DIN/AFNOR/ANSI. <AENOR>.
12.- Engineering Technical Drafting. <J.W. Giachino y H.J. Beukema>.

Detailed bibliography

1.- CAD Tools and Algorithms for Product Design. <P. Brunet; C. Hoffmann y D. Roller>.
2.- Geometric Modelling. <G. Brunnett, H. Bieri y G. Farin>.
3.- Curves and surfaces for computer aided geometric design: a practical guide. <G..Farin>.
4.- Principles of CAD/CAM/CAE Systems. <Kunwoo Lee>.
5.- Applied Geometry for Computer Graphics and CAD. <Duncan Marsh>.
6.- CAD after 2000: integrated, intelligent, collaborative. <L.Piegl y J. Woodwark>.

Journals

Web sites of interest

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree ININD902 - Master in Industrial Engineering **Year** First year

COURSE

503923 - Product Life Cycle **Credits, ECTS:** 4,5

COURSE DESCRIPTION

Introduction to the product life cycle. Information management systems. Design of the product structure. Software for product data management. Implementation of a PLM (Product Life Cycle Management) system.

In case health conditions prevent a teaching activity or face-to-face evaluation, non-presential options will be enabled and students will be informed immediately.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

IPCC4. Knowledge and skills to design security installations.
IPCC6. Knowledge and skills to perform verification and control of facilities, processes and products.
IPCC7. Knowledge and skills to perform certifications, audits, verifications, tests and reports.
TI2. Knowledge and skills to design and calculate integrated manufacturing systems.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

Unit 1. Introduction to product life cycle.
Unit 2. Principles of product life cycle.
Unit 3. Information management systems.
Unit 4. Product structure.
Unit 5. Integration of a PLM system in other applications.
Unit 6. Implementation of a PLM system.
Unit 7. PLM strategies.
Unit 8. Integrative exercise of competencies.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Lectures	37,5	40 %
Laboratory practicals	75	40 %

TYPES OF TEACHING

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

Denominación	Ponderación mínima	Ponderación máxima
Written examination	15 %	40 %
Otros	15 %	40 %
Practical tasks	40 %	70 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Product Lifecycle Management. <Antti Saaksvuori - Anselmi Immonen>.
Global Product. <John Stark>.
Product Lifecycle Management. <Michael Grieves>.
Product Design. Practical Methods for the Systematic Development of New Products. <M. Baxter>.
Product Lifecycle Management: 21st century paradigma for product realisation. <Stark>.
PDM: Product Data Management. <R. Burden>.
The Product Managers Handbook: The complete Product Management Resource. <Linda Gorchels>.
Life Cycle Management. <David Hunkeler>.

Detailed bibliography

The basics of process mapping. <Robert Donelio>.
Bills of Material for a Lean Enterprise . <Dave Garwood>.
Manufacturing Data Structures: building foundations for excellence with BOM and process information <J.Clement>.
Implementing and Integrating Product Data Management and Software Configuration Management. <I.Crnkovic>.
Collaborative Design and Manufacturing Methodologies and Applications. <W.D. Li - S.K.Ong>.
Class A ERP Implementation: Integrating Lean and Six Sigma. . <Donald H. Sheldon>.

Journals

Web sites of interest

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree ININD902 - Master in Industrial Engineering **Year** Second year

COURSE

503924 - Product Design Laboratory **Credits, ECTS:** 4,5

COURSE DESCRIPTION

Methods of capture and registration of geometric information. Recognition techniques. Reverse engineering applications. Recover of information. Verification of geometries. Design Updates. Rapid prototyping techniques.

In case health conditions prevent a teaching activity or face-to-face evaluation, non-presential options will be enabled and students will be informed immediately.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Knowledge and skills to design and calculate integrated manufacturing systems.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

Practice 1. Scanning an industrial part.
Practice 2. Processing and meshing of point clouds.
Practice 3. Recognition and reconstruction of parameterizable geometry.
Practice 4. Obtaining and redesigning the CAD model.
Practice 5. Verification/Inspection of real geometries by comparison.
Practice 6. Verification/Inspection of geometric and dimensional tolerances (GD & T).
Practice 7. Prototyping of an industrial part.
Practice 8. Prototyping of an industrial assembly.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Laboratory practicals	112,5	40 %

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	40 %	60 %
Practical tasks	40 %	60 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Reverse Engineering. An Industrial Perspective<V. Raja, K.J. Fernandes.>
Curves and surfaces for Computer Aided Design <Farin, G.>
Advance Manufacturing Technologies for Medical Applications <Ian Gibson>
Wohlers Report. Additive Manufacturing State of Industry <Terry Wohlers>

Detailed bibliography

Self-Referenced Hand-Held Range Sensor <Patrick Hébert.>
Principles of Computer Automated Fabrication <J. Jhonson.>
Rapid Prototyping System: Fast Track to Product Realization <L. Binstock.>
Proceedings of the 3rd. European Conference on Rapid Prototyping and Manufacturing, The University of Nothingham.
Automated Fabrication: Improving Productivity in Manufacturing <M. Burns.>
Rapid Automated Prototyping: an Introduction <L. Wood>

Journals

Web sites of interest

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree ININD902 - Master in Industrial Engineering **Year** Second year

COURSE

503955 - Integration of Industrial Systems **Credits, ECTS:** 4,5

COURSE DESCRIPTION

The aim is to provide the student with the fundamentals, techniques and technologies used in the integration of control systems in an automated industrial environment, with emphasis on information exchange and supervision systems.

The course looks for a balance between theoretical, methodological, technological and practical subjects.
- Theoretical regarding basics on industrial systems integration and the necessary elements. It will start from the knowledge acquired in the course "Process Automation" taught in the fourth year of the Degree in Industrial Technology for the pre-intensification in Electrical, Electronics and Control Technologies.
- Methodological regarding on the design of systems for automated production systems.
- Technological regarding on the study of devices and components in industrial communications and monitoring systems.
- Practical regarding on to laboratory sessions that will be held on programmable logic controllers (PLCs) and industrial communications networks, in order to solve real automation issues.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Ability to design and plan automated production systems and advanced process control.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

- Use the acquired knowledge to select, design and implement integration systems within automated production environments.
- Use the acquired knowledge to select the strategies for integrating appropriate process control systems, design and validate them as a step prior to their implementation.

Theoretical and Practical Contents

THEORETICAL SUBJECTS:

1st Lesson. Basic concepts in industrial communications. Automation layers. Communication networks. Transmission media and types. Monitoring systems. Encoding and data transmission. Serial protocols in manufacturing environments.
2nd Lesson. Network architecture. OSI from ISO Reference model. Hierarchy of protocols. Reference levels. Industrial network architectures.
3rd Lesson. Industrial communications. Device-oriented: network buses and architectures. Control-oriented: control buses. Plant networks.
4th Lesson. Industrial networks. Features. Network topologies and transmission media. Network architectures.
5th Lesson. Distributed control systems. Monitoring and Monitoring Systems.

TEORICAL SUBJECTS DEVELOPMENT (10 sessions 1,5 hours):

1st BLOCK - Basics in Industrial Communications

1st Lesson. Introduction to Industrial Communications
Basic concepts: Data acquisition and control, transformation of analog signals, data transmission, encoding, communication protocols, basic link protocols.

2nd BLOCK - Network architecture

2nd Lesson. OSI/ISO architecture
Hierarchies of protocols, reference levels, communication between levels, data units, services and primitives, industrial network architectures, plant networks, field buses.

3rd BLOCK - Industrial Communications

3rd Lesson. Actuator/Sensor buses
3.1 Lesson. AS-i Bus: Overview of the AS-i bus, basic bus components, general characteristics, physical level, data link level, active and passive components, frames and services, profiles, functions, network diagnostics, AS-i v2.1 specification.

4th Lesson. Field buses
4.1 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.
4.2 Lesson. CAN: General features, data link, broadcast communication, remote frame request, bus arbitration, communication services, CAN frames, error handling.

5th Lesson. Industrial Ethernet
5.1 Lesson. Ethernet Basics: Technical features, Ethernet types, Frame types, Media access method, Ethernet problems in the industry, Network topologies, Bus components, Transmission media, Industrial Ethernet solutions.
5.2 Lesson. Ethernet TCP/IP: General features, IP stack, TCP or ISO, TCP/IP (features, Internet level, Transport level, Application level), programming interfaces.
5.3 Lesson. PROFInet: Transmission types, real-time communication, decentralized field devices, motion control, decentralized automation, network installation, IT standards, network access security, safety, process.

4th BLOCK - Distributed control systems. Monitoring and Monitoring Systems.

6th Lesson. OPC
6.1 Lesson. Classic OPC: Purpose, situation, architecture, OPC databases, objects and interfaces, OPC applications, general architecture and components, local and remote servers, OPC standards.
6.2 Lesson. OPC UA: Main Features, fundamental components, architecture levels, specifications set, transport protocols, data model, information model, services, profiles, security, information modelling (space address, nodes and references, events, historical access), applications development.

7th Lesson. Supervisory Systems
Goals. Types and benefits. Process monitoring technologies. Acquisition. Registry. Process representation. Detection of failures. Tools of knowledge management and decision making. Interfaces, SCADAs.

SEMINAR SUBJECTS: DEVELOPMENT (10 sessions 1,5 hour):

- 1st Seminar: Industrial communications basics - Serial communications
- 2nd Seminar: SIMATIC communications
- 3rd Seminar: AS-i
- 4th Seminar: PROFIBUS-DP
- 5th Seminar: DeviceNet
- 6th Seminar: TCP/IP
- 7td Seminar: PROFInet-IO
- 8td Seminar: OPC-DA
- 9td Seminar: OPC-UA
- 10td Seminar: SCADA systems

PRACTICAL SUBJECTS: DEVELOPMENT (8 sessions):

- 1st Practice: S7 communications (1,5 hours)
- 2nd Practice: I/O communications - PROFIBUS-DP 1/2 (2 hours)
- 3th Practice: I/O communications - PROFIBUS-DP 2/2 (2 hours)
- 4th Practice: IE communications - TCP/IP (2 hours)
- 5th Practice: I/O communications - PROFInet-IO 1/2 (2 hours)
- 6th Practice: I/O communications - PROFInet-IO 2/2 (2 hours)
- 7th Practice: OPC-DA communications (2 hours)
- 8th Practice: Supervisory systems (2 hours)

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Lectures	37,5	40 %
Seminars	37,5	40 %
Seminars	37,5	40 %
Laboratory practicals	37,5	40 %

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	40 %	70 %
Otros	0 %	10 %
Practical tasks	30 %	60 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Written Test: 70% (Pass score 40%)
Seminar/Laboratory: 30% (Continuous Assessment, PS 50%)

Disposition for Seminar Sessions: 5% (Independent work - Pass score 70%)
Laboratory Reports: 10% (Independent work - Pass score 50%)
Laboratory Practices: 15% (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: 70% (Pass score 50%)
Laboratory Test: 30% (Pass score 50%)

The renounce to the ordinary 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

Documentation corresponding to the transparencies supporting the theory, seminars and laboratory is in the virtual classroom of the subject.
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

Hardware equipment:
- Personal computers
- Programmable controllers - SIMATIC-S7-1500
- Communications processors - PB-DP, PN-IO
- Frequency inverters SINAMIC G120
- Manufacturing cells - FESTO MecLab
- Heterogeneous platforms - Arduino UNO / Ethernet Shield

BIBLIOGRAPHY

Basic bibliography

Title: Comunicaciones Industriales: Principios básicos
Authors: M. A. Castro Gil, G. Díaz Orueta, F. Mur Pérez, R. Sebastián Fernández, etc.
Publisher: UNED Year of Publication: 2007

