

ENGLISH FRIENDLY COURSES (EFC) 2023-2024 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.es/en/web/zientzia-teknologia-fakultatea/en-home>

Contact: ciencia.internacional@ehu.es

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	A	
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 2023 to May 2024

1st: September 2023 to January 2024

2nd : January 2024 to May 2024






² SCHEDULE: Morning (M)/ Afternoon (A): begins at 13.30

ENGLISH FRIENDLY COURSES (EFC) 2023-2024 CAMPUS OF BIZKAIA

MASTER COURSES FACULTY OF ECONOMICS AND BUSINESS (321)

<https://www.ehu.es/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: Empirical Applications and Policies					
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 Naturales y Ambiental y Recursos Política	2nd	6	M & A	

³ SEMESTER: Annual: September 2023 to May 2024

1st: September 2023 to January 2024

2nd : January 2024 to May 2024


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

ENGLISH FRIENDLY COURSES (EFC) 2023-2024 CAMPUS OF BIZKAIA

MASTER COURSES FACULTY OF ENGINEERING – BILBAO (345)

<https://www.ehu.es/en/web/bilboko-ingeniaritza-eskola/hasiera>

Contact: ingenieria.internacional@ehu.es










	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	
504011	Tratamiento Avanzado de Señal	1st	6	A	
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	

⁵ SEMESTER: Annual: September 2023 to May 2024

1st: September 2023 to January 2024

2nd : January 2024 to May 2024

⁶ SCHEDULE: Morning (M)/ Afternoon (A): begins at 13.30

	COURSE	SEMESTER⁵	CREDITS	SCHEDULE⁶	LINK TO SYLLABUS
503956	Automatización y Robótica	1st	6	A	
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	
Master in Mechanical Engineering					
504244	Metrología Dimensional	1st	6	A	

COURSE GUIDE

2023/24

Faculty 310 - Faculty of Science and Technology

Cycle .

Degree INQUI901 - 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

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

Dirigir y supervisar todo tipo de instalaciones, procesos, sistemas y servicios de las diferentes áreas industriales relacionadas con la ingeniería química

Diseñar, construir e implementar métodos, procesos e instalaciones para la gestión integral de suministros y residuos, sólidos, líquidos y gaseosos, en las industrias, con capacidad de evaluación de sus impactos y de sus riesgos

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									
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	75 %	85 %
Practical tasks	15 %	25 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

3 tasks (none of them being face-to-face):

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 (none of them being face-to-face):

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 Omnibook, 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 Heidelberg, 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

COURSE GUIDE

2023/24

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

CONTENIDOS TEÓRICO-PRÁCTICOS

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 %

COURSE GUIDE

2023/24

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 egeela 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/

COURSE GUIDE

2023/24

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. Studying 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

CONTENIDOS TEÓRICO-PRÁCTICOS

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 %

COURSE GUIDE 2023/24

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 %
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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

COURSE GUIDE

2023/24

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 decaaketides.

Tetracyclines. Macrocyclic antibiotics. Polyketides of marine origin..

Chapter 3. The Acetate pathway (II). Terpenes. From monoterpenes to tetraterpenes. MVA and MEP pathways.

Cannabinoids. Natural fragrances. 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. Tobacco 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", 3^a 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

COURSE GUIDE

2023/24

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-económicos 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-económicos 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-económicos 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-económicos modernos para la cuantificación de las relaciones económicas, el contraste de teorías y la predicción.
- Aplicar los métodos estadístico-económicos 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-económicos 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 official 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 University 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.ogasan.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/>

COURSE GUIDE

2023/24

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 heteroscedasticity, 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
Theory	5	100 %
Seminars	15	33 %
Classroom practicals	20	50 %
Computer practicals	30	33 %
Lectures	80	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	40 %	60 %
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. & Johnson, 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*, International 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/

COURSE GUIDE

2023/24

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: Economic 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, 4^a ed.
- P. Riera, D. García, B. Kriström y R. Bränlund. Manual de Economía Ambiental y de los Recursos Naturales, Thomson Editores, 2005 (3^o reimpresión 2011).
- Stavins Robert N. (ed.), 2019 (7^o 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/>)

COURSE GUIDE

2023/24

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. Brännlund. *¿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

COURSE GUIDE

2023/24

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
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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>

COURSE GUIDE

2023/24

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 reinforces 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 speech and correct body language. Very long or very short presentations will be penalized.

