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

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

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

English Friendly Courses taught in SPANISH:

FACULTY OF SCIENCE AND TECHNOLOGY (310)						
	COURSE	SEMESTER[1]	CREDITS	SCHEDULE[2]	LINK TO SYLLABUS
Bachelor`s Degree in Chemistry					
26114	Química Orgánica II	Annual	9	M/A	
26117	Química Física I	Annual	9	M/A	
26123	Química Física II	Annual	9	M	
26699	Interfases y Coloides	1st	6	M	
26700	Química Ambiental	1st	6	M/A	
26703	Química Organometálica	1st	6	M/A	
26111	Química General I	1st	6	M/A	
26135	Química General II	2nd	6	M/A	
26701	Química de Polímeros	2nd	6	M/A	
26707	Síntesis Orgánica	2nd	6	M/A	
Bachelor`s Degree in Chemical Engineering					
26750	Cálculo Numérico en Ingeniería Química	Annual	9	A	
26757	Ingeniería de Procesos y Producto	Annual	9	M/A	
26111	Química General I	1st	6	M	
26728	Ampliación de Biología Molecular	1st	4,5	M	
26731	Nanobiotecnología	1st	4,5	M	
26738	Análisis de Riesgos y Seguridad en Plantas Industriales	1st	4,5	A	
26752	Experimentación en Ingeniería Química I	1st	9	M	
26754	Termodinámica Aplicada	1st	6	A	
26759	Experimentación en Ingeniería Química II	1st	9	A	

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

Universidad del País Vasco / Euskal Herriko Unibertsitatea

FACULTY OF SCIENCE AND TECHNOLOGY (310)

	COURSE	SEMESTER[1]	CREDITS	SCHEDULE[2]	LINK TO SYLLABUS
26763	Diseño Mecánico de Equipos	1st	6	M/A	➡
26765	Petróleo y Petroleoquímica	1st	4,5	M/A	➡
26766	Análisis Económico de los Procesos Químicos	1st	4,5	M/A	➡
26767	Ingeniería Energética	1st	4,5	M/A	➡
26768	Ingeniería de Procesos Biotecnológicos	1st	4,5	M	
26770	Ingeniería Química y Sostenibilidad	1st	4,5	M/A	➡
26135	Química General II	2nd	6	M/A	➡
26755	Cinéticas de los Procesos Químicos	2nd	6	A	➡
26769	Organización y Gestión de Proyectos	2nd	7,5	M/A	➡
Bachelor`s Degree in Mathematics					
26645	Algebra Lineal y Geometría I	Annual	12	M/A	➡
26666	Algebra Lineal y Geometría II	1st	6	A	➡
26675	Grupos y Representaciones	1st	6	M	➡
26677	Ampliación de Métodos Numéricos	1st	6	M/A	➡
26678	Códigos y Criptografía	1st	6	M/A	➡
26687	Topología	1st	6	M/A	➡
26212	Diseño de Algoritmos	2nd	6	M/A	➡
26671	Teoría de números	2nd	6	M/A	➡
26672	Variedades Diferenciables	2nd	6	M	➡
26682	Métodos Numéricos II	2nd	6	M/A	➡
26681	Modelización Matemática	2nd	6	M/A	➡
Bachelor`s Degree in Geology					
27806	Física	Annual	12	M/A	➡
26786	Sedimentología	1st	6	A	➡
26797	Micropaleontología	1st	6	M/A	➡
26777	Yacimientos Minerales y Rocas Industriales	2nd	9	M/A	➡
26778	Geología Ambiental y Riesgos Geológicos	2nd	6	M/A	➡
26783	Mineralogía	2nd	9	A	➡

FACULTY OF SCIENCE AND TECHNOLOGY (310)					
	COURSE	SEMESTER[1]	CREDITS	SCHEDULE[2]	LINK TO SYLLABUS
26790	Estratigrafía	2nd	6	A	➡
26803	Análisis de Cuencas y Geología Histórica	2nd	6	M/A	➡
26794	Bioestratigrafía y Paleoecología	1st	6	M	
Bachelor`s Degree in Biochemistry and Molecular Biology					
27806	Física	Annual	12	M/A	➡
26856	Regulación del Metabolismo	1st	6	A	➡
26860	Métodos avanzados en Bioquímica	1st	6	M	➡
26710	Bioquímica I	1st	6	M	➡
26714	Genética	1st	6	M	➡
26721	Metodología Química Básica	2nd	9	M	➡
26724	Bioinformática	2nd	6	M	➡
26725	Técnicas histológicas y cultivos celulares	2nd	6	A	➡
26746	Genómica	2nd	4,5	M	➡
26857	Bioquímica Clínica	2nd	6	M	➡
26859	Espectroscopia de Biomoléculas	2nd	6	M	➡
26865	Farmacología Molecular	2nd	4,5	M/A	➡
25267	Técnicas Instrumentales	2nd	6	A	➡
Bachelor`s Degree in Biology					
26818	Ecología Marina	1st	6	M/A	➡
26819	Ecología Forestal	1st	4,5	M/A	➡
26710	Bioquímica I	1st	6	M	➡
26714	Genética	1st	6	M	➡
26813	Evolución Molecular	2nd	4,5	M	➡
26817	Limnología	2nd	6	M/A	➡
26820	Fisiología Animal Ambiental	2nd	6	M	➡
26824	Ingeniería Genética y Análisis Genético Molecular	2nd	6	M	➡
26837	Fisiología Vegetal Avanzada	2nd	6	M	➡
26815	Zoogeografía	2nd	4,5	M	➡

Universidad del País Vasco | Euskal Herriko Unibertsitatea

FACULTY OF SCIENCE AND TECHNOLOGY (310)

	COURSE	SEMESTER[1]	CREDITS	SCHEDULE[2]	LINK TO SYLLABUS
Bachelor`s Degree in Biotechnology					
27806	Física	Annual	12	M/A	➡
26728	Ampliación de Biología Molecular	1st	4,5	M	
26731	Nanobiotecnología	1st	4,5	M	➡
26738	Análisis de Riesgos y Seguridad en Plantas Industriales	1st	4,5	A	➡
26681	Modelización Matemática	2nd	6	M/A	➡
26721	Metodología Química Básica	2nd	9	M	➡
27804	Cultivos celulares y tisulares	2nd	6	A	➡
26746	Genómica	2nd	4,5	M	➡
26740	Biotecnología Microbiana	2nd	4,5	M/A	➡
26710	Bioquímica I	1st	6	M	➡
26714	Genética	1st	6	M	➡
Common Courses for Physics and Electronic Engineering					
26636	Termodinámica y Física Estadística	Annual	12	M/A	➡
26645	Algebra Lineal y Geometría I	Annual	12	M/A	➡
26632	Sensores y Actuadores	1st	6	M/A	➡
26634	Óptica	1st	6	M/A	➡
26640	Electromagnetismo I	1st	6	A	➡
26643	Electromagnetismo II	1st	6	M	➡
26648	Física del Estado Sólido I	1st	6	M	➡
26652	Mecánica Cuántica	1st	6	M/A	➡
26653	Electrodinámica	1st	6	M/A	➡
26847	Diseño de Sistemas Digitales	1st	6	M/A	➡
26848	Microelectrónica y Microsistemas	1st	6	M/A	➡
26631	Instrumentación I	2nd	6	M	➡
26649	Física del Estado Sólido II	2nd	6	M/A	➡
26654	Gravitación y Cosmología	2nd	6	M/A	➡
26655	Astrofísica	2nd	6	M/A	➡
26656	Temas de Física Avanzada	2nd	6	M/A	➡
26658	Física de los Medios Continuos	2nd	6	M	
26659	Física Nuclear y de Partículas	2nd	6	M/A	➡
Bachelor`s Degree in Electronic Engineering					
26662	Fundamentos de Programación	2nd	6	M	➡
26849	Electrónica de Comunicaciones	2nd	6	M	➡

English Friendly Courses taught in BASQUE:

FACULTY OF SCIENCE AND TECHNOLOGY (310)					
	COURSE	SEMESTER	CREDITS	SCHEDULE[3]	LINK TO SYLLABUS
Bachelor`s Degree in Chemistry					
26113	Kimika Organikoa I	Annual	9	A	
Bachelor`s Degree in Chemical Engineering					
26753	Bero transmisioa	2nd	6	A	
Bachelor`s Degree in Biology					
26710	Biokimika I	1st	6	M	
26833	Genética Molecular	2nd	6	M	
Bachelor`s Degree in Geology					
26795	Petrologia Metamorfikoa	2nd	6	M	
26803	Arro analisia eta geologia historikoa	2nd	6	M/A	
Bachelor`s Degree in Mathematics					
26668	Probabilitatea eta Prozesu Estokastikoak	2nd	6	M	
26690	Ecuaciones Diferenciales		12	M	
Common Courses for Physics and Electronic Engineering					
25992	Elektronika Analogikoa	2nd	6	M	
26630	Señales y sistemas	1st	6	M	
26646	Teknika Esperimentalak III	1st	9	M	
26657	Solidoen Egituren Propietateak	1st	6	M	

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

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GQUIMI30 - Bachelor`s Degree in Chemistry	Year	First year

COURSE

26111 - General Chemistry	Credits, ECTS:	6

COURSE DESCRIPTION

"General Chemistry I" is a mandatory course from the first year of the Degree in Chemistry and the Degree in Chemical Engineering. It is taught in the first semester and together with the subject of the same course "General Chemistry II" (second semester), it is the basis of the chemistry courses of the basic module.
Building upon the knowledge and capabilities already acquired by the student in his/her previous studies; this course focuses on the atoms and the classification of the elements in the periodic table, micro- and macroscopic properties of the elements and their compounds as well as on the different theories of the chemical bond and reactivity. The student will also learn the rules of nomenclature and formulation of both organic and inorganic compounds as well as basic concepts of isomerism in organic materials and the reactivity of the most important functional groups in organic chemistry.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIES
In this subject, the aim is that the student
1. Learns and uses the language of chemistry related to the designation and formulation of chemical elements and compounds.
2. Has a clear notion of the most basic aspects of Chemistry that are related to the laws of chemical combination, and the stoichiometry of chemical reactions.
3. Masters the basic concepts related to the composition, structure bonds in the subject.
4. Can handle the basic knowledge related to the structure and reactivity of the most common inorganic and organic chemical compounds.
5. Uses and relates the different experimental sciences for an understanding of chemical phenomena or conversion processes.
6. Knows the most common sources of information and documentation in experimental sciences.