Title: Comunicaciones Industriales: Sistemas Distribuidos y Aplicaciones
Authors: M. A. Castro Gil, G. Díaz Orueta, F. Mur Pérez, R. Sebastián Fernández, etc.
Publisher: UNED Year of Publication: 2010

Title: Redes de Computadoras
Authors: A. S. Tanenbaum
Publisher: Pearson Universidad. 5ª edición Year of Publication: 2013

Title: Comunicaciones Industriales. Una visión práctica con Simatic S7
Authors: V.M Sempere, J. Silvestre, J.A. Martínez
Publisher: Publisher de la Universidad Politécnica de Valencia Year of Publication: 2002

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

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

Detailed bibliography

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

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

Title: Comunicaciones Industriales
Authors: V. Guerrero, L. Martínez y R.L. Yuste
Publisher: Marcombo Year of Publication: 2010

Title: AS-Interface. The Actuator-Sensor-Interface for Automation
Authors: W.R. Kriesel, O.W. Madelung
Publisher: Publisher Hanser. 2ª edición Year of Publication: 1999

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

Title: Profibus PA. Instrumentation Technology for the Process Industry
Authors: Ch. Diedrich, Th. Bangemann.
Publisher: Oldenbourg Industrieverlag GmbH Year of Publication: 2002

Title: Controller Area Network. Basic, Protocols, Chips and Applications
Authors: K. Etschberger
Publisher: IXXAT Press Year of Publication: 2001

Title: OPC Unified Architecture
Authors: W. Mahnke, S.-H. Leitner, M. Damm
Publisher: Springer Year of Publication: 2009

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

Title: Aprenda WinCC
Authors: J. Martínez Torres, J.M. Díez Aznar
Publisher: Publisher de la Universidad Politécnica de Valencia Year of Publication: 2011

Journals

Automática e Instrumentación http://www.tecnipublicaciones.com/automatica/
IEEE Transactions on Industrial Informatics. http://www.ieee.org/
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/
Open DeviceNet Vendor Association http://www.odva.org
EtherCAT Technology Group http://www.ethercat.org
OPC Foundation http://www.opcfoundation.org

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree ININD902 - Master in Industrial Engineering **Year** Second year

COURSE

503956 - Automation and Robotics **Credits, ECTS:** 6

COURSE DESCRIPTION

Robotics is a multidisciplinary subject, that deals with the elements composed by a robotic system, its design and programming. Hence, this subject covers all these areas, from the modelling, control and programming of a robot, to the integration of a robot in an automated system, providing tools to evaluate the convenience of installing a robot and the most suitable way to do it.

The subject is composed by 6 ECTS credits (60 lecture hours and 90 personal working hours). From these credits, 3 ECTS (30 hours) correspond to theory, 1,5 ECTS to seminars and 1,5 ECTS to laboratory sessions.

This subject is given in the 2nd course of the Industrial Engineering Master

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Ability to design and plan automated production systems and advanced process control.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

- Use the acquired knowledge to formulate the kinematic and dynamic model of an industrial robot, design the high-level control system (trajectory generator) and low-level control system (control strategies to ensure with the established specifications), as well as knowing how to programme any given task at robot level.

- Use the acquired knowledge to design robotised cells in which the integration of industrial robots is appropriate.

Theoretical and Practical Contents

The contents of the subject are divided in 7 themes:

1. Introduction to automated processes using robotics
1.1. Robot introductory aspects
1.2. Components and subsystems of a robot

2. Kinematics
2.1. Introduction
2.2. Spatial location tools
2.3. Position problem
2.4. Velocity Problem

3.Dynamics
3.1. Introduction
3.2. Dynamic Modelling approaches
3.3. Direct and Inverse Dynamics

4-Industrial Robot Programming
4.1. Introduction
4.2. Programming methods
4.3. Programming system requirements
4.4. Programming languages
4.5. Programming examples

5. Trajectory generation - Cinematic control
5.1. Introduction
5.2. Trajectory generation algorithms
5.3. Joint Interpolators
5.4. Trajectory in task space

6. Control Strategies
6.1. Introduction
6.2. Monoarticular control
6.3. Multiarticular control

6.4. Position/Hybrid/Force control

7. Selection of the robot and design of an automated cell (3 h)
7.1. Elements of a cell
7.2. Considerations in the design of a cell
7.3. Robotic cell simulators
7.4. Safety aspects of robotic cells
7.5. Case study examples
7.6. Case study:
  7.6.1. Specifications and functionality. Definition of working substations
  7.6.2. Selection of robots, peripherals and sensors
  7.6.3. Control system design
  7.6.4. Layout development Simulations

Practical/Laboratory sessions

Practical sessions on Automation in Robotised Cells
- PL-C1: Design of the robotic cell (I)
- PL-C2: Design of the robotised cell (II)
- PL-C3: Robotisation in the automotive sector. Visit to Mercedes Benz

Simulation
PL1-Position problem
PL2-Velocity problem and dynamic model
PL3-Kinematic and Dynamic Control

Programming
PL4- Industrial Robot Programming I
PL5- Industrial Robot Programming II

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Laboratory practicals	37,5	40 %
Seminars	37,5	40 %
Seminars	37,5	40 %
Lectures	75	40 %

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	40 %	100 %
Otros	0 %	10 %
Practical tasks	0 %	60 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The following evaluation tools are used to evaluate this subject:
1.-Midterm exam. Robotised Cell Work. Written report and oral presentation to be given halfway through the course. Marking 25%.
2.-Laboratory work. Practical session preparation works and calculations will be evaluated using eGela. Marking 15%
3.-Final exam. Written exam that will be carried out in the official dates defined by the Faculty, with short question and problems. Marking 60%

In order to pass the subject it will be required to obtain at least the 50% the value of the Final Exam. If this is achieved, then the points obtained in the midterm exam and the laboratory work will be added.

In order to pass the subject it will be required to obtain at least the 50% the value of the Final Exam. If this is achieved, then the points obtained in the midterm exam and the laboratory work will be added.

RESIGNATION TO THE CALL
A no-show in the final exam will be considered a resignation to the call.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The same tools defined for the ordinary call will be defined:
1.-Laboratory work. Practical session preparation works and calculations will be evaluated using eGela. Marking 15%.
2.-Final exam. Written exam that will be carried out in the official dates defined by the Faculty, with short question and the development of several problems both on the robotic cell part and on the industrial robot part. Marking 85%.

The evaluation tools 1 and 2 will be maintained from the ordinary call, being part of the continuous evaluation of the subject.

In order to pass the subject it will be required to obtain at least the 50% the value of the Final Exam. If this is achieved, then the points obtained in the midterm exam and the laboratory work will be added.

RESIGNATION TO THE CALL
A no-show in the final exam will be considered a resignation to the call.

MANDATORY MATERIALS

Support documentation for the theory, seminars and laboratory can be found in the virtual classroom of the course.

"Automatización y Robótica" (2024). I. Cabanes, A. Mancisidor, A. Zubizarreta. Documentación de apoyo a la teoría y seminarios. Sección de Publicaciones; también disponible en el aula virtual de la asignatura.

"Laboratorio Automatización y Robótica" (2024) A. Mancisidor, I. Cabanes, A. Zubizarreta. Documentación de apoyo al Laboratorio. También disponible en el aula virtual de la asignatura.

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- FUNDAMENTOS DE ROBÓTICA. 2ª Edición. A. Barrientos, L.F. Peñin, C. Balaguer, R. Aracil. Ed. McGraw-Hill, 2007.
- ROBOTS Y SISTEMAS SENSORIALES. (CEA-IFAC, Robótica & Automática). F. Torres, J. Pomares, P. Gil, S.T. Puente, R. Aracil. Ed. Prentice Hall, 2002.
- INTRODUCTION TO ROBOTICS: MECHANICS AND CONTROL. Ed. Addison Wesley. 2005
- INSTRUMENTACIÓN INDUSTRIAL. A. Creus. Ed. Marcombo, 2005

Detailed bibliography

- INTRODUCTION TO ROBOTICS. Phillip John McKerrow. Ed. Addison-Wesley, 1993.
- ROBOTICA: MANIPULADORES Y ROBOTS MÓVILES. A. Ollero. Ed. Marcombo, 2001.
- HANDBOOK OF INDUSTRIAL ROBOTICS. Shimon Y. Nof. Ed. John Wiley & Sons, 1985.
- MACHINE VISION: THEORY, ALGORITHMS, PRACTICALITIES. Davies, E.R. Academic Press, 1990.
- VISIÓN POR COMPUTADOR. IMÁGENES Y APLICACIONES. G. Pajares. Ed. Ra-Ma, 2001.
- TRATAMIENTO DIGITAL DE IMÁGENES. R. González y R. Woods. Ed. Addison Wesley, 1996.

Journals

- ADVANCED ROBOTICS
- IEEE ROBOTICS & AUTOMATION MAGAZINE
- INTERNATIONAL JOURNAL OF ROBOTICS & AUTOMATION
- ROBOTICS AND COMPUTER-INTEGRATED MANUFACTURING
- INTERNATIONAL JOURNAL OF COMPUTER VISION
- JOURNAL OF VISION
- VISION RESEARCH

Web sites of interest

- Grupo Robotica GTRob. Grupo Temático de Robótica del Comité Español de Automática CEA-IFAC http://www.cea-ifac.es/wwwgrupos/robotica/index.html
- ABB - Fabricante de robots. http://www.abb.com/robots

- KUKA - Fabricante de robots. http://www.kuka.es
- Staübli - Fabricante de robots. http://www.staubli.com/en/robotics
- Fanuc - Fabricante de robots. http://www.fanucrobotics.es
- Robotics Glossary http://www.learnaboutrobots.com/glossary.htm
National Instruments - Instrumentación http://www.ni.com/es/
- Grupo de Visión por Computador CEA-IFAC http://ceavision.unileon.es/
-UKIVA - Información Visión http://www.ukiva.org/
-OpenCV - Software libre Visión
o http://sourceforge.net/projects/opencv/
o http://opencv.willowgarage.com/wiki/Welcome

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree ININD902 - Master in Industrial Engineering **Year** First year

COURSE

503959 - Management of Hydraulic Resources and Hydro-Electric Plants **Credits, ECTS:** 6

COURSE DESCRIPTION

With this subject the student will be provided with an elementary theoretical base to solve specific problems, typical within engineering, in the management of hydraulic resources and hydroelectric facilities.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Knowledge and skills to perform verification and control of facilities, processes and products.
Knowledge and skills for the design and analysis of thermal machines and engines, hydraulic machines and industrial heating and cooling facilities.
Knowledge and skills to project and design electrical and fluid facilities, lighting, air conditioning and ventilation, energy saving and efficiency, acoustics, communications, home automation and intelligent buildings and security facilities.
Project, calculate, design and manage hydraulic resources and hydroelectric plants.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

Topic 1. Water and hydrology. Antecedents of hydraulic planning. Scope. Water management in the world. Applications. The balance between uses and resources. Necessary endowments of use. The management of demand. Water cycle. Precipitation. Surface water. Watersheds. Stochastic analysis of hydrological information.

Topic 2. Physical principles of hydroelectric exploitation. Review of the principles of fluid mechanics.

Topic 3. Hydraulic systems for the use of resources. Regulation and energy accumulation. Description of the works to be done in order to take advantage of the different resources.

Topic 4. Hydroelectric power plants. Types of facilities. Control of facilities and audits. Types of hydroelectric power plants. Facilities. Maintenance and control. The process of auditing this type of facility.