No-show

<p>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.</p>

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

<p>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.</p>

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>

COURSE GUIDE

2023/24

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 Adaptive 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 óptica" 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 óptica" Alberto Oleaga, 1998

Detailed bibliography

- "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/>

VLT

<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; XMM-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>

COURSE GUIDE 2023/24

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 Science 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>

COURSE GUIDE

2023/24

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 range of concepts and tools developed in those subjects. The course is also related with the optional course of Optic System Design and Adaptive 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: INTERFEROMETRY 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 evaluation 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.

Aldabaldetrekue, 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>

COURSE GUIDE 2023/24

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 career 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 Astrophysics 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), 3^a 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

COURSE GUIDE

2023/24

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 expansion as space 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 platform 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).

Detailed bibliography

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/>)

COURSE GUIDE

2023/24

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.sciencedirect.com

COURSE GUIDE

2023/24

Faculty 345 - Faculty of Engineering - Bilbao

Cycle .

Degree ININD901 - Master in Industrial Engineering

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.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

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	40 %	60 %
Otros	30 %	50 %
Practical tasks	10 %	30 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Osasun egoerak aurrez aurreko irakaskuntza edota ebaluazioa eragotziz gero, onlineko jarduerara joko da eta ikasleei aldaketa horren berri emango zaie

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Osasun egoerak aurrez aurreko irakaskuntza edota ebaluazioa eragotziz gero, onlineko jarduerara joko da eta ikasleei aldaketa horren berri emango zaie

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 paradigm 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

COURSE GUIDE

2023/24

Faculty 345 - Faculty of Engineering - Bilbao

Cycle .

Degree ININD901 - Master in Industrial Engineering

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 In 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.

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

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

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.

3.2 Lesson. Programming Basics - STEP7: Program structure, Module types, Processing types, Cycle and response times.

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
- 7th Seminar: PROFINet-IO
- 8th Seminar: OPC-DA
- 9th Seminar: OPC-UA
- 10th Seminar: SCADA systems

PRACTICAL SUBJECTS:DEVELOPMENT (8 sessions):

- 1st Practice: S7 communications (1,5 horas)
- 2nd Practice: Process control communications - AS-i (1,5 horas)
- 3rd 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 (2 hours)
- 6th Practice: I/O communications - PROFINet-IO 1/2 (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 %
Laboratory practicals	37,5	40 %

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: OPC - From Data Access to Unified Architecture

Authors: J. Lange, F. Iwanitz, T.J. Burke

Publisher: Vde Verlag Gmbh, 4ª Edición

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: 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: OPC Unified Architecture

Authors: W. Mahnke, S.-H. Leitner, M. Damm

Publisher: Springer

Year of Publication: 2009

Title: Sistemas SCADA (2ª Edición)

Authors: A. Rodríguez

Publisher: Marcombo, Ediciones Técnicas

Year of Publication: 2007

Title: Aprende 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/>

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>

COURSE GUIDE 2023/24

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 acquire 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 Ludwig, 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

COURSE GUIDE

2023/24

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 %
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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 separately (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

COURSE GUIDE 2023/24

Faculty 345 - Faculty of Engineering - Bilbao

Cycle .

Degree INTEL902 - Master in Telecommunication Engineering

Year First year

COURSE

504011 - Advanced Signal Processing

Credits, ECTS: 6

COURSE DESCRIPTION

Establishes the basis of discrete random processes for the development of adaptive techniques applied to communications systems. It covers advanced channel coding techniques and digital modulations.

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 and the students will be promptly informed about it.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

Capacidad para aplicar métodos de la teoría de la información, la modulación adaptativa y codificación de canal, así como técnicas avanzadas de procesamiento digital de señal a los sistemas de comunicaciones y audiovisuales.

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

Theoretical and Practical Contents

BLOCK 1: RANDOM SEQUENCES

- Topic 1 Discrete random processes
- Topic 2 Stationary processes
- Topic 3 Ergodic stationary processes
- Topic 4 Process Modeling

BLOCK 2: ADAPTIVE PROCESSING IN COMMUNICATIONS

- Topic 5 Linear Prediction
- Topic 6 Optimal Filtering: Wiener Filtering
- Topic 7 Adaptive filtering

BLOCK 3: ADVANCED MODULATION TECHNIQUES

- Topic 8: Channel coding: block and convolutional codes
- Topic 9: Band-limited channel modulations

Seminars

- Sem. 1: Deterministic Signals and Systems
- Sem. 2: Basic principles of Convolutional Coding and Modulation.