LEARNING OUTCOMES
Students who have completed the requirements will
-Use correctly the chemical language related to the designation and formulation of inorganic and organic chemical elements and compounds, in accordance with the standard rules from the IUPAC.
-Identify the type of bond present in different chemical compounds and will be able to predict their structures and some of their micro- and macroscopic properties: acidity/basicity, states of aggregation, mechanical, electrical or magnetic properties...
-Recognize the main characteristics of atoms as constituent units of matter, the classification of the elements in the periodic table and their periodic properties.
-Evaluate and analyse both conformational and configurational isomerism in organic compounds with special emphasis on chiral compounds.
-Analyse the main types of organic reactions from an energetic and mechanistic point of view.

Theoretical and Practical Contents

1. Nomenclature in Inorganic Chemistry
Binary compounds of metals and non-metals. Acids. Oxoacids. Salts. Oxysalts. Coordination compounds.

2. Atomic structure.
Quantum Mechanics historical background. Wave-particle duality. Uncertainty principle. Schrödinger's equation. The Hydrogen atom. Quantum numbers. Atomic orbitals. Multielectronic atoms. Pauli's exclusion principle and orbital occupation. Hund's rules.

3. The Periodic Table of the Elements.
Atomic properties and their evolution across the Periodic Table. Periodic classification of the elements. The Periodic System. Size of atoms and ions. Ionization potential. Electronic affinity.

4. The chemical bond: theories and types of bonds.
Covalent bond: Valence bond theory. Lewis model. Hybridization. Molecular orbitals theory. Metallic bonding: Band theory. Ionic bond: Lattice energy; the Born-Haber cycle. Polarity. Intermolecular forces: Dipole-dipole interactions. Hydrogen bonds.

5. States of aggregation of matter.
Solids: properties, classification and structural models. Gases: Ideal gases. Kinetic-molecular theory. Maxwell-Boltzmann distribution. Real gases. Liquids: Properties; Brownian motion; kinetic theory; transport properties.

6. Nomenclature in Organic Chemistry
Hydrocarbons. Alcohols and ethers. Aldehydes and ketones. Carboxylic and acids and their derivatives. Nitrogen compounds. Heterocycles.

7. Structure and bond in organic molecules.
Lewis structures and formal charges. Molecular models. Structure and physical properties.

8. Isomerism in Organic Chemistry.
Concept and types. Constitutional (structural) isomerism. Stereoisomerism. Configurational isomerism. The concept of chirality. Enantiomers. Optical activity. Different types of chiral molecules. Organic molecules projection. Absolut configuration: sequential rules. Diastereoisomers. Racemates.

9. Main reaction types in Organic Chemistry.
Homolytic and heterolytic cleveage. Inductive and resonance effect / mesomers. Reaction intermediates. Nucleophiles and electrophiles. Acid-base nature of organic compounds.

TEACHING METHODS

The teaching will be given as lectures (M, 30 hours) which consist in theoretical lessons, classroom practices - consisting of solving problems and answering questions - (GA, 25 hours) and seminars (S, 5 hours), which delve into various key aspects of the subject.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	5	25						
Horas de Actividad No Presencial del Alumno/a	45	7,5	37,5						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

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

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The assessment tools used will be:
- Work done in the classroom, as well as the grading of the problems and assignments handed in: 30% of the final grade (minimum grade 4.0/10).
- Theoretical-practical written test: 70% of the final grade (minimum grade 4.0/10. This grade needs to be balanced all along the test).
- There will also be a formulation test that the student will have to pass in order to pass the whole subject.

The following aspects are evaluated in all the activities:
- Good formulation of questions
- Precision and coherence of the answers
- Clarity and reasoning

In this assessment system (30/70), the performance of the exercises proposed by the professor throughout the course will be compulsory.

If the student does not wish to be assessed in this modality, he/she may take a final test (100%) in the January call. To do this, he/she should present his/her withdrawal in writing to the professor before week 9.

Non-presentation at the final exam for the subject will be considered as withdrawal from the call.

Academic Ethics Protocol
During the evaluation tests, the use of books, notes or diagrams, as well as the use of telephones, computers or other electronic devices by the students will be prohibited [Only a calculator is allowed]. In the event of any dishonest or fraudulent practice, the protocol on academic ethics and prevention of dishonest or fraudulent practices in evaluation tests and academic works at the UPV/EHU will be applied.

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EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The grade for the extraordinary call will be taken in its entirety from the grade obtained in the exam (100% exam).

Non-presentation at the final exam for the subject will be considered as withdrawal from the call.

Academic Ethics Protocol
During the evaluation tests, the use of books, notes or diagrams, as well as the use of telephones, computers or other electronic devices by the students will be prohibited [Only a calculator is allowed]. In the event of any dishonest or fraudulent practice, the protocol on academic ethics and prevention of dishonest or fraudulent practices in evaluation tests and academic works at the UPV/EHU will be applied.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

- R.H. Petrucci, F.G. Herring, J.D. Madura and C. Bissonnette. "General Chemistry: Principles and Modern Applications", (11th ed.), Pearson Prentice Hall, Upper Saddle River, NJ. 2011.
- P. Atkins, L. Jones and L. Laverman. "Chemical Principles", (7th ed.), W. H. Freeman Ed., New York, 2016.

Detailed bibliography

- Chang, R. and Goldsby, K. "Chemistry", (11th ed.) McGraw-Hill Education, New York, 2014.
- "Chemsitry. A project of the American Chemical Society". W. H. Freeman Ed., New York, 2004.
- D.W. Oxtoby and N.H. Nachtrieb. "Principles of Modern Chemistry", (5th ed.), W. H. Freeman Ed., New York, 2010.
- J.C. Kotz, P.M. Treichel and J.M. Townsend. "Chemistry and Chemical Reactivity" (7th ed.), Brooks/Cole Publishing, Salt Lake City, UT, 2009.
- M.S. Silberberg. "Principles of General Chemsitry" McGraw-Hill Education, New York, 2006.
- K. P. C. Vollhardt "Organic Chemistry" (4th ed.), W. H. Freeman Ed., London, UK, 2002.
- L. G. Wade. "Organic Chemistry" (6th ed.) Pearson Prentice Hall, Upper Saddle River (NJ), USA. 2006.
- N.G. Connelly and T. Damhus. "Nomenclature of Inorganic Chemistry: IUPAC Recommendations ". IUPAC Red Book; RSC Publishing, London, 2005.
- H. A Favre and W. H Powell. "Nomenclature of Organic Chemistry: IUPAC Recommendations ". IUPAC Blue Book; RSC Publishing, London, 2014.

Journals

Journal of Chemical Education

Web sites of interest

http://webbook.nist.gov/chemistry
http://www.chem.ox.ac.uk/vrchemistry/
http://www.800mainstreet.com/1/0001-000-TOC.html
http://www.webelements.com/

OBSERVATIONS

Universidad del País Vasco Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GQUIMI30 - Bachelor`s Degree in Chemistry	**Year**	Third year

COURSE

26114 - Organic Chemistry II	**Credits, ECTS:**	9

COURSE DESCRIPTION

The main spectroscopic properties of organic compounds will be analyzed. With regard to reactivity, reactions involving carbon-carbon bond formation will be discussed with a focus on the chemistry of enols, enolates and enamines, olefination and cycloaddition reactions, and a brief introduction to heterocyclic chemistry. Practical laboratory works include synthesis planning and structure determination by spectroscopic methods.
"Organic Chemistry II" improves the knowledge acquired by "Organic Chemistry I", a course of the second year of the degree, and prepares the student for the more in-depth optional subjects "Determination of organic structures" and "Organic synthesis".

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Specific skills:
1. Ability to improve in the knowledge of the structure, properties, preparation methods and main chemical reactions of organic compounds.
2. Ability to plan and carry out in the laboratory simple synthetic procedures and characterization of chemical compounds safely and using proper techniques, and to evaluate the data derived from experimental observations in the various fields of chemistry.
3. Ability to apply the basic principles of chemistry to industrial chemical operations and to chemical installation projects.

Transversal skills:
1. Ability to select and use several instrumental techniques for the characterization of chemical entities.
2. Ability to explain orally and in writing phenomena and processes related to Chemistry and associated subjects in an understandable way.
3. Ability to search for and select information in the field of Chemistry and other scientific fields using the literature sources and information technologies.
4. Ability to relate Chemistry to other disciplines, as well as to understand its positive impact on society and the importance of the chemical industrial sector.

Theoretical and Practical Contents

Chapter 1. Introduction to Structure Determination by Spectroscopic methods

1.1. The electromagnetic spectrum
1.2. IR
1.3. UV-Vis
1.4. NMR
1.5. MS
1.6. Structure determination of organic compounds by spectroscopic techniques

Chapter 2. Chemistry of enols and enamines.

Chapter 3. Other C-C and C=C bond-forming reactions.

Chapter 4. Heterocyclic chemistry.

Chapter 5. Cycloadditions.

Laboratory sessions:

Session 1. Michael addition and aldol condensation. Structure determination (RMN, IR).
Session 2. Stereocontrolled reduction. Structure determination (RMN, IR).
Session 3. Acetonide. Structure determination (RMN, IR).
Session 4. Wittig reaction. Structure determination (RMN, IR).
Session 5. Synthesis of a heterocycle. Structure determination (RMN, IR).

TEACHING METHODS

In lectures, the student will be given the core concepts he/she needs to assimilate. The themes will be dealt with a selection of illustrative exercises that will be provided with sufficient advance notice for preparation as non-presence-

based work.
The seminars are designed to make the best use of the laboratory sessions, in which the experimental work to be carried out will be examined in advance.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	45	5	15	25					
Horas de Actividad No Presencial del Alumno/a	67,5	7,5	22,5	37,5					

Legend:

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Exercises, cases or problem sets 30%
- Individual assignments 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

As described in Methods and Types of teaching, assessment of the subject in the ordinary call will be done based on the three sections, to which a percentage or specific weight will be assigned, and reflected in the final grade of the call. This assessment will be weighted as follows:

- Written test 60%
- Practical work (exercises, cases or problems) 30%
- Individual work 10% Two partial exams (January and May) (60%)

Laboratory (practical work + reports) and seminars (30%)
Classroom exercises (10%)

To pass the subject, you need to get a mark of at least 5.0 out of 10 in each section (independently). Passing partial exams, or even the final exam, does not guarantee that you will pass the subject, as the assessment also depends (for the remaining 40%) on the Laboratory, Seminars and Classroom work section.