Topic 5. Hydroeconomy and master plan for the design of an exploitation. Integral water resources the cost, price and value of water. The cost of a hydroelectric power station. Complete master plan.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Computer practicals	12,5	40 %
Field practicals	25	40 %
Classroom practicals	37,5	40 %
Lectures	75	40 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30		15		5				10
Horas de Actividad No Presencial del Alumno/a	45		22,5		7,5				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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Otros	50 %	50 %
Practical tasks	50 %	50 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Continuous evaluation will be done, valuing the attendance to class (25%), the participation (25%) and the delivery of the works on the subjects of the subject (50%).

In the ordinary convocatory, the student can be evaluated through the final evaluation system (exam for 100% of the subject), if requested to the teacher responsible for the Group in which he / she has enrolled (in writing, by email, within the established term of the first 9 weeks of the course). In this case, the structure of the final exam for 100% of the subject will maintain identical percentages and criteria for calculating the final grade (through specific exercises of each task).

Failure to perform the face-to-face task and not request a final evaluation means a waiver of the call.

Note.- in case sanitary conditions do not allow carrying out one face-to-face teaching task and/or evaluation, a non faceto-
face modality will be activated and students will be informed punctually (applicable to all calls: ordinary, extraordinary and advance of call).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary convocatory, the student will be assessed by exam for 100% of the subject maintaining identical percentages and criteria for calculating the final grade.

Failure to submit to the final examination of the extraordinary call supposes the resignation to this convocatory.

MANDATORY MATERIALS

Gestión de recursos hídricos. Luis Balairón Pérez. Edicions UPC. (Universidad Politécnica de Catalunya. 2000). ISBN: 84-8301-403-3
Energía Minihidráulica. Publicación del Ente Vasco de la Energía. (Bilbao).
Tratado básico de presas y obras hidráulicas. Eugenio Vallarino

BIBLIOGRAPHY

Basic bibliography

Centrales Hidroeléctricas. Ediciones Paraninfo
Saltos de agua y presas de embalse. Gómez Navarro.
Centrales eléctricas I. Ángel Luis Orille Fernandez. Edicions UPC. (Universidad Politécnica de Catalunya. 1997). ISBN: 84-89636-50-8

Detailed bibliography

Gestion des eaux. F. Valirón. Colegio de Ingenieros de Caminos, Canales y Puertos de Francia. Edición ISBN: 2-85978-157-9.
Hidrología aplicada. Ven Te Chow. Editorial Mc-Graw- Hill. 1993. ISBN: 958-600-171-7

Journals

Tecnología del agua
Ingeniería del agua

Web sites of interest

https://www.consorciodeaguas.com/Web/Inicio/index.aspx
ftp://ftp.ehu.es/cidirb/profs/inpibbeg/material_08_09/08_09_3_adicional_bestelakoa/Fernando_Santos_MH_07-08.pdf
http://ga.water.usgs.gov/edu/hyhowworks.html
http://www.youtube.com/watch?v=htT_8sFJx1w

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree ININD902 - Master in Industrial Engineering **Year** First year

COURSE

503960 - Oil Hydraulics **Credits, ECTS:** 3

COURSE DESCRIPTION

a) The objective of "Fluid power" is to study the generation, transmission and control of motions and forces by pressurized oil. This liquid is an incompressible fluid capable of transmitting high forces at a very high pressure level. This subject completes the core knowledge about hydraulic pumps by introducing the positive displacement machines. This way, the students can perceive a complete perspective of the group of hydraulic machinery.
The subject is developed with a high experimental and practical orientation, so that the student will be able to design a wide variety of fluid power circuits, with the corresponding computational simulation and experimental testing in the hydraulic benches of the laboratory.
The abilities acquired in the subject of fluid power will permit to apply this technique in different industrial fields such as heavy machinery, aircrafts, watercrafts or programmed manufacturing processes. All the necessary components for the fluid power systems will be selected according to the criteria studied in the subject.

b) "Fluid Power" contributes significantly to the development of the competencies under the Industrial Technology Module, in all the subjects related with the positive displacement machinery and its application in any industrial generic projects, integrated manufacturing processes, process control systems or automatic manufacturing systems.

c) The horizontal and vertical coordination of the subject with others is assured by the internal relationship of all the subjects in the Hydraulic Engineering majoring studies and the collaborative work developed by the lecturers in relation to the common competencies developed by the students in the master´s degree and the module (of Industrial Technologies in this case).

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

TI5. Knowledge and capacities for the design and analysis of thermal machinery and motors, hydraulic machinery and industrial heat and cooling facilities.
TI8. Capacity to design and project automated manufacturing systems and advanced control of processes.
IH3. To project, calculate and design fluid networks and fluid power (pneumatic and oil hydraulic) components.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

- Understanding the operation of the machinery and facilities of oil hydraulics by means of the design of its components, basic physical fundamental laws and characteristic curves.
- Planning and designing oil hydraulic facilities.
- Understanding the regulation and control of the processes related to the field of the oil hydraulic machinery and facilities for their optimum management.
- Performing the operation, management, experimental testing and analysis of oil hydraulic facilities.
- Developing technical and diagnostic reports.

Theoretical and Practical Contents

CHAPTER 1: INTRODUCTION TO FLUID POWER
1.1. Definition of Fluid Power
1.2. Properties of oil
1.2.1. Viscosity
1.2.2. Desity
1.2.3. Fluency point
1.2.4. Compressibility
1.2.5. Vapour pressure, saturation pressure, cavitation
1.2.6. Emulsion removing capacity
1.2.7. Foam generation
1.2.8. Flammability
1.3. Fundamental laws
1.3.1. Conservation of mass
1.3.2. Conservation of energy
1.3.3. Positive displacement principle
1.3.4. Hydrostatic law and Pascal principle
1.4. Energy transformation
1.5. Advantages and disadvantages of pressurized oil

1.6. Comparison between fluid power pneumatic systems and fluid power hydraulic systems.
CHAPTER 2: THE HYDRAULIC GROUP
2.1. Introduction
2.2. Hydraulic tanks
2.3. Hydraulic pumps
2.3.1. General concepts
2.3.2. Alternative pumps: radial pistons, axial pistons (aligned pistons, inclined swash-plate type, oscillating wobble-plate type, bent axis type), oscillating pistons.
2.3.3. Rotary pumps: external gear, lobe type, screw pump, internal gear (gerotor type and crescent seal type), vane pump
2.4. Filters
CHAPTER 3: ACTUATORS
3.1. Introduction
3.2. Cylinders
3.3. Limited rotation actuators
3.4. Rotary motors
3.5. Hydraulic grippers
CHAPTER 4. VALVES AND HYDRAULIC ACCESORIES
4.1. Introduction
4.2. Pressure valves
4.2.1. Safety relief valves
4.2.2. Sequence valves
4.2.3. Reducing valves
4.2.4. Counterbalance valves
4.2.5. Unloading valve
4.3. Valves for fluid distribution
4.3.1. Directional control valves
4.3.2. Check valves
4.4. Valves for flow regulation
4.4.1. Flow restrictor (uncompensated)
4.4.2. Pressure compensated flow control valve
4.4.3. Flow divider valve
4.5. Proportional valves
4.5.1. Directional (flow control)
4.5.2. Relief valves
4.5.3. Reducing valves
4.6. Servo valves
4.6.1. Feedback signal by pressure
4.6.2. Feedback mechanical signal
4.6.3. Feedback electrical signal
4.7. Cartridge valves
4.8. Other valves
4.9. Accumulators
4.10. Hydraulic-Pneumatic systems
4.10.1. Hydraulic-neumatic converter
4.10.2. Oil breking cylinder
4.10.3. Pressure multiplier
4.11. Other accessories
4.11.1. Manometers
4.11.2. Flowmeters
4.11.3. Pressure switch
4.11.4. Heat exchanger
4.11.5. Joining elements
CHAPTER 5: FLUID POWER HYDRAULIC CIRCUITS
5.1. Differential circuit
5.2. Circuit with actuator in series
5.3. Circuit with actuator in parallel
5.4. Circuit with heavy traction loads
5.5. Sequence control in two cylinders
5.6. Hydraulic press
5.7. Drill with different forward velocities
5.8. Circuits for a rotary hydraulic motor
5.9. Hydraulic maintenance
CHAPTER 6: CALCULATIONS IN A HYDRAULIC CIRCUIT
6.1. Cylinder selection

6.2. Directional valve
6.3. Pipes
6.4. Pump selection
6.5. Safety valve
6.6. Accumulator
6.7. Tank
6.8. Refrigerator

LAB EXPERIMENTS
Practical 1: Gear pump, blocking valve, manometer
Practical 2: Pressure relief valve
Practical 3: Directional valve
Practical 4: Simple effect cylinder
Practical 5: Double effect cylinder
Practical 6: Check valve
Practical 7: Flow restrictor valve
Practical 8: Compensated flow control valve
Practical 9: Fluid flow resistance
Practical 10: Differential circuit
Practical 11: Pressure counterbalance
Practical 12: Flow control as a functin of the stroke
Practical 13: Flow restrictor with chechk valve in parallel
Practical 14: Pilot operated check valve
Practical 15: Inflow control
Practical 16: Outflow control
Practical 17: Pressure operated sequence of actuators
Practical 18: Pressure reducing valve
Practical 19: Pilot operated pressure relief valve
Practical 20: Hydraulic motor
Practical 21: Accumulator
Practical 22: Circuit with fast/slow motion

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Computer practicals	17,5	40 %
Lectures	37,5	50 %
Laboratory practicals	37,5	50 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15			15					
Horas de Actividad No Presencial del Alumno/a	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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Otros	40 %	60 %
Practical tasks	40 %	60 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

GRADING POLICY AND TASKS: the grading system corresponds to "continuous assessment".

T1: 40% practical tasks
T2: 60% Laboratory experiments
The attendance to classes (either theoretical or practical) is part of the evaluation of each task within the continuous evaluation.

In the ordinary call the student can be evaluated by the final exam system (by an exercise on 100% of the subject), providing they claim for it to the teacher responsible of the group where they are enrolled in. The request must be

forwarded by electronic mail during the 9 first weeks of the year. In this case the structure of the exam will maintain the same percentages and calculation method to obtain the final mark from the 2 tasks of the subject T1 and T2 (assessed through specific exercises).

The absence of in-person task T2 and not having requested the final exam will be considered a withdrawal from the ordinary call.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary call, the student has to sit an exam with a grading weight of 100% with the same percentages and calculation criterion of the final mark as in the ordinary call.

Not sitting the final exam T1 in the extraordinary call will be considered a withdrawal from that call.

MANDATORY MATERIALS

- G. A. Esteban Alcalá, Collection of slides, "Fluid power", 2018, Bilbao.
- HRE-HIDRAULIC, COMPENDIUM OF LAB PRACTICALS. 2018.

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1. A. Serrano Nicolás, Oleohidráulica, 1ª ed., McGraw-Hill, Madrid, 2002.
2. Felip Roca Ravell, Oleohidráulica básica, Edicions UPC, Barcelona, 1998.
3. J. Almandoz Berrondo et al., Sistemas Neumáticos y Oleohidráulicos, Escuela Universitaria Politécnica, Donostia, 2007.
4. Roldán Viloria, José. NEUMÁTICA, HIDRÁULICA Y ELECTRICIDAD APLICADA. Editorial Thomson-Paraninfo. 2001
Colección de películas:
1. Introduction to Fluid Power, Meridian Education Corporation (19 min)
2. Fluid Power Technology: At Work, Meridian Education Corporation (23 min)
3. Fluid Power Technology: Pumps, Lines, Filters, Meridian Education Corporation (28 min)
4. Fluid Power Technology: Actuators, Meridian Education Corporation (22 min)
5. Fluid Power Technology: Control Mechanisms, Meridian Education Corporation (25 min)

Detailed bibliography

1. Andrew Parr, Hydraulics and Pneumatics, 2nd ed., Butterworth-Heinemann, Oxford, 1998.
2. Qin Zhang, Basics of Hydraulic Systems, CRC Press, London, 2009.
3. Mannesmann -Rexroth, Proyecto y Construcción de equipos hidráulicos, Goimendi S.A., 1988.
4. Mannesmann - Rexroth, Fundamentos y componentes de la oleohidráulica : Manual de enseñanza e información sobre fundamentos y componentes de la técnica de fluidos,oleohidráulica, 1991.
5. Frank Yeaple, Fluid Power Design Handbook, 3rd ed., Marcel Dekker Inc., New York, 1996.
6. Antonio Díez de la Cortina León, Manual de Oleohidráulica, Creaciones Copyright S.L., España, 2008.
7. E. Carnicer Royo, C. Mainar Hasta, Oleohidráulica, Conceptos básicos, 2ª ed., Thomson Paraninfo, Madrid, 1998.
8. E. C. Fitch, I. T. Hong, Hydraulic Component Design and Selection, BarDyne, 1998.