Laboratory practicals

- P1: Handling of signals and systems in Matlab.
- P2: Random variables. Non-stationary random processes.
- P3: Stationary processes and ergodic processes.
- P4: Random processes through SLI
- P5: Linear prediction applied to speech coding.
- P6: Optimal decoding of convolutional systems
- P7: Decoding band-limited systems
- P8: Optimal filtering: Wiener FIR filtering
- P9: Applications of adaptive filtering I
- P10: Adaptive filtering applications II

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Seminars	12,5	40 %
Seminars	12,5	40 %
Laboratory practicals	56,25	40 %
Lectures	81,25	40 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	32,5	5		22,5					
Horas de Actividad No Presencial del Alumno/a	48,75	7,5		33,75					

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

Evaluation tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Continuous evaluation	10 %	60 %
Written examination	40 %	90 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The final evaluation is based on two grades:

1. Theory grade, which is obtained through a written exam of the part corresponding to the theoretical classes (60% of the total).
2. Practice grade, which corresponds to the practical part of the course (40% of the total). It is distributed as follows:
 - Individual practical exam (30% of the total)
 - Evaluation of the reports presented jointly (10% of the total).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary call, the evaluation scheme of the ordinary call is maintained, with two tests:

1. Theory grade (written exam of the part corresponding to the theoretical classes, 60% of the total).
2. Practical grade (individual practical exam, corresponding to the practical part of the course, 40% of the total).

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Material developed by the professors available in eGela (<http://egela.ehu.es/>)² including:

- Course notes (topics 1-7).
- Problems of the course.
- Support material for seminars.
- Scripts of the laboratory practices.

Detailed bibliography

J.G. Proakis, Advanced digital signal processing, Prentice Hall
B. Widrow, S.D. Stearns, Adaptive signal processing, Prentice Hall
S. Haykin, Adaptive Filter Theory, Prentice Hall
Stephen P. Wilson Digital Modulation and Coding Prentice Hall, 1996
John G. Proakis and Masoud Salehi, Digital Communications 5ed. McGrawHill International 2008.

Journals

IEEE Transactions on Communications
IEEE Transactions on Information Theory
IEEE Communications Magazine

Web sites of interest

www.complextoreal.com
<http://www.dsprelated.com/>
Modulation and coding:
<http://www.educatorscorner.com/experiments/spectral/SpecAn10.shtml>
http://dbserv.maxim-ic.com/tarticle/view_article.cfm-article_id=70

COURSE GUIDE

2023/24

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>
- * Zynq-7000 SoPC Documentation: <http://www.xilinx.com/products/silicon-devices/soc/zynq-7000.html>

BIBLIOGRAPHY

Basic bibliography

- * Clive "Max" Maxfield. "The Design Warrior's Guide to FPGAs". Ed. Newnes, 2004.
- * Pong P. Chu. "RTL Hardware Design Using VHDL: Coding for Efficiency, Portability, and Scalability". Ed. Wiley- IEEE Press, 2006.
- * 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

Detailed bibliography

- IEEE Std 1076-1993. "IEEE Standard VHDL Reference Manual". Junio de 1994.
- 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/>

COURSE GUIDE

2023/24

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 distributed into two parts:

i) Tests carried out along the teaching period (up to a 20% of the final grade of the 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% and 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. The laboratory part will be a 30-question test with there being no minimum r

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Even though the evaluation format is the same as in the first call, the laboratory test for the not on-going assessment will have 20 questions.

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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Basic bibliography

- Radio Regulations. International Telecommunication Union - Radio Sector, ITU-R. Geneva 2008.
- 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

Detailed bibliography

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Stuzman, Warren. Antenna Theory and Design. John Wiley and Sons, 1981.

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.

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

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

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

Journals

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://ieeexplore.ieee.org>
<http://www.esa.int/esaNA/galileo.html>
<http://www.gps.gov>

COURSE GUIDE

2023/24

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.

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 scientific 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 %

BIBLIOGRAPHY

Basic bibliography

- Alan Chalmers, "Qué es esa cosa llamada ciencia", Siglo XXI, 2006
- Pestaña, A . " El sistema español de ciencia y tecnología", Investigación y Ciencia, Diciembre, 1996.
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- Michael Shermer, "¿Por qué creemos en cosas raras?", Alba, 2002.
- Decartes, R., "Discurso del Método", Alianza editorial, (Libro de bolsillo, sección clásicos),1987.
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- R. P. Feynman: ¿Qué significa todo eso?. Editorial Crítica, 1999.
- R. P. Feynman: El placer de descubrir. Editorial Crítica, 2000.
- J. Losee: Introducción histórica a la filosofía de la ciencia. Alianza editorial, AU 165, 1985.
- A. Pestaña, "Veinticinco años de ciencia y técnica en España: Institucionalización e infraestructuras", Investigación y Ciencia, Septiembre, 2001.
- How to write a thesis - Rowena Murray , 2006
- Writing for Academic Journals - Rowena Murray, 2009
- How to Survive Your Viva - Rowena Murray, 2009