The January and May exams will give an average grade, as will the five practical exercises and all classroom work that can be assessed. To reach the average mark of the two exams (January and May) you will need to score a minimum 5.0 in each one. Students who do not reach this grade will repeat the exam in the final ordinary call.

Furthermore, regarding the laboratory part, the student will be asked to make brief reports on the practical work in the laboratory. The practical work, the associated reports, the laboratory notebook and the exercises done in seminars and during the practical work will also be assessed.

As for classroom work, aspects to be considered are: attendance in class, participation in class, the gradual mastery of the competences to be acquired, and the performance by the student of illustrative exercises that will be collected and scored by the professor, as well as others done throughout the year.

The student will have the opportunity to withdraw from continuous (or combined) assessment and opt for a final assessment, regardless of whether he/she has participated (or not) in continuous assessment until then. To do this, the student must present his/her withdrawal to the professor responsible for the subject in a period that will end in week 18 of the academic year (as set in the Faculty of Science and Technology). This final assessment will consist of an overall exam covering all the aspects of the subjects, and will be taken within the official exam calendar.

Finally, students who decide to waive the opportunity to sit an an exam must indicate this in writing to the professor responsible for the subject before the end of week 18.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The exam to be taken in the extraordinary call will represent 100% of the final grade. Both theoretical and practical (related to the experimental practical work in the subject) content will be evaluated.
Students not taking the exam will waive the right to this assessment.

MANDATORY MATERIALS

Lab coat, safety googles and lab notebook

BIBLIOGRAPHY

Basic bibliography

1. J. I. Borrell, J. Teixidó, J. L. Falcó, SÍNTESIS ORGÁNICA, Síntesis, 2004.

2. M. Carda; S. Rodríguez; F. González; J. Murga; E. Falomir; E. CASTILLO, SÍNTESIS ORGÁNICA. RESOLUCIÓN DE PROBLEMAS POR EL MÉTODO DE DESCONEXIÓN. Publicaciones de la Universitat Jaume I, Castellón, 1996

3. J. L. Marco, QUÍMICA DE LOS PRODUCTOS NATURALES, Síntesis 2006

4. T. L. Gilchrist QUÍMICA HETEROCÍCLICA. 2 ed. Addison-Wesley Iberoamericana, USA, 1995.

5. M. J. Rodríguez, F. Gómez, CURSO EXPERIMENTAL EN QUÍMICA ORGÁNICA, Síntesis, 2008.

6. M. A. Martínez, A. Csákÿ, TÉCNICAS EXPERIMENTALES EN SÍNTESIS ORGÁNICA, Síntesis, 2005.

7. SAFETY IN ACADEMIC CHEMISTRY LABORATORIES: VOLUME 1 y2. ACCIDENT PREVENTION FOR FACULTY AND ADMINISTRATORS, 7ª Ed. American Chemical Society, Washington, DC, 2003

8. M. Hesse, H. Meier, B. Zeeh, MÉTODOS ESPECTROSCÓPICOS EN QUÍMICA ORGÁNICA, Síntesis, 2006.

9.2. P. Pretsch, C. Bühlmann, A. Affolter, R. Herrera, Martínez, Tablas para la determinación estructural por métodos espectroscópicos, Springer-Verlag Ibérica, 2001.

Detailed bibliography

1. S. Warren, P. Hyatt, ORGANIC SYNTHESIS: THE DISCONNECTION APPROACH, Wiley, 2008
2. F. A. Carey, R. J. Sundberg, ADVANCED ORGANIC CHEMISTRY, Partes A y B, 5ª Edición, Springer, 2007.
3. M. B. Smith, J. March, MARCH¿S ADVANCED ORGANIC CHEMISTRY: REACTIONS, MECHANISMS AND STRUCTURE, 6ª Ed. Wiley, 2007.
4. R. Bruckner, ADVANCED ORGANIC CHEMISTRY: REACTION MECHANISMS, Academic Press, Londres, 2001.
5. J. A. Joule, K. Mills, HETEROCYCLIC CHEMISTRY, 4ª Ed., Blackwell Science, 2000
6. P. M. Dewick, MEDICINAL NATURAL PRODUCTS. A BIOSYNTHETIC APPROACH, 2ª Ed.,Wiley, Chichester, 2002.
7. R. M. Silverstein; F.X. Webster; D. Kiemle, SPECTROMETRIC IDENTIFICATION OF ORGANIC COMPUNDS, 7ª ed., Wiley & Sons, Nueva York, 2005
8. D. W. Williams; I. FLEMING, SPECTROSCOPIC METHODS IN ORGANIC CHEMISTRY, 6ª Ed., McGraw-Hill, Londres, 2007.

Journals

Organic Syntheses: http://www.orgsyn.org/
The Journal of Organic Chemistry: http://pubs.acs.org/journal/joceah
Organic Syntheses: http://www.orgsyn.org/
The Journal of Organic Chemistry: http://pubs.acs.org/journal/joceah
Organic Letters: http://pubs.acs.org/journal/orlef7
European Journal of Organic Chemistry: http://www3.interscience.wiley.com/journal/27380/home
Tetrahedron: http://www.sciencedirect.com/science/journal/00404020
Organic and Biomolecular Chemistry: http://www.rsc.org/Publishing/Journals/Ob/Index.asp
The Journal of Chemical Education: http://jchemed.chem.wisc.edu/
Organic Letters: http://pubs.acs.org/journal/orlef7
European Journal of Organic Chemistry: http://www3.interscience.wiley.com/journal/27380/home

Web sites of interest

Organic Chemistry Portal: http://www.organic-chemistry.org/
Organic Resources Wordwide: http://www.organicworldwide.net/
Organic compounds database: http://pubchem.ncbi.nlm.nih.gov/ , http://www.chemspider.com/

OBSERVATIONS

(for more information, see the Student Guide)

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GQUIMI30 - Bachelor`s Degree in Chemistry	Year	Second year

COURSE

COURSE	Credits, ECTS:
26117 - Physical Chemistry I	9

COURSE DESCRIPTION

The subject will deepen and extend the knowledge acquired in the General Chemistry II course about the study of the macroscopic behavior of the matter in areas related to the Chemical Thermodynamics, Chemical Kinetics and Electrochemical Phenomena. Also, students will acquire the theorical and applicated knowledge of different areas of Physical Chemistry such as, Transport Phenomena, Surface Phenomena and Macromolecular and Colloidal Systems. The experimental part of this subject will be supplemented in the so-called Experiments in Physical Chemistry.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Specific Skills:
1. (M02CM01) Understanding and managing the principles of physical chemistry and their influence on chemical processes
2. (M02CM05) Understanding the relationships between structure, properties and processing of the different types of materials and their selection based on the intended applications.

Transversal Skills:
3. (M02CM09) To be able to explain orally and in writing, in an understandable way, phenomena and processes related to Chemistry and related subjects.
4. (M02CM10) To be able to search and select information in the field of Chemistry and other scientific fields making use of the bibliography and information and communication technologies.
5. (M02CM11) To be able to relate Chemistry with other disciplines, as well as understand its impact on current society and the importance of the chemical sector.

Theoretical and Practical Contents

Chemical thermodynamic. Maxwell Relations. Reaction enthalpy, entropy, Gibbs energy: Use of thermodynamic tables. Chemical potentilas. Material equilibrium conditions.
Real disolutions. Fugacity of real gases mixtures. Partial molar magnitude. Activity coeficients. Henry`s law. Electrolite solutions. Debye-Hückel`s limiting law.

Phase equilibrium in multycomponents system . Phase diagram in multycomponents system : liquid-liquid, liquid-vapor:azeotrops, solid-liquid:eutectics.

Chemical equilibrium in real systems. Chemical equilibrium in ideal and real gases. Heterogeneous equilibria. Solution equilibria.

Electrochemical equilibria. Electrochemical systems. Electrochemical potemtial. Electrochemical cells. Standard electrode potential. Electrochemical cell types. Determination of thermodynamic properties. Fuel cells.

Surface phenomena. Surface tension. Capillarity. Surface films. Adsorption: chemisorption and physisorption. Adsorption isotherms.
Transport phenomena. Kinetic model of gases and transport properties. Viscosity. Thermic conductivity. Ionic solutions electric conductivity.

Chemical kinetic. Formal kinetic. Mechanism of chemical reactions. Reversible reactions, branched chains reactions and consecutive reactions. Unbranched and branched chain reactions.
Homogeneous catalysis. Heterogeneous catalysis. Enzymatic catalysis. Electrodic kinetic.

Introduction of macromolecules and colloids. Polymers and polymerization. Molar average masses and methods of determination. Conformation and configuration of macromolecules. Properties of Colloids: Classification and preparation. Structure and stability. Micelle formation. The electrical double layer.

TEACHING METHODS

The theoretical explanation of the topics will be done through master classes (M) supported by egela, where all the necessary material to follow the classes will be available. The theoretical concepts developed will be applied to practical cases by completing problems in classroom practices (GA). The seminars (S) will work accordinto to the research-based

Universidad del País Vasco / Euskal Herriko Unibertsitatea

learning methodology (RBL) applied to one of the development and sustainable objectives in accordance with the ikd3 project guidelines.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	45	5	40						
Horas de Actividad No Presencial del Alumno/a	67,5	7,5	60						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 75%
- Exercises, cases or problem sets 15%
- Teamwork assignments (problem solving, Project design) 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The continuous evaluation (classroom practices and seminars) accounts for 25% of the final grade and the student must sit all the tests evaluated.
Continuous assessment will consist of the student carrying out activities (for example problem solving or taking tests or questionnaires) in classroom practices, as well as discussing questions in small groups in seminars.
To complete the grade, there will be a final written exam at the end of each semester (75%), on the dates set by the Faculty, where a minimum grade of 4 is required to average with the continuous evaluation. It will be enough not to appear to said final test so that the final grade of the subject is not presented or not presented.
To pass the subject, it is necessary to pass both parts.
In the exam corresponding to the official call, the same evaluation criteria previously set forth will be followed and the approved partial exams will be kept.
The student has 18 weeks from the start of the course to communicate to the teachers their resignation to continuous assessment. In this case, the evaluation will be done through a written test (100%) on the date of the ordinary call.
Unless otherwise indicated, during the development of an assessment test, the use of books, notes or notes, as well as telephone, electronic, computer or other devices or devices, by students will be prohibited.