Journals

Hydraulics and pneumatics. Industrial Publishing. Cleveland. Estados Unidos de América. ISSN: 0018-814X
FLUIDOS: Oleohidráulica, Neumática y Automoción. PUBLICA S. A., Barcelona, España. ISSN 0211-1136

Web sites of interest

Videos de clases (nivél básico, generalista):

1) Will Durfee and James D. Van de Ven
Dpt. Mechanical Engineering, University of Minnesota
https://www.youtube.com/playlist?list=PL_onPhFCkVQhN-72royiGW36C-kFBpYlS

2) Jim Pytel
Bigbadtech channel (funded by National Science Foundation)
https://www.youtube.com/playlist?list=PLdnqjKaksr8ruhw85YYSSO6EWLhVVmSKm

Casas comerciales:

GLUAL:
http://www.glual.es/es/home.html

HINE:
http://www.hine.es/

ROQUET:
http://www.pedro-roquet.com/es_ES/

ENERPAC:
http://www.enerpac.com/es

Bosch Rexroth:
http://www.boschrexroth.com/en/xc/
http://www.boschrexroth.com/es/es/

PARKER:
http://www.parker.com/

EATON: (VICKERS, AEROQUIP IBÉRICA,…)
http://www.eaton.com/

Danfoss:
http://powersolutions.danfoss.com/home/

WALVOIL:
http://www.walvoil.com/

HIDRAM
http://www.hidram.com/

MOOG:
http://www.servovalve.com/

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree INGMA702 - Master in Advanced Materials Engineering **Year** .

COURSE

503320 - Mechanical Behaviour of Materials **Credits, ECTS:** 4,5

COURSE DESCRIPTION

This course provides a global perspective on the mechanical behavior of engineering materials (including Fracture Mechanics) in current knowledge. In it, a comparative analysis is carried out between metallic, ceramic, polymeric and composite materials, and their mechanical properties are related to the atomic-crystalline structure, the manufacturing and processing of the materials and the service conditions of the materials.
The elastic, plastic, viscous characteristics and behavior against brittle fracture are studied, analyzing these situations based on variables such as service temperature or external aggressive agents. With all this, interesting conclusions are obtained regarding the design, use and selection of materials in their engineering applications.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

IM8-Know the principles and mechanisms that govern the deterioration processes of materials as well as the methods to combat them.
IM7-Select materials for precise applications taken away the corresponding specifications.
IM3-Understand the structure, properties and applications of the different families of materials: metallic, polymeric, ceramic (including glass), composite and functional.
IM10-Analyze complex and multidisciplinary problems.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Knowledge and understanding of the mechanical behavior of materials
- Correctly interpret results.
- Ability to carry out bibliographic searches, consults and judiciously use of databases and other information sources.
- Ability and skill to interpret results and reach conclusions in the field of materials engineering.
- Ability to effectively communicate information, ideas, problems and solutions in the field of engineering.
- Ability to cooperate with people from other disciplines.

Theoretical and Practical Contents

Types of materials versus mechanical behavior. Failures, economic importance. Possibilities of improvement of the current materials.
Bonds. Crystal structure. Elastic deformation and theoretical strength. Non-crystalline structure. Inelastic deformation. Alloying and processing the materials. Iron and steel. Non-ferrous metals. Polymers. Ceramics and glass. Composite materials. Selection of materials for components.
Introduction to the tensile test. Stress-strain engineering properties. Trends in tensile behavior. True stress and strain. Compression tests. Notched impact test. Flexural and torsion tests.
Brittle fracture historical review. Energy approach. Stress approach and elastic-linear fracture. Fracture toughness tests. CTOD. The J integral. The HRR fields. Experimental methodology. Macro and microscopic aspects of Fracture in materials. Fracture versus plastification. Design.
Effects of cyclic loads. Fatigue tests. Physical nature of fatigue damage. Material trends in S-N curves. Fatigue design. Fatigue crack growth. Paris law. Stress Corrosion. Corrosion-fatigue.
Viscoelasticity in polymers. Stress-strain-time curves. Storage and loss modulus.
Composite materials with particles and fibers: rigidity and strength. Short fibers: distribution, transmission of stress.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Laboratory practicals	12	50 %
Classroom practicals	30	40 %
Lectures	70,5	38 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	27		12	6					
Horas de Actividad No Presencial del Alumno/a	43,5		18	6					

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Presentations	20 %	40 %
Practical tasks	40 %	60 %
Questions to discuss	10 %	20 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation system will be continuous with a final exam. The weighting will be as detailed below:
- Exhibitions: 40% mark
Evaluation of the comprehensive ability to use theoretical-practical knowledge to solve open problems on materials.
Evaluation of the communicative capacity of knowledge both in writing and speaking.
- Practical work: 40% mark
Evaluation of the ability to work in a team making proposals, analyzing contributions from others, discussing ideas and executing pertinent actions. Interpersonal skills.
- Theory written exam: 20% mark
Degree of use of the lessons taught in the syllabus and in the practical exercises in the classroom. Assessment of the ability to work autonomously.

The student has the right to waive the continuous assessment and will have to inform the teacher as soon as possible and always before 3 weeks from the start of the course.
In the case in which the student wants to resign, the final exam will be carried out with the rest of his classmates and it will be appropriate to add more questions.

By default, the student who does not appear for the exam will be considered to have resigned.

All this is properly reported on the master's website:

http://www.ehu.eus/es/web/masteringenieriamaterialesavanzados/egutegia-eta-ordutegia

In the web section "Schedule and calendar/SCHEDULE" in May of the previous year, the schedules for the following year are already posted, including the dates of the ordinary calls.

In addition, the 3rd and 4th call courts are posted on the following link:

http://www.ehu.eus/es/web/masteringenieriamaterialesavanzados/aurkezpena

On the other hand, in the first commented link you can download the Word file with the necessary explanations to proceed to make a resignation (section "Schedule and calendar / TEACHING CALENDAR") according to its section (first page): CANCELLATION OF CALL.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the case in which the student wants to resign, the final exam will be carried out with the rest of his classmates and it will be appropriate to add more questions.

In addition, it is adequately informed on the master's website:

http://www.ehu.eus/es/web/masteringenieriamaterialesavanzados/egutegia-eta-ordutegia

In the web section "Schedule and calendar/SCHEDULE" in May of the previous year, the schedules for the following year are already posted, which include the dates of the extraordinary calls.

MANDATORY MATERIALS

Todo el material docente necesario para seguir la asignatura es facilitado por el profesorado en el servicio de reprografía de la escuela. Así mismo si algún alumno quisiera el formato digital también podrá ser puesto a su alcance en caso de que así se lo haga saber a la profesora.

BIBLIOGRAPHY

Basic bibliography

Mechanical behavior of materials. N.E. Dowling. Prentice Hall. ISBN 0-13-905720-X
Mecánica de la Fractura. J.L. Arana, J.J. González. Servicio Editorial UPV/EHU. ISBN 84-8373-455-9

Detailed bibliography

Mecánica de la Fractura. J.L. Arana, J.J. González. Servicio Editorial UPV/EHU. ISBN 84-8373-455-9

Journals

Theoretical and Applied Fracture Mechanics
Engineering Fracture Mechanics
International Journal of Fracture

Web sites of interest

www.sciencendirect.com

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree CITEC401 - Master in Space Science and Technology **Year** .

COURSE

501990 - Space Physics **Credits, ECTS:** 3

COURSE DESCRIPTION

Contrary to popular belief, space is a place full of activity. Although the density of matter is very low, we have a plasma consisting of charged particles of very different energies. The behavior of this plasma is influenced by the variable behavior of the sun's magnetic field, which in turn is also the main source of charged particles, emitted in what is known as the solar wind. The interaction of this complex system of particles and fields with the Earth's magnetic field gives rise to the appearance of radiation belts and auroras.

The enormous amount of energy released by the sun in the form of radiation and particles can damage and even destroy satellites, and it affects life very seriously, limiting the possibilities of space travel. Knowledge of the properties of the space environment is therefore essential in the development of any space program, and must be part of any space science and technology program.

As a compulsory subject, Space Physics will be taught in the first term. The subject is related and reinforce contents taught in other compulsory subjects, such as Orbital Movement (different orbits cross different space environments) and Spaceships II (in relation to the peculiarities of the propagation of the EM waves in the space environment and communication problems related to disturbances in this environment). The subject provides a basis for the study of elective subjects such as Astronomy and Astrophysics, Solar System, and from a more technological point of view, Materials for space II.

The prerequisites for this course are a basic knowledge of electromagnetism and calculus including differential equations. These prerequisites are guaranteed by the required undergraduate qualifications.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Knowledge of the physical properties of the space environment, and the implications of this medium on space development programs.
Ability to deduce quantitative properties of the behaviour of space plasmas and their interactions with objects in space.
Ability to analyse, working as a team with people of different training, the different aspects of the influence of the spatial environment on a project, effectively communicating the competences of their field of specialization to other team members.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

At the end of the course the student should be able to:

 Define a plasma and the most important parameters that define its behavior.

 Describe the basic characteristics of the solar atmosphere, the solar cycle, the solar wind and the Earth's magnetosphere.

 Explain through physical models some of these characteristics (for example, the position of the magnetopause, the direction of the interplanetary magnetic field, the temperature of sunspots...)

 Know the different types of waves that propagate in the interplanetary medium and their basic properties.

 Describe the different Space Weather phenomena of technological relevance.

 Know some information databases about the space environment and the Space Weather prediction portals.

 Know different packages of models frequently used in the study of the spatial environment.

Theoretical and Practical Contents

 Introduction to the space environment.

 Part I: Plasma Theory

 Electromagnetism. Review of concepts.
 Physics of Plasmas.
 Magnetohydrodynamics.
 Movement of charged particles in electromagnetic fields.
 Waves in plasmas
 Part II: The space environment

 The sun: Interior and atmosphere. Variable activity in the sun ..
 The solar wind and the interplanetary magnetic field
 The Earth's magnetosphere
 The ionosphere
 Influence of solar activity on the magnetosphere: Magnetic storms
 Space weather. Current status and technological impact

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Utilization of Computer Programs	2	50 %
Individual work and/or group work	10	40 %
Exercises	28	36 %
Expositive classes	35	43 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15	4	10		1				
Horas de Actividad No Presencial del Alumno/a	20	6	18		1				

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	10 %	60 %
Essay, Individual work and/or group work	0 %	30 %
Exhibition of work, readings...	0 %	10 %
Realización de prácticas (ejercicios, casos o problemas)	20 %	60 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Assessment tools and percentages

Problems: 50% of the final grade. There will be three hand-outs consisting of a set of problems that will be marked and returned to the students. The correct solutions will be published in EGELA as feedback. The grading of problems will take into account whether the answers are correct (when they are closed answers) or the depth of the analysis (when they are open answers). In addition, precision of notation, adequate use of physical laws and correct use of units and significant figures will be valued.