Detailed bibliography

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- Francis S. Collins, "Cómo habla Dios", Temas de Hoy, Planeta, 2007.
- Leonard Susskind, "El paisaje cósmico", Drakontos, 2007.
- Richard Dawkins, "Evolución", Espasa Calpe, 2009
- Richard Dawkins, "El espejismo de Dios", Espasa Calpe, 2007
- 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.
- C. Allégre: Dios frente a la ciencia. Ediciones Península, 2000
- Jean-Marc Levy-Leblond, "Conceptos contrarios", Metatemas 70, 2002
- Richard Dawkins, "Escalando el monte improbable", Metatemas Tusquets, 2008
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- Tipler, F.J., "La física de la inmortalidad", Alianza editorial, AU 840, 1996.

Journals

JOURNAL OF MANAGEMENT INFORMATION SYSTEMS, M E SHARPE INC
INTERNATIONAL JOURNAL OF SOCIAL RESEARCH METHODOLOGY BY ROUTLEDGE
ACADEMY OF MANAGEMENT JOURNAL
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/>

COURSE GUIDE

2023/24

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>

COURSE GUIDE 2023/24

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

- Conocer e interpretar los procesos de generación y percepción de la voz humana.
- Comprender e interpretar los principales parámetros utilizados en la representación de la señal de voz
- Conocer las estrategias fundamentales empleadas en los sistemas de síntesis y de codificación de la señal de voz, manejando las herramientas informáticas básicas para el procesado y tratamiento de la señal de voz.
- Comprender la terminología empleada en el campo del tratamiento de la señal de voz, de forma que sea capaz de interpretar un trabajo de investigación descrito en una revista

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 conding
- Lesson 5 Introduction to speech and speaker recognition
- Lesson 6 Text to speech conversion

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Laboratory practicals	56,25	40 %
Lectures	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
Written examination	30 %	70 %

Practical tasks	30 %	70 %
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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 almost 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 extraordinary call, 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

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- 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)

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- P. Taylor. Text-to-Speech Synthesis. Cambridge University Press, 2009. (ISBN: 978-0521899277)
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- 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
- Speech Technology Hyperlinks Page
<http://www.speech.cs.cmu.edu/comp.speech/Section5/speechlinks.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://speech-to-text-demo.ng.bluemix.net/>
<https://www.google.com/intl/en/chrome/demos/speech.html>

COURSE GUIDE

2023/24

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 acquisition and conditioning
- TOPIC 3 - Characterization of unidimensional biomedical signals
- TOPIC 4 - Applications of biomedical signal processing of unidimensional signals
- TOPIC 5 - Analysis and processing of biomedical images

LAB SESSION:

- SESSION 1 - Acquisition 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 electromyogram
- 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 part and the LAB 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>

COURSE GUIDE

2023/24

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 7 topics. The theoretical content is presented below:

0. Presentation of the subject.
1. Introduction
 - 1.1. Introductory aspects
 - 1.2. Subsystems of a robot
2. Kinematics of industrial robots
 - 2.1 Introduction
 - 2.2 Mathematical tools for spatial localisation
 - 2.3 Position problem
 - 2.4 Velocity problem
3. Industrial Robot Dynamics
 - 3.1 Introduction
 - 3.2 Dynamic Modelling Methods
 - 3.3 Direct and inverse dynamics
4. Programming of industrial robots
 - 4.1 Introduction
 - 4.2 Programming modes. Classification
 - 4.3 Programming System Requirements
 - 4.4 Basic characteristics of various languages
 - 4.5 Examples of industrial robot programming
5. Path Generation
 - 5.1 Introduction
 - 5.2 Path Generation.
 - 5.3 Solving Interpolators
 - 5.4 Examples
6. Control Strategies
 - 6.1 Introduction
 - 6.2 Single-joint control
 - 6.3 Multi-joint control
 - 6.4 Position/Force/Hybrid Control
 - 6.5 Design and implementation examples
7. Industrial applications
 - 7.1 Introduction
 - 7.2 Presentation of a robot manufacturer

7.3 Current market data

7.4 Industrial applications of robots

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
Classroom practicals	25	40 %
Laboratory 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" (2021). 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" (2021) 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>