In all cases, the evaluation will be carried out following the Protocol on academic ethics and the prevention of dishonest or fraudulent practices in the evaluation tests and in academic work at the UPV / EHU. In particular, the guidelines for action in the event of possible fraud, copying or plagiarism will be followed (Article 4).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In accordance with the regulations governing the evaluation of students in official degrees, the evaluation in the extraordinary call will be carried out exclusively through the final evaluation system. The positive results obtained by the students during the course will be kept, in the case of having obtained negative results through continuous evaluation, these results will not be maintained for the extraordinary call, in which the student will be able to obtain 100% of the grade.
Extraordinary evaluation test will consisted of evaluation activities comparable to those used in the ordinary call.
The use of books, notes, as well as telephone, electronic, computer, or other devices or devices by students will be forbidden, unless otherwise indicated by the faculty.

In all cases, the evaluation will be carried out following the Protocol on academic ethics and the prevention of dishonest or fraudulent practices in the evaluation tests and in academic work at the UPV / EHU. In particular, the guidelines for action in the event of possible fraud, copying or plagiarism will be followed (Article 4).

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

R.J.Silbey, R.A.Alberty, Kimika Fisikoa, Euskal Herriko Unibertsitatea, 2006.
I. R. Levine, Fisicoquímica, vols. 1 y 2. 5º ed. Ed. Mac Graw Hill, 2004.
P.Atkins, J.de Paula, Quimica Física, Ed. Panamericana, 2008.

Detailed bibliography

J. Bertrán, J. Núñez (coords.), Química Física, vols. 1 y 2, Ariel Ciencia, 2002.
J. A. Rodríguez Renuncio, J. J. Ruiz Sánchez, J. S. Urieta Navarro, Termodinámica Química, Ed. Síntesis, 1999.
S. R. Logan, Fundamentos de Cinética Química, Ed. Addison Wesley-Iberoamericana, 2000.

Journals

Journal of Physical Chemistry
Journal of Chemical Physics
Journal of Chemical Education

Web sites of interest

http://bcs.whfreeman.com/pchem8e
http://www.shu.ac.uk/schools/sci/chem/tutorials/
http://scidiv.bcc.ctc.edu/s/s.html.
http://riodb01.ibase.aist.go.jp/sdbs/cgi-bin/cre_index.cgi
http://webbook.nist.gov/chemistry

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GQUIMI30 - Bachelor`s Degree in Chemistry	**Year**	Third year

COURSE

26123 - Physical Chemistry II	**Credits, ECTS:** 9

COURSE DESCRIPTION

The main goal of the subject is the study of chemical-physical systems from a microscopic point of view, in such a way that the individual properties of the atomic-molecular systems that constitute matter can be related to their macroscopic properties, previously studied in Physical Chemistry I. For this, Quantum Chemistry is applied to study atoms and molecules, whose predicted properties from computational calculations, are compared with the experimental data obtained by several spectroscopic techniques. By means of Statistical Thermodynamics, different physicochemical features of the macroscopic systems are determined from their microscopic properties. Physical Chemistry II includes a series of Computer and Laboratory Practices that allow the student to perform quantum-mechanical simulations using computer programs and obtaining experimental data in systems of interest, respectively.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The student should be able to understand the principles of Quantum Chemistry, Spectroscopy and Statistical Thermodynamics and apply them to chemical processes. Likewise, the student must acquire skills in computational chemistry calculations and in the recording of spectra with conventional techniques. To get the ability to select different instrumental techniques, simple or combined, for the characterization of chemical substances.
The above tasks will be complemented with the following transversal competences:
-Being able to talk, in an understandable way, about phenomena and processes related to Chemistry and related subjects.
-Being able to relate Chemistry with other disciplines, as well as understand its impact on today's society and the importance of the industrial chemical sector.

Theoretical and Practical Contents

1. Quantum Chemistry. Fundamentals: wave function and Schrödinger equation. Uncertainty principle
2. Quantum Chemistry. Application to the study of simple systems: Translational movement. Vibrational movement. Angular momentum and rotational movement
3. Atomic structure: Hydrogen-like atoms. Polyelectronic atoms: The Variational Method. Pauli exclusion principle. Hartree-Fock method. Spectral term symbols
4. Molecular Structure: Molecular orbital theory. Electronic configurations. Molecular term symbols. Computational Quantum Chemistry.
5. Fundamentals of Spectroscopy: Radiation-matter interaction. Absorption and emission phenomena. Raman effect. Rotational spectroscopies: microwave and Raman spectra in diatomic molecules.
6. Vibrational spectroscopies: IR and Raman spectra of vibration in diatomic molecules. Rotational structure. Normal modes of vibration. IR and Raman spectra in polyatomic molecules. Characteristic bands of functional groups.
7. Electronic spectroscopy: Absorption spectra in diatomic molecules. Chromophores. Charge transfer complexes. Fluorescence and phosphorescence. Quantum yield and lifetime. Lasers. UV and X-ray photoelectron spectra
8. Resonance spectroscopies: Basics of nuclear magnetic resonance and electron spin resonance. Chemical shifts and spin-spin coupling.
9. Statistical Thermodynamics: Fundamentals. Molecular partitions functions. Canonical partition function. Calculation of thermodynamic quantities. Equilibrium constant.

Computational Practices: practices in Computational Chemistry.

Laboratory Practices: practices in FT-IR, UV / Vis absorption and fluorescence spectroscopies.

TEACHING METHODS

Physical Chemistry II consists of classroom sessions, where theoretical aspects are developed, problems are addressed and seminars of the subject are established, as well as computational practices and experimental practices

Computer and laboratory practices are mandatory.

Computational practices (quantum-mechanical calculations) will be carried out over the first semester.

Laboratory practices (spectroscopy) will be carried out throughout the second semester.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	34	5	15	26	10				
Horas de Actividad No Presencial del Alumno/a	51	7,5	22,5	39	15				

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 75%
- Exercises, cases or problem sets 10%
- Individual assignments 10%
- Teamwork assignments (problem solving, Project design) 5%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

- Final test and other classroom activities: 75% of the grade
- Computational and laboratory practices (including reports): 25% of the grade.

In any case, it is necessary to obtain at least 35% of each part to pass the subject.
Not attending to the ordinary exam is sufficient to resign the subject.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The same items as in the ordinary call. The qualifications obtained during the computational practices and in the laboratory will be saved for the extraordinary exam.

Not attending to the ordinary exam is sufficient to resign the subject.

MANDATORY MATERIALS

Lab coat, lab glasses and lab notebook

BIBLIOGRAPHY

Basic bibliography

P. Atkins, J.de Paula, "Elements of Physical Chemistry", 6th ed. Oxford University Press, 2013.
P. Atkins, J.de Paula, "Química Física", 8th ed., Panamericana, 2008 / "Physical Chemistry", 11th ed., Oxford University Press, 2017.
I. N. Levine, "Physical Chemistry", 6th ed., Mac Graw Hill, 2009.
R.J.Silbey and R.A. Alberty, "Kimika Fisikoa", Euskal Herriko Unibertsitatea, 2006.
E.H. Brittain, W.O. George and C.H. Well, "Introduction to Molecular Spectroscopy. Theory and Experiment", Academic Press, 1970.
Practical Reports, UPV/EHU

Detailed bibliography

A. Requena and J. Zúñiga, "Espectroscopía", Pearson Prentice-Hall, 2004.
J.M. Hollas, "Modern Spectroscopy" (4th ed.), Wiley, 2003.
J. Bertran, V. Branchadell, M. Moreno and M. Sodupe, "Química Cuántica", Síntesis, 2002.
A.M. Harlpern, "Experimental Physical Chemistry. A Laboratory Textbook", 3rd ed., Prentice, 2006.

Journals

Journal of Chemical Education
Education in Chemistry
Journal of Physical Chemistry

Web sites of interest

http://riodb01.ibase.aist.go.jp/sdbs/cgi-bin/cre_index.cgi
http://webbook.nist.gov/chemistry

http://www.chemtube3d.com
https://ocw.mit.edu/courses/chemistry/5-61-physical-chemistry-fall-2007/lecture-notes/
https://chem.libretexts.org/Core/Physical_and_Theoretical_Chemistry

OBSERVATIONS

During the writing exam, only the usual writing material and a scientific calculator is allowed unless otherwise is indicated.

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GQUIMI30 - Bachelor`s Degree in Chemistry	Year	First year

COURSE

26135 - General Chemistry II	Credits, ECTS:	6

COURSE DESCRIPTION

"General Chemistry II" is a basic subject of the first year of the Degree in Chemistry and the Degree in Chemical Engineering. It forms part of the fundamental module and is a complement to the subject of the same course "General Chemistry I" (first semester). These two subjects are the basis of the chemistry subjects of the basic module.

The theoretical contents of "General Chemistry II" are put into practice in the subject of the first year of the Degree in Chemistry "Experimental Methodology in Chemistry".

The first part of the subject begins with the study of two of the main fields of Chemistry such as Kinetics and Thermodynamics. Regarding the first one, the necessary knowledge about the rate of reactions is acquired, which allows carrying out experimental studies on this subject. Thermodynamics is the main tool to carry out studies on the energetic changes that accompany chemical and physical processes, as well as to address the study of equilibrium and spontaneity of the processes. In fact, the study of the equilibrium state is deepened, which includes the chemical equilibrium itself and the equilibrium between phases in one-component systems. From a professional point of view, with these tools, we can find out how fast a product can be obtained industrially, what energy is needed to produce it, or what is the performance of the process in question. In addition, we can also determine which are the most appropriate conditions to optimize these parameters.
The second part of the subject deals with the study of equilibria in solution. As an introductory way, the dependence of the equilibrium constants with the ionic force is described, and the concentration constants are introduced, as well as the characteristic terminology of the different types of reactions involved in the equilibria. It then goes on to describe the four fundamental pillars on which chemistry in solution is based: acid-base reactions, complex formation, precipitation and finally oxidation-reduction reactions. For the four types of reactions, the numerical and graphical methodologies that allow solving the chemical problems of equilibrium in solution are explained.