Minitests: 10% of the final grade. The minitests will consist of a short question related to content of previous lectures and hand-outs. They will be answered individually in approximately 10 minutes during lectures.

Essay: 30% of the final grade. They will be assessed taking into account the rigor and quality of writing, its adjustment to the contents of the subject, and the correct reference to used sources.
Failure to comply with formal requirements, particularly those related to essay length, will lower the final grading.
Plagiarism will be penalized with a no pass.

Oral presentation of the essay: 10% of the final grade. It will be assessed taking into account the quality of the support material, the precision of speach and correct body language. Very long or very short presentations will be penalized.

No-show

People who do not submit at least two of the three problem sets and / or do not present the essay will be considered as "no show" in the ordinary call.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

To pass the subject in the extraordinary call, the students will have to present the problem sets and a written essay. They will also be offered the possibility of taking a short exam to improve the grading of the mini-tests.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

 Understanding Space Weather and the Physics Behind it, D.d. Knipp, McGraw Hill 2011
Space Physics - An Introduction, C.T. Russell; J.G. Luhmann, R.J. Strangeway, Cambridge University Press 2016
Planetary Sciences, 2nd Edition, I. de Patter y J.J. Lissauer, Cambridge University Press 2010
Basic Space Plasma Physics, W. Baumjohan y R.A. Treumann, Imperial College Press 1997
 Space Weather, environment and societies, J.Lilensten J.Bornarel, Springer

Detailed bibliography

Space Physics, 3rd Edition, M-B Kallenrode, Springer,2003
Physics of the Earth¿s Space Environment. Gerd W. Prölss, Springer, 2003
Physics of the Solar System Plasmas, T.E. Cravens, Cambridge University Press1997
 Physics of the Space Enviroment, T.I. Gombosi, Cambridge University Press 2004
 The Space Enviroment, A.C. Tribble, Princeton University Press 2003

Journals

Web sites of interest

Space Weather:
http://www.swpc.noaa.gov/
http://www.esa-spaceweather.net/spweather/current_sw/index.html
http://sohowww.nascom.nasa.gov/spaceweather/
http://spaceweather.com/

A few relevant missions
SDO http://sdo.gsfc.nasa.gov/
SOHO http://sohowww.nascom.nasa.gov/
STEREO http://www.nasa.gov/mission_pages/stereo/main/index.html
TRACE http://trace.lmsal.com/
HINODE http://solarb.msfc.nasa.gov/
ULYSSES http://ulysses.jpl.nasa.gov/

Summary of NASA and ESA missions
 http://www.nasa.gov/missions/past/index.html
 http://orbits.esa.int/science/index.htm

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree CITEC401 - Master in Space Science and Technology **Year** .

COURSE

501991 - Fundamentals of Optical Instrumentation **Credits, ECTS:** 3

COURSE DESCRIPTION

This is a compulsory subject as it is one of the master’s backbones. It provides the foundations for more specific optional courses such as "Design of Optical Systems and Adaptative Optics" and "Space Interferometry". It is also a good starting point for "Antennas and Radio-Telescopes". As a basic compulsory course, "Fundamentals of Optical Instrumentation" will be taught before these optional courses, which secures strong foundations to proceed with the masters studies.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

The students are expected to know and explain the origin of laws and theorems in Optics.
The students are expected to understand how optical instruments work, based on Optics laws and theorems.
The students are expected to solve mathematical problems related to complex optical systems, as well as present the results in a clear and comprehensive manner.
The students are expected to be able to take, analyze and interpret data on instrumentation-related magnitudes, as well as present conclusions.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

1. Knowledge, understanding and application of Geometrical Optics laws in image formation by optical systems
2. Knowledge and understanding of the different types of optical aberrations in image formation by optical systems
3. Knowledge, understanding and application of Physical Optics in the formation of interference and diffraction patterns.
4. Understanding of diffraction-limited optical quality of images.
5. Deep understanding of the following optical systems: eye, magnifying glass, telescopes and cameras.
6. Usage of experimental set-ups to take data on images provided by complex optical systems.
7. Usage of experimental set-ups to take data on interference and diffraction patterns.
8. Ability to write laboratory reports in a clear, comprehensive and concise manner.

Theoretical and Practical Contents

1. Ray Optics
2. Paraxial Optics
3. Aberrations
4. Aperture and Field Limitations
5. Interference and diffraction
6. The eye
7. Magnifying glasses and eyepieces
8. Telescopes
9. Cameras

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Utilization of Computer Programs	4	50 %
Laboratory/Field	6	67 %
Exercises	22	45 %
Expositive classes	43	33 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	14		10	6					
Horas de Actividad No Presencial del Alumno/a	29		12	4					

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination (theory)	35 %	70 %
Internship Report/Summary	15 %	35 %
Realización de prácticas (ejercicios, casos o problemas)	15 %	35 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The assessment will be as follows:
- For each chapter, the students will solve a number of problems and hand them in in a week. The problems will be graded on a 10 scale and handed out to the students. Students can return an amended version of the solutions in one week, but with a maximum available grade of 7. The average grade of all problems in the course will contribute 25% to the final grade.
- Students will complete two laboratory sessions (in groups of two or three). Following the laboratory instructions, each group will hand in a laboratory report for each session. The average grade in the laboratory work will contribute 25 % to the final grade.
- At the end of the course the students will take a written exam, with all exercises equally weighted. The exam grade will contribute 50 % to the final grade. A minimum exam grade of 3.5 is required to pass the course.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

- The extraordinary exam will be a written exam covering 100% of the contents, including the laboratory work. All exercises will be equally weighted to compute the final grade.

MANDATORY MATERIALS

"Física":Vol II Typler, Ed Reverté 1994.
"Physics": vol II. Typler, Ed. Freeman & Co. 2008
"Física" Alonso Finn, Ed Addison-Wesley 1995.
"Principios de Instrumentación optica" Alberto Oleaga, 1998

BIBLIOGRAPHY

Basic bibliography

"Física":Vol II Typler, Ed Reverté 1994.
"Physics": vol II. Typler, Ed. Freeman & Co. 2008
"Física" Alonso Finn, Ed Addison-Wesley 1995.
"Principios de Instrumentación optica" Alberto Oleaga, 1998

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"Optica" Hecht-Zajac, Ed. Addison-Wesley.
"Optica" J. Casas, Ed. Univ Zaragoza.
"Light" R.W. Ditchburn, Ed Dover, New York.
"Optica Fisiológica: Psicofísica de la visión", J.M. Artigas Ed Interamericana McGraw-Hill.
"Microscopía Teórico-práctica", J.D. Casartelli, Ed. Urmo.
"Telescope Optics:Evaluation and Design" H. Rutten, M. van Benrooj, Ed. William Bell.
"How to make a telescope", J. Texereau, Ed. William Bell.
"The design and Construction of Large Optical telescopes" P. Bely, Springer-Verlag 2003
"Reflecting Telescope Optics I y II", R.N. Wilson, Springer.
"Applied Photographic Optics" S.F. Ray, Ed. Focal Press.
"The Photographic Lens", S.F. Ray, Ed. Focal Press.
"The Fire within the Eye" D. Park, Ed. Princeton.
"Color and Light in Nature" D. Lynch, Cambridge Univ. Press.

Journals

Web sites of interest

Simulación óptica geométrica y óptica física:
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

Óptica y ondas en general:
http://www.cordonline.net/laserapplets/

Instalaciones de Telescopios en general:
http://www.gemini.edu/
http://hubblesite.org/the_telescope/hubble_essentials/
http://www.keckobservatory.org/
http://keckobservatory.org/gallery
http://www.gtcdigital.net/

VLTI
http://www.eso.org/sci/facilities/paranal/instruments/overview.html
http://www.eso.org/sci/facilities/paranal/telescopes/vlti/index.html

LISA-Pathfinder
http://www.esa.int/esaSC/120376_index_0_m.html

Telescopio de Rayos X; XXM-Newton
http://www.esa.int/esaSC/120385_index_0_m.html

ESA con todas las misiones
http://sci.esa.int/science-e/www/area/index.cfm?fareaid=1

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree CITEC401 - Master in Space Science and Technology **Year** .

COURSE

501994 - Space Materials I: Fundamentals **Credits, ECTS:** 3

COURSE DESCRIPTION

This course presents the fundamentals of the internal structure of materials and their relationship with their properties, emphasizing the materials used in space technology. These fundamentals will be useful in subjects of later courses such as "Space Mechanical Structures", "Non Destructive Testing: Space Materials", "Materials for Space: II. Applications" and "Detectors and Sensors".

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Provide the student with well-founded knowledge related to heat transfer mechanisms and the thermal properties of the materials used in space technology.
To acquire the needed knowledge to solve complex problems related to thermal behaviour and heat transfer on materials.
To understand the mechanics of the measurements of thermal properties in materials in the high and low temperature range.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

The learning outcomes that students are expected to achieve by the end of the subject are:
- Demonstrate detailed understanding of the basic concepts related to Material Science and Technology, as well as their application for the reasoned resolution of problems related to space technology.
- Mastery of instrumentation related to the measurement of thermal properties of all types of materials.

Theoretical and Practical Contents

1.- Materials for space: metal alloys, ceramics and composites
2.- Heat diffusion mechanisms: conduction, convection and radiation
3.- Thermal properties of space materials: conductivity, specific heat, thermal expansion
4.- Thermal properties at low temperatures: cryogenics
5.- Thermal properties at high temperatures: furnaces

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Laboratory/Field	10	50 %
Exercises	25	40 %
Expositive classes	40	38 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15		10	5					
Horas de Actividad No Presencial del Alumno/a	25		15	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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	40 %	100 %
Realización de prácticas (ejercicios, casos o problemas)	0 %	60 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In order for the students to achieve the learning results, they must correctly carry out the exercises/tests proposed throughout the course. These exercises will be scored out of 10 and their average will be the resulting mark for the course. To pass the subject it will be necessary to obtain at least a 5.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

A single examination will be carried out in order to measure the learning achievements of the student. To pass the subject it will be necessary to obtain at least a 5.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

- "Fundamental University Physics: Quantum and Statistical Physics Volume III", N. Alonso, E.J. Finn
- "Physics for Scientists and Engineers" P.A. Tipler, G. Mosca, 6th Ed
- "Materials Science and Engineering: An Introduction" W.D. Callister Jr., D.G. Rethwisch, 10th Edition
- "The Feynman Lectures on Physics" R.P. Feynman; M. Sands , Ed. Basic Books
- "Foundations of Materials Science and Engineering" W.F. Smith, J. Hashemi Mc Graw Hill. 7th Ed, 2022

Detailed bibliography

- "Principles of Materials Sience and Engineering" William F. Smith, Mcgraw-Hill 1986
- "Transferencia De Calor", Yunus A. Cengel, Macgraw-Hill, 2004
- "Heat Conduction", M. Necati Özisik, John Wiley & Sons, 1980

Journals

- International Journal of Thermophysics
- International Journal of Heat Transfer
- Infrared Physics and Technology

Web sites of interest

European Space Agency Website: http://www.esa.int/esaCP/Spain.html
NASA Website: http://www.nasa.gov

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree CITEC401 - Master in Space Science and Technology **Year** .