"General Chemistry II" is the starting point for other subjects of higher courses. Specifically, in the Degree in Chemistry three subjects from the basic module of the second year: "Physical Chemistry I", "Experimentation in Physical Chemistry" and "Analytical Chemistry I" and also subjects from the third year of the same degree. In the case of the Degree in Chemical Engineering, it is important to control the contents obtained in "General Chemistry II" to study the subjects "Applied Thermodynamics" and "Kinetics of Chemical Processes" in the second year of the degree.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

In this subject, the bases of Chemical Kinetics and Thermodynamics are studied, as well as Ionic Equilibria in Solutions.

COMPETENCIES
In this subject, the student develops the following competencies:
1.Understanding and use of the principles and basic theory of the chemical reaction of different types of substances.
2.Understanding and use of mathematical tools and data analysis processes in a scientific environment.
3.Capacity for observation, analysis and presentation of results in the field of chemistry and other experimental sciences
4.Knowledge and use of reference styles of scientific literature in oral and written communication.
5. Know the most frequent sources of information and documentation in experimental sciences and demonstrate their efficient use.

LEARNING RESULTS
The student achieves the following Learning Results related to the afore mentioned competencies:

Chemical kinetics
-Adequately interpretS the experimental results of a chemical reaction to quantify the reaction rate and to predict the reaction mechanism.

Thermodynamics
-AnalyzeS, calculateS and interpretS the energy changes that occur in chemical processes.
-Using the entropy concept predicts the direction and extent to which chemical and physical changes occur

Chemical/physical Equilibrium
-Using thermodynamic concepts, quantitatively and qualitatively describes the chemical equilibrium and the effect of

external factors on it.
- Evaluates and analyzes the conditions for phase changes to occur in pure substances and for these phases to be in equilibrium.
- Identifies the relationships between the different chemical equilibria and the variables that can change the equilibrium conditions.
- Predicts the reactions that take place (neutralization, titration, masking, coprecipitation, etc...) when mixing different substances in solution and deduces the majority species present at equilibrium.
- Handles the appropriate methodologies to solve numerically and graphically the problems associated with equilibria in solution

Theoretical and Practical Contents

The contents of the course "General Chemistry II" are theoretical and are applied through problem solving. In the Chemistry Degree, the laboratory practices related to these theoretical contents are developed in the subject "Experimental Methodology in Chemistry"

I. CHEMICAL KINETICS.
REACTION RATE. Factors that affect the rate of reaction. Differential velocity equation. Reaction order. Experimental methods to determine the rate of reaction. Initial velocity method. Integrated rate equations. half-reaction period. Influence of temperature on the reaction rate.

MECHANISMS OF CHEMICAL REACTIONS. elementary processes. Complex processes. Obtaining the rate equation consistent with a given mechanism: Approximation of the limiting stage. Steady state approximation. Collision theory: activation energy.Transition state theory. Energy profile of an elemental reaction and a complex reaction. Catalysis.

II. CHEMICAL THERMODYNAMICS.
THERMOCHEMISTRY. Job. Heat. First Law of thermodynamics. Internal energy and enthalpy. Experimental determination of heats of reaction. Calorimetry Enthalpies of reaction and standard formation. Link energies. Effect of temperature on the enthalpy of a reaction.

CHEMICAL THERMODYNAMICS. ENTROPY AND FREE ENERGY. Entropy concept. Calculation of entropy. Second principle of thermodynamics. Criterion of spontaneity and balance in a closed system. Entropy calculations for different types of processes. General condition of spontaneity and equilibrium: Gibbs free energy. Helmholtz free energy. Entropy at the molecular level. Third Principle. Gibbs free energy change of a reaction.Coupled reactions.

III. CHEMICAL EQUILIBRIUM. Chemical potential and material equilibrium. The equilibrium constant. Influence of temperature on the equilibrium constant. Modification of the equilibrium state. Chemical equilibrium in non-electrolytic solutions. Chemical equilibrium in electrolyte solutions.

IV. PHASE EQUILIBRIUM IN PURE SUBSTANCES. Liquid-vapour balance. Vapor pressure. Dependence of Pv with temperature. Solid-vapor equilibrium. Solid-liquid balance. Thermodynamic treatment of phase equilibria. Phase diagram. Critical state. Phase rule.

V. EQUILIBRIA IN DISSOLUTION. Types of equilibrium constants. Ionic force. Activity coefficients. Debye-Hückel theory.

ACID-BASE EQUILIBRIA. The role of the solvent. Acid-base behavior of water. Strength of acids and bases. Acid-base balance calculations. The mass balance. Electroneutrality equation. Proton balance equation. Numerical and graphic resolution of the acid-base balance. Weak monoprotic and polyprotic protoliths. Buffer solutions. Buffer capacity.

VI. COMPLEX FORMATION EQUILIBRIA. Description of the balance. Types of complexes. Monodentate and polydentate ligands. Addition complexes and chelates. Stability and inertia. Equilibrium constants: successive and global. Mass balance equations. Balance calculations. logarithmic diagrams. Influence of pH. Applications: Masking.

VII. PRECIPITATION EQUILIBRIA. Description of heterogeneous equilibrium. Solubility product. Solubility. Factors that affect solubility. saline effect. Common ion effect. parasitic reactions. logarithmic diagrams. Fractional precipitation. Influence of pH. Influence of complex formation reactions. Applications.

VIII. OXIDATION-REDUCTION EQUILIBRIA. Introduction. Standard electrode potential. Types of redox processes. Nersts equation. Equilibrium constant. Equilibrium potential. Redox system of water. Factors on the electrode potential. dismutation.

IX. SOLUTIONS. Types of solutions. Partial molar properties. Multicomponent systems and chemical potential. Thermodynamic properties of ideal solutions. non-ideal solutions. electrolyte solutions. Colligative properties.

TEACHING METHODS

The course includes master classes (M) where the theoretical concepts of each content are given. Group or individual activities can also be carried out so that the student can discuss the given contents.

In order to achieve the learning results of the subject, the master classes are complemented with classroom practices (GA) where in a reasoned way and analyzing data and results, practical problems are solved. The problems can be solved individually or in groups and the results are obtained together, always guided by the teacher. These problems constitute a model for the student on their own or in a group to solve similar situations that can be evaluated.

Likewise, seminars are held where doubts are resolved and unknown situations are evaluated, using the knowledge that the students are acquiring in their learning process and reasoning the ideas.

In the second part of the course, classes are taught in computer rooms (GO). Through the MEDUSA program, acid-base equilibria, complex formation, precipitation and oxidation-reduction exercises are solved graphically.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	5	20		5				
Horas de Actividad No Presencial del Alumno/a	45	7,5	30		7,5				

Legend:

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

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

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The general evaluation criteria are:
- Degree of knowledge of the contents
- Data analysis and critical achievement of results
- Use of scientific language
- Clarity in reasoning

The evaluable tasks required during the course are obligatory and consist of:
- Individual or group reports on the quantitative resolution of problems about chemical reactions and chemical equilibrium situations
- Individual or group questionnaires carried out both in person and on-line, focused on the development of the analysis and diagnosis of unknown situations.

The sum of the grade obtained in these two tasks will constitute 25% of the final grade.
- Final test, whose grade will account for 75% of the final grade.

Likewise, active attendance in face-to-face classes and participation in required tasks are taken into account.

For non-face-to-face evaluable tasks, the corresponding feedback is provided to promote the learning process. The tasks carried out in the face-to-face sessions, the feedback will be collective in said sessions.

To pass, 5 points out of 10 are required and it is a requirement to obtain a minimum of 4 points out of 10 in the final test, this score being balanced between all parts of the test.

If the minimum required grade is not achieved in the final test, the grade for the subject is the one obtained in said test.

If the final test grade is greater than or equal to the minimum required grade, the final grade constitutes 75% of the final test grade and 25% of the grade for the evaluable tasks carried out during the course.
If a student cannot perform the evaluable tasks scheduled during the course, the grade for the subject is the one obtained in the final test. If this is the case, the teaching staff must be notified in writing within the period stipulated by the evaluation regulations.

Failure to take the scheduled test means renunciation of the call.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

It consists of a written test and it is necessary to obtain a minimum of 5 points out of 10, this score being balanced between all the parts of the test.
If the grades obtained throughout the course are positive, they are taken into account and the final grade consists of 75% of said test and 25% of the tasks. On the contrary, if the grades for the tasks are negative, it is not taken into account in the final grade for the subject and this is 100% of the grade for the final test.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

- R.H. Petrucci, W.S. Harwood ,F.G. Herring, "Química General", (8. ed.), Prentice Hall, Madrid, 2003
- UEUko Kimika Saila, "Kimika Orokorra", Udako Euskal Unibertsitatea, 1996.
- P. Atkins, L. Jones, "Principios de Química. Los caminos del descubrimiento", (3. ed.), Médica Panamericana, 2009.
- A. J. Bard "Equilibrio Químico" Ediciones del Castillo, 1977.

Detailed bibliography

- D.W. Oxtoby, H.P.Gillis, N.H. Nachtrieb, "Principles of Modern Chemistry", (5. ed.), Brooks Cole, 2002.
- R. Levine, "Fisicoquímica", 1 eta 2 liburukiak, (5. ed.), Mac Graw Hill, 2004.
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- I.Urretxa , J.Iturbe, "Kimikako Problemak", Udako Euskal Unibertsitatea, 1999.
- Skoog, West, Holler, Crouch, "Fundamentos de Química Analítica", 8ª edición, Thomson, 2005.
-- M. Silva, J. Barbosa, "Equilibrios Iónicos y sus Aplicaciones Analíticas", Síntesis, 2002.

Journals

Web sites of interest

http://webbook.nist.gov/chemistry/
http://www.chem1.com/acad/webtext/virtualtextbook.html
http://www.buruxkak.org

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GQUIMI30 - Bachelor`s Degree in Chemistry	**Year**	Fourth year

COURSE

26699 - Interfaces and Colloids	**Credits, ECTS:**	6

COURSE DESCRIPTION

In the subject, the mechanical, thermodynamic and microscopic properties of the systems dominated by interfacial effects are studied from an applied chemical-physical point of view. The following interfaces are studied: gas-liquid, liquid-liquid, gas-solid and solid-liquid, and the importance of each of them in chemical systems will be evaluated. Thus, issues of such practical importance as detergency, the formation of foams, aerosols, the types of colloidal systems and their formation and stability mechanisms will be addressed in order to determine their applicability in fields such as food, cosmetics, industry of oil, etc. Finally, the main types and characteristics of nanostructures and nanomaterials are also shown. The theoretical contents are complemented by simple laboratory practices.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SPECIFIC SKILLS
-To be able to apply chemical-physical tools on systems dominated by interfacial effects.
-To be able to distinguish between the different types of interfaces in order to assess their importance on chemical systems.
-To recognize the different types of colloidal systems and their formation and stability mechanisms in order to determine their industrial applicability.
-To be able to describe the structure and properties of solid surfaces, as well as the characteristics of adsorbed molecules on them in order to differentiate their technological applications.
-To differentiate the main types and characteristics of nanostructures and nanomaterials and to evaluate their impact and projection in the technological scientific advance.

TRANSVERSAL SKILLS
-To explain orally and in a written way properly phenomena and processes related to Surface Chemistry.
-Use information and knowledge to train in new or emerging fields related to Chemistry.
-Interpret and discuss the most relevant results derived from the experimental activity and to make and present conclusions in the form of scientific-technical reports and oral presentations.
General skills in accordance with ANECA: M03CM02, M03CM09, M03CM11, M03CM12

Theoretical and Practical Contents

Surfaces and interfaces. Definition of surface and interface. Surface tension and measurement methods. Laplace and Kelvin equations. Curved surfaces and condensation.
Superficial adsorption in liquids. Adsorption. Magnitudes of superficial excess. Gibbs isotherm. Surface behavior of compounds. Monolayers
Colloidal systems. Types of colloidal systems. Structure and stability in colloidal systems. Emulsions. Foams. Aerosols. Associated colloids. Types of surfactants. Associated molecular systems. Micelles, microemulsions and membranes: characteristics and types. Industrial applications of micellar systems.
Solid surfaces. Adsorption on solids. Chemisorption and physisorption. Adsorption. Chemisorption: Langmuir and Freundlich isotherms. Phisisorption: BET isotherm. Speed of surface processes. Catalytic activity on surfaces
Nanostructure and nanomaterials. Types of nanostructures. Types of nanomaterials.

TEACHING METHODS

It will be based on master classes, accompanied by problem classes in which the proposed exercises will be discussed together. Works related to the science of colloids and surfaces will be proposed, in which it is intended to get deeper insight in aspects not addressed in the master classes. These works may be done individually or in pairs. Likewise, the practical aspects of this subject will be addressed in laboratory sessions, in which, detailed written reports will be required for the interpretation and treatment of the obtained results.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	33	6	15	6					
Horas de Actividad No Presencial del Alumno/a	49,5	9	22,5	9					

Legend:

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 40%
- Multiple choice test 10%
- Exercises, cases or problem sets 20%
- Teamwork assignments (problem solving, Project design) 20%
- Oral presentation of assigned tasks, Reading¿ 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Laboratory practices will be mandatory.
A minimum score of three points out of ten will be required in each of the types of evaluation activities indicated above in order to access the average and pass the course.
In accordance with the regulations governing the evaluation of students in official degrees, the evaluation tests must be kept by the department at least until the end of the following course. Likewise, not submitting to the final test will be graded as "not presented".
Nevertheless, students may be evaluated by a final evaluation system, regardless they have participated in the continuous evaluation system. To do this, students must submit (writing) to the faculty responsible for the subject the waiver of the continuous evaluation, in a period of 9 weeks from the beginning of the semester according to the academic calendar of the Faculty. This final evaluation test will consist of evaluation activities comparable to those used in the continuous evaluation system.
The use of books, notes, as well as telephone, electronic, computer, or other devices or devices by students will be forbidden, unless otherwise indicated by the faculty.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In accordance with the regulations governing the evaluation of students in official degrees, the evaluation in the extraordinary call will be carried out exclusively through the final evaluation system. The positive results obtained by the students during the course will be kept, in the case of having obtained negative results through continuous evaluation, these results will not be maintained for the extraordinary call, in which the student will be able to obtain 100% of the grade.
Extraordinary evaluation test will consisted of evaluation activities comparable to those used in the ordinary call.
The use of books, notes, as well as telephone, electronic, computer, or other devices or devices by students will be forbidden, unless otherwise indicated by the faculty.

In case on-line assesment is required:
Resources (if online): The tools to be used will be those available in eGela. It will be possible to have notes.
Note: When a student has connection problems at the time of completing any of the questionnaires, they must notify the teacher by email or in the BBC session during the test, in order to offer you an alternative way of communication.

If the teachers consider it appropriate, they can carry out an oral ratification of what has been done in the case of an online test. In all cases, the evaluation will be carried out following the Protocol on academic ethics and the prevention of dishonest or fraudulent practices in the evaluation tests and in academic work at the UPV / EHU. In particular, the guidelines for action in the event of possible fraud, copying or plagiarism will be followed (Article 4).

MANDATORY MATERIALS

Laboratory practices: Gown, glasses and laboratory notebook

BIBLIOGRAPHY

Basic bibliography

P. Atkins, J. de Paula, Química Física, 8ª ed., Panamericana, 2008

Ira N. Levine, Fisicoquímica, 5ª ed., McGraw Hill, 2004

Geoffrey Barnes y Ian Gentle, Interfacial Science ¿ An Introduction, Oxford Univ. Press, 2005.

Detailed bibliography

Drew Myers, Surfaces , interfaces and colloids, Principles and Applications, Wiley, 1999

Arthur W. Adamson y Alice P. Gast, Physical chemis¿try of Surfaces, 6th ed., Wiley-Interscience, 1997

Hans-Jürgen Butt, Karlheinz Graf, Michael Kappl, Physics and Chemistry of Interfaces, 2nd ed., Wiley-VCH, 2008

Journals

Journal of Chemical Education
Journal of Colloid and Interface Science
Advanced in Colloid and Interface Science
Langmuir

Web sites of interest

http://www.elsevier.com/wps/find/journaldescription.cws_home/622861/description#description

OBSERVATIONS

Universidad del País Vasco Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GQUIMI30 - Bachelor`s Degree in Chemistry	Year	Third year

COURSE

26700 - Environmental Chemistry	Credits, ECTS:	6

COURSE DESCRIPTION

Physicochemical tools (Thermodynamics, Quantum Chemistry, Spectroscopy and Kinetics) will be applied to the study of environmental compartments. In a first part, the processes in the atmosphere are studied, an optimal system that will enable the acquisition of the main physicochemical bases and the posterior extrapolation to other media. In each process, the associated problem of air pollution will also be studied: photochemical smog, acid rain, climate change and the decrease in the ozone layer. In a second part, the terrestrial systems, hydrosphere and lithosphere are treated together, studying the cycles of chemical entities in the hydrosphere and in the lithosphere, as well as the behavior and destination of pollutants according to their physicochemical characteristics. Finally, the influence of pollution on the biosphere will be considered.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SPECIFIC COMPETENCES
C1.- Develop the tools of Physical Chemistry (Thermodynamics, Quantum Mechanics-Spectroscopy and Kinetics) in their application to the environment: behavior of pollutants in the different compartments.
C2.- Analyze and synthesize the way to apply the tools to solve problems of chemical atmospheric contamination and terrestrial systems.
C3.- Seminar/Project.
C4.- Work as a team in the development of C3.
C5.- Develop awareness to contamination problems.

CROSS COMPETENCES:
Recognize which are the operating guidelines in a work team with the aim to tackle innovative projects in multidisciplinary environments.
To be able to explain, orally and written, in an understandable way phenomena and processes related to environmental chemistry, in basque and / or spanish and english.
Use information and knowledge to train in new existing or emerging fields related to Chemistry.

Theoretical and Practical Contents

I. Chemistry of the Atmosphere.
1. The atmosphere.
2. Air pollutants.
3. Photochemical properties of the tropospheric components.
4. Photochemical reactions in the troposphere: Photochemical Smog.
5. Transport of pollutants between phases.
6. Tropospheric aerosols.
7. Acid formation: Acid rain.
8. Greenhouse effect: Climate change.
9. Stratospheric chemistry: Decrease in the ozone layer.

II. Chemistry of Earth Systems.
10. Terrestrial systems: hydrosphere and lithosphere. Behavior and destination of pollutants in terrestrial systems.

TEACHING METHODS

Teaching Modality Proposal: Main Tasks:
C1-C2.- Expository classes (Program): Follow-up with questions and diagrams of the topics and / or exam.
C3 and C4.- Seminar / project: on a topic related to pollution.
C5.- Participation in group work, round tables, forums, class etc.
A field trip is proposed among several options: the Zabalgarbi incinerator, a thermal power plant, waste separation power plant (Amorebieta).

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	37	5	15						3
Horas de Actividad No Presencial del Alumno/a	55,5	7,5	22,5						4,5

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Individual assignments 60%
- Teamwork assignments (problem solving, Project design) 25%
- Oral presentation of assigned tasks, Reading¿ 15%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The waiver to the continuous assessment may be presented in writing to the teacher, within 9 weeks after the start of the course, in accordance with the regulations of 13th.March.2017.
Students who gave up on continuous assessment must take the final assessment system. This final test will consist of two parts: a written exam and, if the grade exceeds 4 points, an oral test.
- It is necessary to obtain a minimum of 5 points out of 10 to pass the course.
- Failure to present the fixed test supposes the waiver of the call.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation system of the extraordinary call will be similar to that of the final evaluation proposed in the ordinary call. A failure to appear to the final evaluation will automatically entail the renounce of the call.

MANDATORY MATERIALS

Available on the website e-Gela.

BIBLIOGRAPHY

Basic bibliography

J.E. Figueruelo y M. Marino Dávila: Química Física del Medio Ambiente. (Ed. Reverté, 2001 ó 2004).
X. Doménech y J. Peral: Química Ambiental de sistemas terrestres (Ed. Reverté, 2006).
X. Doménech: ¿Química de la Contaminación¿, Ed. Miraguano, 1999)
C. Baird: Química Ambiental .Ed. Reverté, 2001.)