COURSE

502005 - Space Interferometry **Credits, ECTS:** 3

COURSE DESCRIPTION

This course develops the main theoretical and practical knowledge of interferometry applied to Space Science and Technology that allows the resolution of problems and the development of real projects in the field. The course is related to the mandatory subjects of Basis of Optic Instrumentation, Detectors & Sensors and Space Data Processing, as it makes use of a wide rage of concepts and tools developed in those subjects. The course is also related with the optional course of Optic System Design and Adaptative Optics, as the knowledge taught in optics is also used in interferometry technologies.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

That students acquire knowledge of the basic and theoretical aspects of interferometry, with special emphasis on the concept of coherence.
That students know how to identify and analyze the constituent components of basic interferometers.
That students are able to solve problems applied to interferometry in an orderly and justified manner.
That students have knowledge of the techniques, methods and systems used in interferometry stellar.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

The learning outcomes that students are expected to achieve at the end of the semester are:
To acquire knowledge of the basic and theoretical aspects of interferometry, with emphasis on the concept of coherence.
To identify and analyze the constituent components of basic interferometers.
To be able to resolve in an orderly and justified manner, problems applied to interferometry.
To possess basic knowledge of the techniques, methods and systems used in space interferometry.

Theoretical and Practical Contents

UNIT 1: INTRODUCTION TO SPACE INTERFEROMETRY
UNIT 2: FOUNDAMENTS OF SPACE INTERFEROMETRY
UNIT 3: IMAGE FORMATION
UNIT 4: OPTICAL EFFECTS OF THE ATMOSPHERE
UNIT 5: INSTRUMENTAL TECHNIQUES
UNIT 6: INTERFEROMERY OBSERVATION PLANNING

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Laboratory/Field	10	100 %
Exercises	20	50 %
Preparation of works	20	0 %
Expositive classes	25	40 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	18	2	10						
Horas de Actividad No Presencial del Alumno/a	30	0	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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Internship Report/Summary	50 %	60 %
Realización de prácticas (ejercicios, casos o problemas)	40 %	50 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

A) The following tools will be used for continuous evaluation:
- Mid-term tests consisting on problem resolutions:
The following will be valued: The knowledge degree of the basic principles of interferometry, the precision in the use of arguments, the obtention of exact numerical values, the completeness of the solutions, the correct use of the verbal, mathematical and/or graphical language. The serious conceptual errors will be penalized.
- Evaluation of laboratory reports. The students must hand in 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 grade will be calculated according to the following percentages:
Midterm exam marks: 40%
Practice report marks: 60%.
It is a necessary condition to pass the course to have passed the practices and to 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 tehvea luaticoono rrdeinsspayotosnrtseimbl e must present for the subject a waiver of continuous evaluation in written form, for which they will have a period of 9 weeks, starting from the beginning of the semester. In this case, the learning outcomes will be evaluated through a test, consisting of:
-A final written 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 Interferometry, 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 graphic language. Serious conceptual errors will be penalized in the correction. must contain: obtaining and mathematical treatment and graphing of experimental data, calculation of errors, discussion of results and the conclusions of the work.
The final mark will be calculated according to the following percentages:
Written exam mark: 40%
Practice report marks: 60%
It is a necessary condition to pass the course to have passed the practices and to have obtained an overall mark equal to or greater than 5.
In the case of the final evaluation, the no attendance to any exam will entail the automatic waiver of the evaluation call and will appear as Not Presented.

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 Interferometry, 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 graphic language. Serious conceptual errors will be penalized in the correction.
-A practical exam that will be carried out in the laboratory. In this exam, the students 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 the conclusions of the work.
The final mark will be calculated according to the following percentages:
Written exam mark: 40%
Practice report marks: 60%
It is a necessary condition to pass the course to have passed the practices and to have obtained an overall mark equal to or greater than 5.
In the case of the final evaluation, the no attendance to any exam will entail the automatic waiver of the evaluation call and will appear as Not Presented.

MANDATORY MATERIALS

[1] E. Hecht, Optics, 4th Ed. , Addison-Wesley, 2001.
[2] M. Born, E. Wolf, Principles of Optics, 6th Ed., Pergamon Press, 1990 (New York).

BIBLIOGRAPHY

Basic bibliography

• Optics, E. Hecht, 5th Ed., Pearson, 2017.
• Principles of Optics, M. Born and E. Wolf. 7th Ed., Cambridge University Press, 2000.
Introduction to Optics, F.L. Pedrotti, L.M. Pedrotti and L.S. Pedrotti, 3rd Ed., Pearson Education, 2014.
Bibliografía para las prácticas de laboratorio
• "A daylight experiment for teaching stellar interferometry." M. A. Illarramendi, R. Hueso, J. Zubia, G. Aldabaldetreku, G. Durana, and A. Sánchez-Lavega. American Journal of Physics 82, 649 (2014).
• "Interferometry of binary stars using polymer optical fibres", L. Arregui, M. A. Illarramendi, J. Zubia, R. Hueso and A. Sánchez-Lavega. European Journal of Physics, 38, 045704 (2017).
• "Teaching stellar interferometry with polymer optical fibers", M. A. Illarramendi, L. Arregui, J. Zubia, R. Hueso and A. Sánchez[ ]Lavega. Proceedings Volume 10452, 14th Conference on Education and Training in Optics and Photonics: ETOP 2017; 1045216 (2017)
• "Adaption of the Michelson interferometer for a better understanding of the temporal coherence in lasers", M. A. Illarramendi, J. Zubia, J. Arrue and I. Ayesta.Proceedings Volume 10452, 14th Conference on Education and Training in Optics and Photonics: ETOP 2017; 1045249 (2017)

Detailed bibliography

[1] P. Hariharan, optical interferometry, 2nd ed., Academic Press, 2003 (san diego).
[2] E. Wolf, Introduction to the theory of coherence and polarization of light, 1st ed., Cambridge University Press, 2007.
[3] A. R. Thompson, J. M. Moran, G. W. Swenson jr., Interferometry and synthesis in radio astronomy, 2nd ed., John Wiley & Sons, 2001.
[4] Joseph W. Goodman, Statistical optics, 1st ed., John Wiley & sons, 1985.
[5] J. D. Monnier, Optical Interferometry in Astronomy, Reports on Progress in Physics, vol. 66, pp. 789-857, 2003.

Journals

- American Journal of Physics
- European Journal of Physics
- European Journal of Engineering Education

Web sites of interest

- Tutorials European Southern Observatory
https://www.eso.org/sci/facilities/paranal/telescopes/vlti/tuto.html

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree CITEC401 - Master in Space Science and Technology **Year** .

COURSE

502006 - Astronomy and Astrophysics **Credits, ECTS:** 3

COURSE DESCRIPTION

This course provides a theoretical and practical scientific background to the physical processes operating in the Universe at very different scales (interstellar, intergalactic and cosmological scales).

This knowledge is required for both a scientific carrer and for the implementation of technological projects in the field of Space Sciences.

A basic knowledge of the celestial coordinate systems and of the apparent movement of the stars is also very important for telemetry and positioning technologies.

We also intend to provide the students familiarity with the astronomical instrumentation and the most common astrophysical techniques.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

To acquire scientific knowledge on Astronomy and Astrophysics to provide a background for the development of technical applications and/or for the development of a scientific career.
To know and handle with confidence the basic astronomical instrumentation and software, as well as to be able to process common astronomical data.
To be able to solve scientific problems by determining an adequate strategy for the gathering and processing of scientific data.
To get familiar with team work in a scientific context, assuming the adequate role depending on each team member¿s background.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

1. Astrophysics Foundations: Introduction. History of the Astronomy. Fundamentals.
2. Observational Astronomy: Celestial coordinates. Time account. Astronomical instrumentation.
3. Stellar Astrophisics I: Stellar parameters determination. HR Diagram. The Sun as a normal star.
4. Stellar Astrophysics II: Stellar atmospheres and interiors. Stellar formation. Stellar evolution.
5. Interstellar medium and Galactic Astrophysics: Interstellar medium. Stellar clusters. The Milky Way.
6. Extra-galactic Astrophysics and Cosmology: Galaxies. Extra-galactic Astrophysics. Cosmology Foundations.
7. Experimental techniques on Astrophysics: Night-sky orientation. Databases: SIMBAD and VO. Telescope control. Observation techniques: imaging and photometry, long-slit spectroscopy. Astronomical data processing using MATLAB.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Laboratory/Field	20	25 %
Utilization of Computer Programs	20	25 %
Expositive classes	35	57 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15		5	10					
Horas de Actividad No Presencial del Alumno/a	15		15	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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Practice Memory	10 %	25 %
Solving practical cases	75 %	90 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The course will be evaluated through four problem lists given by the teacher. These will be proposed at the end of the topics 2, 4 and 6 and at the end of the course for the astrophysical techniques.

The students are allowed to opt for a final written exam at the end of the course covering all the topics in the program.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The students are evaluated with a final written exam covering all the topics in the program.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

B.W. Carroll, D.A. Ostlie. An Introduction to Modern Astrophysics. Pearson (2008).
H. Karttunen, P. Kröger, H. Oja, M. Poutanen, M. J. Donner, Fundamental Astronomy, Springer-Verlag (Heidelberg), 3ª edición (1996).
S. Green, M.H. Jones, An Introduction to the Sun and Stars, Cambridge (2003).
M.H. Jones, R. Lambourne, M.H. Jones, R. Lambourne, An Introduction to Galaxies and Cosmology Introduction to Galaxies and Cosmology, Cambridge , Cambridge (2003).
A. Unsöld, The New Cosmos, Springer-Verlag (Heidelberg), (1977).
M. L. Kutner. Astronomy, a physical perspective. Cambridge University Press (2003).

Detailed bibliography

Journals

Web sites of interest

Universidad del País Vasco Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree CITEC401 - Master in Space Science and Technology **Year** .

COURSE

502007 - Physics of the Solar System **Credits, ECTS:** 3

COURSE DESCRIPTION

This subject gives a general context of scientific and technological activities in the field of Solar System research. The study of the Solar System forms a fundamental part of scientific knowledge of the Universe. This knowledge is in fast revision and expasion as sace agencies develop large projects to explore the solar system that regularly revolutionize our knowledge in this area. For these reasons, this subject is intended to introduce the student to the basic aspects of the physics of the Solar System, studying it as a whole, and in detail for each of the main groups of bodies that constitute it (except the Sun) in a comparative way.

One of the fundamental challenges of this subject is to provide a modern and complete vision of the solar system in an area of knowledge in permanent conceptual revolution thanks to the space exploration programs of the main space agencies (NASA, ESA, JAXA). Although this elective course has a scientific orientation, the practical part develops common activities in the processing of data from space and may be of interest to students whose subsequent professional activity is linked to the development of instrumentation or the exploitation of scientific data.

Prerequisites for this course are a basic knowledge of general physics and mathematical tools of calculus and differential equations. These prerequisites are guaranteed by the entrance qualifications. In the context of the Master in Space Science and Technology, this subject is directly linked to the compulsory subjects: "Orbital movement" and "Space physics" and has contents of interest in the study of the subjects "Spaceships I", "Space data processing and "Fundamentals of optical instrumentation ". All of them are subjects that students have previously taken before the start of this subject. Among the elective subjects of the Master in Space Science and Technology, this subject is largely related to the subjects of "Astronomy and Astrophysics" and "Planetary atmospheres". It also has a lesser relationship with the subjects: "Physics of the Earth's Atmosphere" and "Design of optical systems and adaptive optics". The final professional scope of this subject is framed both in scientific activities for entry into a doctoral program, as well as in technological activities in companies in the sector such as collaborators in the Master in Space Science and Technology (Deimos Space, AVS, SENER, IDOM, Satlantis).

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Possess a general knowledge of the Solar System that provides context for technological applications or development of a research career.
Know the basic characteristics of astronomical instrumentation and elementary astronomical software, as well as basics of astronomical data.
Being able to solve the problems associated with the need to obtain a certain series of scientific data, establishing the appropriate methodological and instrumental strategies.
Have a basic experience in carrying out a scientific and technical task, working as a team and establishing a productive work chain.
That students are able to present their ideas and knowledge on a scientific or technological subject clearly and precisely.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

At the end of the course the student should be able to:

1.- Know and describe the general characteristics of the different objects in the solar system, their similarities and differences.
2.- Solve simple physics problems associated with objects in the solar system.
3.- Manage the basic elements of scientific literature in the field of the solar system, being able to analyze the general content of research articles in the area of the Solar System.
4.- Relate the general knowledge that we have of the Solar System with the aspects that we begin to learn about planetary systems around other stars.
5.- Know the elemental aspects related to the formation of the Solar System.

Theoretical and Practical Contents

1.- Introduction to the Solar System: Structure of the Solar System (2 hr).
2.- Terrestrial planets and icy satellites: Interiors and surfaces (3hr).| Task: Journal Club (topic 2).
3.- Planetary atmospheres (2 hr).

4.- Minor bodies of the Solar System (3 hr). | First list of problems (topic 3 and 4).
5.- Recent discoveries in the field of the Solar System. | Second list of problems (topic 5).
6.- The magnetic environment of the planets (3 hr). | Group task: Basic design of a mission proposal (to be developed over the course).
7.- Formation of the Solar System and planetary systems (5 hr). | Third list of problems (topic 6).
8.- Exoplanets (4 hr).| Fourth list of problems (item 7).
9.- Introduction to astrobiology (2 hr).
10.-Classroom and observation practices. The astronomical observation will depend on the meteorological conditions and of the priority use of the facilities by the subject "Astronomy and Astrophysics".

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Individual work and/or group work	0	0 %
Laboratory/Field	4	50 %
Utilization of Computer Programs	4	50 %
Teamwork	10	15 %
Exercises	20	20 %
Expositive classes	37	55 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	18		5	3	4				
Horas de Actividad No Presencial del Alumno/a	18		12	5	10				

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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Presentations	10 %	10 %
Reading and Analysis of the Report	15 %	15 %
Questions to discuss	15 %	15 %
Practice	10 %	10 %
Realización de prácticas (ejercicios, casos o problemas)	35 %	45 %
Writing up the teamwork	15 %	15 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The subject will be evaluated by the tasks proposed throughout the course. The evaluation will follow the following criteria for the different tasks set:

Individual comment work on a scientific article (Journal Club): 15%

Evaluation from 0 to 10:
<5: Serious errors in understanding the article selected by the student. Serious errors in the scientific context of the situation.
5-7: Light understanding of the article and statement of its conclusions without showing a critical analysis.
7-10: Understanding of the article and its main conclusions together with a critical analysis of the ideas raised and possible research that may support the conclusions of the selected article.

Problems: 50%

Individual evaluation of each problem from 0-10.
<5: Conceptual and planning errors with lack of understanding of the situation raised
5-7: Reasonably posed problems but with conceptual errors.
7-8: Problems well solved.
9-10: Problems well solved, reasoned and justified in detail.

Observation and image processing practices: 10%

(Given the difficulties inherent to the variable quality of astronomical observation, it is not considered possible to assign a larger section to this section).
0 - No attendance
7-10: Depending on the results presented at the end of the session.

Group work (space mission proposal): 25% (15% work + 10% presentation of the work)

<5 Not taking into account the scientific context of the proposed mission and previous advances made by similar missions. Serious planning errors.
5-7: Correct scientific approach but without giving a sufficient description of the technology and instrumentation required.
7-8: Correct scientific approach with a realistic approach to the technology and instrumentation necessary to address the selected scientific questions.
9-10: Correct scientific approach with a realistic approach to the technology and instrumentation necessary to address the selected scientific questions along with creativity and originality of the proposal.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Students who have not passed in the ordinary call may take an exam in the extraordinary call where questions related to the tasks posed during the course will be asked.

MANDATORY MATERIALS

Classes will be taught in the Espazio Gela classroom equipped with a digital projector and individual PC computers for each student (25 seats). There will be access to the different telescopes and instruments of the Aula Espazio Gela including, among others, a 50 cm diameter telescope equipped with deep field cameras and a 36 cm robotic telescope installed in the Calar Alto astronomical observatory and accessible online through the classroom computers. In addition, students will be able to consult scientific journals and online publications through the Aula Espazio PCs. The Aula Espazio library contains copies of the recommended bibliography for this subject. The content of all classes are available as pdf documents to students through the page on the eGela platform (digital plattaform at UPV/EHU for online teaching). Additional journal articles to be read will be posted in eGela.

BIBLIOGRAPHY

Basic bibliography

Main references:

Planetary Sciences, I. de Pater, J. J. Lissauer, Cambridge University Press (2001, 2010).
Planetary Systems Now, Lara Jewit, World Scientific (2023).

Basics:

The New Solar System, J. Kelly Beatty Cambridge University Press (1999).
The Solar System, T. Encrenaz et al., Springer-Verlag, (2004).

Intermediate:

Encyclopedia of Planetary Sciences, Elsevier.
Introduction to Planetary Science. The Geological Perspective, Springer (2007).
The Giant Planets in our Solar System, Patrick J. Irwin, 2nd Ed (2008).
Planets and Moons (Geophysics), Spohn and Schubert, Elsevier (2009).

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Planetary Atmospheres, A. Sánchez-Lavega, CRC Press(2010).
Jupiter, Cambridge University Press (2004)
Saturn from Cassini-Huygens, Cambridge University Press (2004).
Saturn in the 21st Century, Cambridge University Press (2018).
Titan from Cassini-Huygens, Cambridge University Press (2004).
The Atmosphere and Climate of Mars, Cambridge University Press (2018).
Protostars and Planets V, Arizona University Press (2006).
Planets and Life (Woodruff, Sullivan and Baross, Cambridge University Press (2007).

Journals

* Nature
* Science
* Nature Geosciences
* Nature Astronomy
* Icarus: International Journal of Solar System Studies

* Journal of Geophysical Research planets
* Geophysical Research Letters
* Planetary and Space Sciences

Web sites of interest

Wikipedia https://en.wikipedia.org/
(Only as introductory for general search of concepts)

Sky & Telescope http://www.skyandtelescope.com/
Astronomy http://www.astronomy.com/

Only available in Spanish:
Eureka: El blog de Daniel Marín (Astronomía y Espacio) (http://danielmarin.naukas.com/)

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree INCAR902 - Master in Control Engineering, Automation and Robotics **Year** .

COURSE

504137 - Industrial Robotics **Credits, ECTS:** 4,5

COURSE DESCRIPTION

An interesting aspect of robotics is its character as an integrative subject in the training of an engineer, dealing in detail with the constitution, design and use of a machine that involves the integration of numerous disciplines. For all these reasons, the contents selected to develop the subject RI establish a balance between the topics related to the detailed knowledge of a robot and its design (modelling, control and programming), and those in which the knowledge is provided to integrate them in a larger automation process, providing criteria to evaluate the convenience of installing a robot and the way to do it.

The Industrial Robotics subject consists of 4.5 ECTS credits (45 classroom hours and 67 non-classroom hours), of which 2.5 ECTS (25 hours) correspond to theoretical credits, 1 ECTS (10 hours) correspond to classroom practice and 1 ECTS (10 hours) to practical laboratory credits, all of them spread over 14 weeks. It is taught in the second four-month period of year 1 of the Master's Degree in Control, Automation and Robotics Engineering.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Afrontar el modelado de sistemas y procesos.
Afrontar el diseño y desarrollo de sistemas utilizando herramientas de automatización y control

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

THEORETICAL CONTENT:
The content of the subject programme has been structured into 6 topics. The theoretical content is presented below:

1. Introduction to automated processes using robotics
1.1. Robot introductory aspects
1.2. Components and subsystems of a robot

2. Kinematics
2.1. Introduction
2.2. Spatial location tools
2.3. Position problem
2.4. Velocity Problem

3.Dynamics
3.1. Introduction
3.2. Dynamic Modelling approaches
3.3. Direct and Inverse Dynamics

4-Industrial Robot Programming
4.1. Introduction
4.2. Programming methods
4.3. Programming system requirements
4.4. Programming languages
4.5. Programming examples

5. Trajectory generation - Kinematic control
5.1. Introduction
5.2. Trajectory generation algorithms
5.3. Joint interpolators
5.4. Trajectory in task space

6. Control Strategies - Dynamic control
6.1. Introduction
6.2. Monoarticular Control
6.3. Multiarticular Control

6.4. Position/Hybrid/Force control

PRACTICAL CONTENT:

This subject consists of 10 hours to carry out practical activities which are essential to learn skills and settle the concepts taught in theory classes. Thus, the practical programme detailed below has been designed to guarantee an adequate practical learning of the subject, and has been structured in three types of activities:

- Simulation practices under the Matlab/EduBot environment, which are carried out in groups. Specifically, the EduBot Toolbox (Educational Robotics Toolbox) will be used, with a graphic interface to solve problems related to the kinematics, trajectory generation and dynamics of a manipulator robot, as well as its control. In this modality of practices are carried out those related to the modelling and control of robots, corresponding to the practices: PL1, PL2 and PL3 of the syllabus of the subject.

- Simulation practices under the Matlab/EduBot environment, which are carried out in groups. Specifically, the EduBot Toolbox (Educational Robotics Toolbox) will be used, with a graphic interface to solve problems related to the kinematics, trajectory generation and dynamics of a manipulator robot, as well as its control. In this modality of practices are carried out those related to the modelling and control of robots, corresponding to the practices: PL1, PL2 and PL3 of the syllabus of the subject.

- Robot programming practices, which are carried out in groups using the Mitsubishi RV-3SB industrial robot with 6 degrees of freedom, with the RT Toolbox offline programming software. In the two planned sessions, students must program the robot using guidance and textual language and solve typical situations that arise in the development of a robotic task (vision, movement planning, object localisation, configuration selection, analysis of the workspace and singular configurations, Cartesian trajectories close to singularities, etc.). PL4 and PL5 correspond to this modality.

Therefore, the practical content is listed in these 5 practices:

PL1: Position problem of serial robots.
PL2: Velocity problem and dynamic model of serial robots.
PL3: Kinematic and dynamic control of serial robots.
PL4: Programming of an Industrial Robot I.
PL5: Programming of an Industrial Robot II.

- Practical visit, carried out with the whole class group and in which the teacher leads the visit "Robotisation in the automotive sector" to the Mercedes Benz company. In this case, the student's work is not as active, but their degree of motivation is greater, so that a reasonable amount of learning is achieved.

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Acquiring basic instrumental skills	0	0 %
Laboratory practicals	25	40 %
Classroom practicals	25	40 %
Expositive classes	62,5	40 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	25		10	10					
Horas de Actividad No Presencial del Alumno/a	37,5		15	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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	60 %	100 %
Presentations	0 %	20 %
Practical tasks	0 %	20 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The different evaluation instruments (and their score out of 10) to be used in this subject are as follows:

Instrument 1: Laboratory work. The practical part will be evaluated by means of the previous work and the performance in the laboratory. Marking: 20%.

Instrument 2: Final exam. Written exam to be held at the end of the course and consisting of short questions and the development of one or more problems. score: 80%.

In order to pass the course, the student must achieve a score equal to or higher than 5 points (out of 10) in the final exam. Once this mark has been exceeded in the final exam, the student will add the points obtained in the laboratory reports.

The points obtained in the laboratory reports will be kept for the two examinations (ordinary and extraordinary) of a course.

In order to waive the assessment of an exam period, it will be sufficient not to take the final exam of that period.