Detailed bibliography

T:G: Spiro y W.M. Stigliani: Química Medioambiental (Pearson, Prentice Hall, 2003).
S Manahan: Environemental Chemistry (CRC Press, 1994).
J. Seinfeld y S. Pandis: Atmospheric Chemistry and Physycs(Wiley, 1998).
B. Finlayson-Pitts y J. Pitts: Chemistry of the Upper and Lower Atmosphere (Academic Press, 2000

Journals

Journal of Chemical Education
Environment Science &Technology
Medio Ambiente (Generalitat, Catalunya)
Ecologista

Web sites of interest

http://eippcb.jrc.es
http://acs.environmental.duq.edu/acsenv/envchem.htm
http://jwocky.gsfc.nasa.gov/
www.nbs.ac.uk/public/icd
www.epa.gov/airs/enved/trends/atm-10f.htm
www.sej.org/env_airp.htmwww.unfccc.de
www.globalchange.org/dgsample/samplei.htm
http://www.eia.doe.gov/aer

OBSERVATIONS

The continuous assessment system assumes compulsory class attendance, allowing three absences for medical reasons and three other unexcused absences.

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GQUIMI30 - Bachelor`s Degree in Chemistry	Year	Fourth year

COURSE

26701 - Chemistry of Polymers	Credits, ECTS:	6

COURSE DESCRIPTION

The aim of the subject is to introduce the student in the field of Polymer Chemistry, particularly in that of synthetic polymers, which today dominate the world of synthetic materials and they are, therefore, fundamental in the integral formation of a chemist. Special emphasis it will be placed on understanding the structure of polymers and the special properties derived from it. The main polymerization methods will be analyzed, as well as, their kinetics and the molecular characteristics that each method. Then, its solution properties will be studied, which will allow describing molecular weight characterization techniques, being of great importance from the point of view of their application. The study of its aggregation states: amorphous, crystalline and elastic, its morphology, properties and thermal transitions, will complete the general vision of the characteristics of these materials. Finally, the main methods of industrial transformation and the most relevant practical applications of these materials will be described. Likewise, a series of laboratory practices have been included that will allow for simple characterization operations that will facilitate the understanding of some fundamental concepts and particular characteristics of polymers.
For an adequate understanding of the subject, student needs to have previous training in the basic tools of physical chemistry (particularly, kinetics and thermodynamics) and know the rudiments of organic chemistry.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Specific skills

- C.E.1. Knowing effectively the characteristics of the different polymer synthesis and its kinetics, as well as the different molecular weight characterization methods, so that you can select the most appropriate method of synthesis and characterization of a specific sample.
- C.E.2. Recognize clearly between the different states of aggregation in which polymers can be found, as well as their characteristics and thermal transitions to evaluate the advantages or disadvantages of their use compared to other materials.
- C.E.3. Ability to understand and use experimental methods of analysis and characterization of the most representative properties of macromolecular substances, as well as to interpret the results derived from them in terms of the structure / properties relationship.
- C.E.4.To know the basic industrial transformation processes of polymers and their applications in order to evaluate their use in specific cases.
- C.E.5.Recognize, without doubt, the terminology proper to the field of polymeric materials so that you can easily consult the specific documentation of these materials.

Transversal skills
- C.T.1. Be able to explain orally and comprehensively, phenomena and processes related to Chemistry and related subjects, in Basque and / or Spanish and English.
- Competition C.T.2. Use the information and knowledge to train in new existing or emerging fields related to Chemistry.
- C.T.3. Demonstrate the ability to work as a team and to solve problems in multidisciplinary contexts.
- C.T.4. Possess those learning skills necessary to undertake further studies with a high degree of autonomy

General Skills according to ANECA: M03CM03, M03CM09, M03CM11, M03CM12

Theoretical and Practical Contents

- Structure and general characteristics of polymers
- Methods of synthesis: addition, polycondensation and copolymerization.
- Polymer solutions and characterization techniques
- States of aggregation, morphology and thermal transitions in polymers.
- Technology and applications of polymers.

There will be an exit to a company in the area of polymers or if it is not possible, there will be two laboratory practices related to the synthesis and characterization of the thermal behavior of polymers.

TEACHING METHODS

It will be based on master classes, accompanied by classroom practices in which the issues and exercises proposed will be discussed together. Tasks will be proposed, related to the science of polymers, in which it is intended to expand aspects not addressed in lectures; These tasks can be done individually or in groups. Likewise, the practical aspects of this subject will be addressed in the laboratory, so that in addition to the management of the instruments will require the preparation of detailed reports in which both the theoretical aspects and the interpretation and treatment of the results

obtained must be addressed.
The realization of the practices will have a mandatory character.
It will be necessary to reach a minimum score of three points out of ten in each of the types of evaluation activities indicated above in order to access the averaging and pass the subject.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	6	16	8					
Horas de Actividad No Presencial del Alumno/a	45	9	24	12					

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 50%
- Teamwork assignments (problem solving, Project design) 40%
- Oral presentation of assigned tasks, Reading¿ 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In accordance with the regulations governing the evaluation of students in the official degree programs, the assessment tests must be kept by the department at least until the end of the next academic year. Likewise, students may waive the call within one month before the end of the teaching period of the subject and in this case you will get the grade of not presented.
In addition, the student can be evaluated through the final evaluation system. To do so, he / she must submit in writing to the faculty responsible for the subject the waiver of the continuous evaluation, for which he / she will have a term of 9 weeks from the beginning of the quarter according to the academic calendar of the Faculty. Said final evaluation test will consist of evaluation activities comparable to those used in the continuous call.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In accordance with the regulations governing the evaluation of students in the official degree programs, the evaluation in the extraordinary call will be made exclusively through the final evaluation system. The positive results obtained by the students during the course will be retained, in the case of having obtained negative results through continuous evaluation, said results will not be maintained for the extraordinary call, in which the student will be able to obtain 100% of the grade. This extraordinary evaluation test will consist of evaluation activities comparable to those used in the ordinary call.

MANDATORY MATERIALS

Bata, gafas y cuaderno de laboratorio

BIBLIOGRAPHY

Basic bibliography

J. Areizaga, M.M. Cortázar, J.M. Elorza y J.J. Iruin. "Polímeros". Editorial Síntesis. Madrid. 2002.
I. Katime "Química Física Macromolecular". UPV. Bilbao. 1994.
I.Katime y C. Cesteros. "Química Física Macromolecular II. Disoluciones y Estado Sólido". UPV. Bilbao. 2002.
I. Katime. "Problemas de Química Física Macromolecular". UPV. Bilbao 1994.

Detailed bibliography

Bibliografía avanzada. G. Odian. ¿Principles of Polymerization¿. 4ª ed. Wiley-Interscience. Hoboken (N.J.). 2004.
Y. Gnanou, M. Fontanille. ¿Organic and Physical Chemistry of Polymers¿. Wiley.-Interscience. Hoboken (N.J.). 2008.
L.H. Sperling. "Introduction to Physical Polymer Science". John Wiley&Sons. New York. 2006.
H.F. Mark y N.M. Bikales (Ed.). "Encyclopedia of Polymer Science and Engineering". 19 volúmenes. John Wiley&Sons. New York 1985.

Journals

Macromolecules
Polymer
Macromolecular Chemistry and Physics
Journal of Polymer Science A y B
Journal of Chemical Education
Plásticos Modernos

Web sites of interest

Macrogalería:
http://pslc.ws/spanish/index.htm
Curso Básico intensivo de plásticos (CBIP):
http://www.jorplast.com.br/cbipep/cbip1ep.html
American Chemical Society Short Course in Polymer Chemistry:
http://www.chem.vt.edu/chem-dept/acs/index.html.
Polymer Chemistry Hypertext:
http://www.polymerchemistryhypertext.com/.
PLC:
http://plc.cwru.edu/tutorial/enhanced/main.htm
Plastics Knowledge:
http://www.plasticsknowledge.com/.

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GQUIMI30 - Bachelor`s Degree in Chemistry	**Year**	Fourth year

COURSE

26703 - Organometallic Chemistry — **Credits, ECTS:** 6

COURSE DESCRIPTION

The Organometallic Chemistry course will provide an introduction to the chemistry and structure of the most relevant types of organometallic compounds, that is, compounds containing one or more metal-carbon bonds. This course is optional for students in the fourth year of Chemistry.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

After completing the course, students will:

1. Master the basic concepts of organometallic chemistry.
2. Know the classification, synthetic methods, properties and reactivity of organometallic compounds.
3. Acquire fundamental knowledge on homogeneous catalysis.
4. Handle efficiently the bibliography and information sources within this field.
5. Have the ability to perform, present and defend works on specific topics of organometallic chemistry.
6. Have the ability to explain orally and in a comprehensive way, phenomena and processes in the chemistry area and related subjects both in Spanish and English.

Theoretical and Practical Contents

Introduction Definition, historical background, nomenclature, 18-electron rule.

Metal carbonyls: Synthesis, properties and reactivity.

Complexes with sigma metal-carbon bonds: Organyls, carbenes and carbynes. Synthesis, bonding and structure, reactivity and applications.

Complexes with pi metal-carbon bonds: Alkene, alkyne, allyl, cyclopentadienyls, arene complexes. Synthesis, bonding and structure, reactivity and applications

Organometallic reactions: Ligand substitution, oxidizing addition, reductive elimination, insertion reactions, electrophilic reactions.

Organometallic catalysis in synthesis and production: Homogeneous catalysis. Applications in organic synthesis.

TEACHING METHODS

This course is taught by a combination of lectures (M), seminars (S) and tutorials or classroom practices (GA). The latter ones will provide opportunities for discussion and interaction, often in smaller groups, and will help students to develop their knowledge and skills more actively than in a lecture. In addition, each student must read, understand, explain and present a current scientific article from the organometallic chemistry field.

If due to sanitary conditions face-to-face lessons were cancelled, then, online teaching through the Blackboard Collaborate virtual classroom and the eGela platform would be offered. These platforms would also be used for notifications, exam calls and tutorials. Likewise, the syllabus of the course and supplementary/training tasks would also be available in eGela.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	6	24						
Horas de Actividad No Presencial del Alumno/a	45	9	36						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 40%
- Exercises, cases or problem sets 30%
- Teamwork assignments (problem solving, Project design) 20%
- Oral presentation of assigned tasks, Reading¿ 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the continuous assessment system, the assessment consists of two blocks:

- A written exam (40% of the final mark).
- Assignments (problem solving, exercises, essays and presentations) made during the course (60% of the final mark).