In the case of waiving the continuous assessment, a laboratory test will be taken (with a maximum evaluation of 20%). The method for requesting such a waiver will be to write to the teaching team notifying the waiver before week 9 from the start of the course.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The different evaluation instruments (and their score out of 10) to be used in this subject are as follows:

Instrument 1: Laboratory work. The practical part will be evaluated by means of the previous work and the performance in the laboratory. Marking: 20%.

Instrument 2: Final exam. Written exam to be held at the end of the course and consisting of short questions and the development of one or more problems. score: 80%.

In order to pass the course, the student must achieve a score equal to or higher than 5 points in the final exam. Once this mark has been exceeded in the final exam, the student will add the points obtained in the laboratory reports.

The points obtained in the laboratory reports will be retained for the two examinations (ordinary and extraordinary) of a course.

In order to waive the evaluation of an exam period, it will be sufficient not to take the final exam of that period.

MANDATORY MATERIALS

"Industrial Robotics" (2024). I. Cabanes, A. Mancisidor, A. Zubizarreta. Support documentation for theory and seminars. Publications section; also available in the virtual classroom of the subject.
"Industrial Robotics Laboratory" (2024) A. Mancisidor, I. Cabanes, A. Zubizarreta. Support documentation for the Laboratory. Also available in the virtual classroom of the subject.

BIBLIOGRAPHY

Basic bibliography

• A. Barrientos, L.F. Peñin, C. Balaguer, R. Aracil. Fundamentos de robótica. 2ª Edición. Ed. McGraw-Hill, 2007.
• F. Torres, J. Pomares, P. Gil, S. Puente, R. Aracil. Robots y sistemas sensoriales. Ed. Prentice Hall, 2002
• A. Ollero. Robótica: manipuladores y robots móviles. Ed. Marcombo, 2001
• J.J. Craig. Introduction to robotics: mechanics and control. 3ª Edición. Ed. Addison Wesley, 2005

Detailed bibliography

W. Khalil & E. Dombre. "Modeling, Identification & Control of Robots". Ed. Kogan Page Science, 2006.
Shimon Y. Nof. "Handbook of industrial robotics". Ed. John Wiley & Sons, 1985.
Bruno Siciliano and Oussama Khatib. "Handbook of robotics". Ed. Springer, 2007
Fu González Lee. "Robótica: control, detección, visión e inteligencia". Ed. McGraw-Hill, 1988.

Journals

Robotics and Computer Integrated Manufacturing.
IEEE Transactions on Robotics and Automation.
IEEE Journal of Advanced Robotic Systems.
Control Engineering Practice.

Web sites of interest

- Grupo Robotica GTRob. Grupo Temático de Robótica del Comité Español de Automática CEA-IFAC http://www.cea-ifac.es/wwwgrupos/robotica/index.html
- ABB - Fabricante de robots. http://www.abb.com/robots
- KUKA - Fabricante de robots. http://www.kuka.es
- Staübli - Fabricante de robots. http://www.staubli.com/en/robotics
- Fanuc - Fabricante de robots. http://www.fanucrobotics.es
- Robotics Glossary http://www.learnaboutrobots.com/glossary.html

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree INCAR902 - Master in Control Engineering, Automation and Robotics **Year** .

COURSE

504140 - Industrial System Integration **Credits, ECTS:** 4,5

COURSE DESCRIPTION

The general objective of the subject is to train the student in the most common technologies used in the automation and control of industrial processes. Knowledge of the available technologies should allow the student to select the most appropriate one based on the specific characteristics of the process to be automated. Likewise, the practical sessions will train the student to design and implement the different solutions. To achieve this objective, the student will be offered the possibility of studying and using technologies and products related to communications in manufacturing environments, supervision and control of industrial processes.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Conocer y aplicar estructuras de control a sistemas y procesos
Afrontar el diseño y desarrollo de sistemas utilizando herramientas de automatización y control
Conocer la estructura y operativa de los diferentes dispositivos utilizados en el control y automatización de procesos.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

- Use the knowledge acquired to select, design and implement integration systems within automated production environments.
- Use the knowledge acquired to select the appropriate process control system integration strategies, design and validate them as a prior step to their implementation.

Theoretical and Practical Contents

THEORETICAL SUBJECTS:

1st Lesson. Communications in manufacturing environments. Basic concepts. Information technologies in process control. Supervision and control systems.
2nd Lesson. Serial and parallel communications. Most common standards. Serial protocols frequently used in manufacturing environments.
3rd Lesson. Network architecture. ISO OSI Reference Model. Transmission media. Information coding. Most relevant architectures.
4th Lesson. Introduction. General characteristics. Network architectures. Services and protocols.
5th Lesson. Introduction. Network architecture of these systems. Characteristics of the physical level. Link layer characteristics. Methods of access to the medium. Link level services. Application level services. Temporal behaviour. Control-oriented systems in the continuous process.
6th Lesson. Introduction to industrial Ethernet. Network architecture. Topologies and transmission media. Protocols and services. Deterministic architectures in Ethernet-based networks. I/O communication. Isochronous communication. Protocols frequently used in manufacturing environments.
7th Lesson. Introduction to the monitoring and supervision of industrial processes. Data acquisition and registration. Representation of the process. Alarms. History and databases. Operator terminals. SCADA systems. OPC architecture.

TEORICAL SUBJECTS DEVELOPMENT (18 sessions 1.5 hours):

1st BLOCK - Basic concepts of industrial communications

1st Lesson. Introduction to Industrial Communications: Goals; Historical vision; Hierarchy of industrial communications; Communications in manufacturing environments; Automation levels; Industry 4.0.

2nd Lesson. Principles of Industrial Communications: Data acquisition and control: Analog signal transformation; Data Transmission: Basic Concepts, Bit Coding, Communication Protocols; Serial Communication.

2nd BLOCK - Industrial network architecture

3th Lesson. Architecture of Industrial Communications Systems: Protocol hierarchies; ISO OSI Reference Model, reference levels, communication between levels, data units, services and primitives; Architectures of industrial networks, plant networks, field buses; Industry 4.0: Communications System, IIoT Architecture, RAMI 4.0 Architecture.

3rd BLOCK - Industrial Communications

3.1 SUBLOCK - Field Buses

4th 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.

4.1 Lesson. PROFIBUS-DP: Characteristics; Types of devices; Access to the medium; Communication functions; Description of devices; Applications development; Master-slave interactions; Profiles; Synchronization.

5. Lesson. CAN: CAN: General characteristics; History; CAN bus types; CAN nodes; physical level; Link level: Access to the medium, Arbitration, Services, Frame types; Application level: CAN based protocols.

3.2 SUBLOCK - Industrial Ethernet

6.1 Lesson. Industrial Ethernet: Basic Concepts of Ethernet: Technical characteristics, Types of Ethernet, Network topologies, Bus components, Transmission media, Types of frames, Medium access method; Ethernet problems in industry: Solutions in Industrial Ethernet.

6.2 Lesson. Industrial Ethernet - TCP/IP: General characteristics, TCP/IP stack, TCP/IP vs. OR IF; TCP/IP levels: Network access, Internet - IP, Transport - TCP/UPD, Application; Programming interfaces.

7. Lesson. PROFInet: Transmission modes; Communication in real time; Decentralized field devices; Movement control; Decentralized automation; Network installation; IT standards, network access security; Security; Process.

7.1 Lesson. PROFInet IO: Device classes; Communication model; Setting; Device model; Diagnosis.

4th BLOCK - Monitoring and Monitoring Systems.

8th Lesson. Supervisory Systems: Objectives. Types and benefits. Process supervision technologies. Acquisition. Record. Representation of the process. Fault detection. Knowledge management and decision-making tools. Interfaces, SCADAs.

PRACTICAL SUBJECTS: DEVELOPMENT (9 sessions):

- 1st Practice: S7 communications 1/2 (2 hours)
- 2nd Practice: S7 communications 2/2 (2 hours)
- 3th Practice: I/O communications - PROFIBUS-DP 1/2 (2 hours)
- 4th Practice: I/O communications - PROFIBUS-DP 2/2 (2 hours)
- 5th Practice: IE communications - TCP/IP 1/2 (2 hours)
- 6th Practice: IE communications - TCP/IP 1/2 (2 hours)
- 7th Practice: I/O communications - PROFInet-IO 1/2 (2 hours)
- 8th Practice: I/O communications - PROFInet-IO 2/2 (2 hours)
- 9th Practice: Supervisory Systems - WinCC (2 hours)

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Handling sources and resources	37,5	40 %
Expositive classes	75	40 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	27			18					
Horas de Actividad No Presencial del Alumno/a	40,5			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 tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Written examination	50 %	90 %

Presentations	0 %	20 %
Otros	0 %	10 %
Practical tasks	0 %	30 %
Questions to discuss	0 %	20 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Written Test: 70% (Pass score 40%)
Laboratory: 30% (Continuous Assessment, PS 50%)
Completion of Practices: 15% (Group work, PS 50%)
Laboratory Reports: 10% (Group work, PS 50%)
Session Use: 05% (Independent work, PS 70%)

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 Exam: 70% (Pass score 50%)
Laboratory Exam: 30% (Pass score 50%)

The renounce to the ordinary 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

Documentation corresponding to the transparencies supporting the theory, seminars and laboratory is in the virtual classroom of the subject.
Students will be equipped with the informatics (software) needed for the development of the different works:
- Tools for hardware devices configuration
- Programming tools for communications
Hardware equipment:
- Personal computers
- Programmable controllers - SIMATIC-S7-1500
- Heterogeneous platforms: motors, drives, etc.
- Network devices and equipment

BIBLIOGRAPHY

Basic bibliography

Title: Comunicaciones Industriales: Principios básicos
Authors: M. A. Castro Gil, G. Díaz Orueta, F. Mur Pérez, R. Sebastián Fernández, etc.
Publisher: UNED Year of Publication: 2007

Title: Comunicaciones Industriales: Sistemas Distribuidos y Aplicaciones
Authors: M. A. Castro Gil, G. Díaz Orueta, F. Mur Pérez, R. Sebastián Fernández, etc.
Publisher: UNED Year of Publication: 2010

Title: Redes de Computadoras
Authors: A. S. Tanenbaum
Publisher: Pearson Universidad. 5ª edición Year of Publication: 2013

Title: Comunicaciones Industriales. Guía Práctica
Authors: Aquilino Rodríguez Penín
Publisher: Marcombo, Ediciones Técnicas Year of Publication: 2002

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

Detailed bibliography

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

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

Title: Comunicaciones Industriales
Authors: V. Guerrero, L. Martínez y R.L. Yuste
Publisher: Marcombo Year of Publication: 2010

Title: AS-Interface. The Actuator-Sensor-Interface for Automation
Authors: W.R. Kriesel, O.W. Madelung
Publisher: Editorial Hanser. 2ª edición Year of Publication: 1999

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

Title: Profibus PA. Instrumentation Technology for the Process Industry
Authors: Ch. Diedrich, Th. Bangemann.
Publisher: Oldenbourg Industrieverlag GmbH Year of Publication: 2002

Title: Controller Area Network. Basic, Protocols, Chips and Applications
Authors: K. Etschberger
Publisher: IXXAT Press Year of Publication: 2001

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

Title: Aprenda WinCC
Authors: J. Martínez Torres, J.M. Díez Aznar
Publisher: Editorial de la Universidad Politécnica de Valencia Year of Publication: 2011

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/
IEEE Transactions on Industrial Informatics. http://www.ieee-ies.org/pubs/transactions-on-industrial-informatics
IEEE Industrial Electronics Magazine http://ieee-ies.org/

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/
Open DeviceNet Vendor Association http://www.odva.org
EtherCAT Technology Group http://www.ethercat.org