A minimum of 4/10 is required in each of the two sections in order to calculate the overall mark by the weighted combination of the written exam and assignment marks. It is compulsory to sit the written exam to pass the course.

Students who do not wish be assessed following the continuous assessment system must formally request it to the lecturer before week 9 of the academic year. In the final assessment system, the assessment will be made based excusively on a final examination.

If any students cannot carry out the assessment in the terms described above due to sanitary conditions, they will have to follow the assessment guidelines issued by the Rectorate at the time of sitting the exam.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The grade for the course will be determined entirely by the mark obtained in a final written/oral exam.

If any students cannot carry out the assessment in the terms described above due to sanitary conditions, they will have to follow the assessment guidelines issued by the Rectorate at the time of sitting the exam.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

1.Astruc D., Química Organometálica, Editorial Reverté, Barcelona, 2003
2.Bochmann, M., Organometallics 1. Complexes with Transition Metal-Carbon s-Bonds, Oxford University Press, Oxford, 1994
3.Bochmann, M., Organometallics 2. Complexes with Transition Metal-Carbon p-Bonds, Oxford University Press, Oxford, 1994

Detailed bibliography

1.Crabtree, R.H. , The Organometallic Chemistry of the Transition Metals, John Wiley & Sons, New York, 1988
2.Elschenbroich C., Organometallics, 3ª ed, Wiley-VCH, Weinheim, 2006.
3.Hill, A. F., Organotransition Metal Chemistry, The Royal Society of Chemistry, Cambridge, 2002
4.Spessard, G. O. y Miessler, G. L., Organometallic Chemistry, Prentice Hall, Upper Saddle River, 1997
5.Whyman, R., Applied Organometallic Chemistry and Catalysis, Oxford University Press, Oxford, 2001

Journals

Organometallics
Inorganic Chemistry
Journal of the American Chemical Society
Angewandte Chemie
Journal of Organometallic Chemistry
Chemistry. A European Journal

Web sites of interest

http://www.ilpi.com/organomet/
http://chemistry.lsu.edu/stanley/Chem4571-stanley.htm
http://chemistry.lsu.edu/stanley/Chem-4571-Notes.htm

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GQUIMI30 - Bachelor`s Degree in Chemistry	Year	Fourth year

COURSE

26707 - Organic Synthesis	Credits, ECTS:	6

COURSE DESCRIPTION

In this course, a previous knowledge in the areas of Organic Chemistry, in particular those related to Chemical Synthesis, will be integrated to expand and deepen into the ideas, concepts and strategies that allow the preparation of complex substances. Special attention will be paid to the reactions that take place with control of stereoselectivity.

This course is based on the notions of reactivity acquired in "Organic Chemistry I" and "Organic Chemistry II", so it is highly advisable to have previously passed these two courses.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

LEARNING OUTCOMES OF THE ADVANCED MODULE that are worked on in this course:

1. CM07. Know how to apply the knowledge of structural analysis and organic reactivity to the synthesis of drugs and molecules of biological interest.
2. CM08. Design and plan experiments efficiently to solve real chemical problems.
3. CM09. Interpret and discuss the relevant results derived from the experimental activity and translate the conclusions in the form of scientific-technical reports and oral presentations.
4. CM11. Be able to explain both orally and in a written form, in a comprehensive manner, phenomena and processes related to Chemistry and related subjects, in Basque and / or Spanish and English.
5. CM18. Know the strategies that allow the design of synthetic processes for organic molecules, including the adequate methodology for the preparation of enantio-enriched substances.
6. G002. Manage appropriately the acquired knowledge and skills to recognize and analyze new problems and propose strategies to solve them.

Theoretical and Practical Contents

1. THE DESIGN OF ORGANIC SYNTHESES. RETROSYNTHETIC ANALYSIS. Introduction to Target-oriented Synthesis. The basics of retrosynthetic analysis: Disconnection, synthon, synthetic equivalent, transforms, retron. Retrosynthetic strategies. Identification of strategic bonds.

2. FUNCTIONAL GROUPS INTERCONVERSION. PROTECTIVE GROUPS. Addition of functional groups (activation). Oxidation level adjustments. Protective groups.

3. DISCONNECTIONS IN MONO- AND DIFUNCTIONALIZED COMPOUNDS. Types of synthons. Natural polarity. Single functional group C-X and C-C disconnections. Two-functional-group C-X and C-C disconnections (1.1, 1.3 and 1.5 relationships). Two-functional-group C-C disconnections (1,2, 1,4 and 1,6 relationships). Transition metal mediated cross coupling reactions. Polarity inversion. Reconnections Rearrangements and fragmentations. Carbon-carbon double bond disconnections.

4. SYNTHESIS OF CYCLIC COMPOUNDS. Cyclization reactions. Thorpe-Ingold effect. Baldwin rules. Three-membered ring formation; carbene intermediates. Four-, five- and six-membered ring formation; pericyclic and radical reactions. Ring expansion and ring contraction reactions. Formation of of cycles of 7 or greater members.

5. STEREOCONTROLLED REACTIONS. Generation and loss of stereogenic centers. Stereoselective and stereospecific reactions. Conformational and steric effects in chemical reactivity. Felkin-Ahn and Zimmerman-Traxler models. Asymmetric synthesis. Catalytic enantioselective reactions: Epoxidation, dihydroxylation, metal hydride carbonyl reduction and catalytic hydrogenation. Organocatalysis.

TEACHING METHODS

Lectures. The teacher will develop the subject explaining all those aspects required to facilitate the understanding and assimilation of the didactic material available to students (textbooks and on-line supplementary material, including exercises/problems).

Classroom exercises/discussions. Their purpose is to illustrate and to exercise the basic principles of the course. The starting point will be a series of exercises proposed by the teacher, where real problems are raised in the context of the preparation of complex molecules. The possible solutions will be discussed to determine the most appropriate one. The direct and personal participation of the students will serve to evaluate their progress, and this will be complemented with individually graded written tests. These tests will include the individual resolution of exercises and/or problems related to any aspect of the topics covered in the course.

Seminars. They will be used for the discussion of synthetic problems selected from the literature due to their special interest, difficulty or novelty. This will include the student presentation and discussion of the synthetic approach, as well as of the actual synthesis of the target molecules. The students performance will be taken as a partial measure of the degree of assimilation achieved throughout the course.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	6	24						
Horas de Actividad No Presencial del Alumno/a	45	9	36						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 50%
- Exercises, cases or problem sets 30%
- Oral presentation of assigned tasks, Reading¿ 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS EVALUATION:

- Resolution of exercises and problems. Weight in the final grade: 40%. A minimum of four points out of ten is required.

- Discussion and presentation of literature examples. Items to be graded will include the participation in the discussion and the quality of the personal work carried out (previous preparation, success in the resolution of the synthetic problem, degree of understanding and answers to the questions). Weight in the final grade: 10%. A minimum of four points out of ten is required.

- Written exam. Resolution of exercises and/or problems related to any aspect of the topics covered in the course. Weight in the final grade: 50%. A minimum of five points out of ten is required.

- Opting out of Continuous Evaluation. Students who wish to be evaluated through the final evaluation system must decline the option of continuous evaluation by writing presented to the teaching staff responsible for the course within a period of 12 weeks from the beginning of the semester in which the course is taught.

END-OF-COURSE EVALUATION:

- Written exam. Resolution of exercises and/or problems related to any aspect of the topics covered in the course. Weight in the final grade: 100%. A minimum of five points out of ten is required.

- Opting out. Failure to attend the exam will result in no evaluation (No Show).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

- Written exam. Resolution of exercises and/or problems related to any aspect of the topics covered in the course.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Basic textbooks (lecture and exercises):

- Carruthers, W.; Coldham, I. Modern Methods of Organic Synthesis, 4th ed., Cambridge University Press, 2004.

- Starkey, L. S. Introduction to Strategies for Organic Synthesis. Wiley: Hoboken N.J., 2012; 2nd ed. 2018.

Additional textbooks for exercises:

- Carda, M.; Marco, J. A.; Murga, J.; Falomir, E. Análisis Retrosintético y Síntesis Orgánica. Resolución de ejemplos prácticos. Editorial Universitat Jaume I: Castellón, 2010.

Detailed bibliography

- Warren, S.; Wyatt, P. Organic Synthesis: The Disconnection Approach; 2nd ed. Wiley: 2011.

- Clayden, J.; Greeves, N.; Warren, S.; Wothers, P. Organic Chemistry; Oxford University Press: New York, 2001; 2nd ed. 2012.

- Clayden, J.; Greeves, N.; Warren, S.; Wothers, P. Solution manual to accompany Organic Chemistry; Oxford University Press: New York, 2001.

- Wade, L. G. Organic Chemistry; Pearson Prentice Hall: New Jersey, 2010.

- Vollhardt, K. P. C.; Schore, N. E. Química Orgánica: Estructura y Función, 3rd ed.; Omega: Barcelona, 2007.

- McMurry, J. Organic Chemistry 7th Ed.; Brooks/Cole: Belmond, 2008.

- Quiñoá, E.; Riguera, R. Cuestiones y Ejercicios de Química Orgánica; Ed. McGraw Hill: Interamericana de España: Madrid, 1994.

- Vollhardt, K. P. C.; Schore N. E. Study Guide and Solutions Manual for Organic Chemistry, 3rd Ed.; W. H. Freeman and Co.: New York, 1999.

Journals

Advanced Synthesis and Catalysis: http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1615-4169
Angewandte Chemie International Edition: http://www3.interscience.wiley.com/journal/117943443/tocgroup
Chemical Communications: http://www.rsc.org/publishing/journals/CC/Article.asp?Type=CurrentIssue
Chemistry - A European Journal: http://onlinelibrary.wiley.com/doi/10.1002/chem.v18.30/issuetoc
Chemistry – An Asian Journal: http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1861-471X/issues
European Journal of Organic Chemistry: http://www3.interscience.wiley.com/journal/27380/home
Journal of Chemical Education:http://jchemed.chem.wisc.edu/
Journal of the American Chemical Society: http://pubs.acs.org/journal/jacsat
The Journal of Organic Chemistry: http://pubs.acs.org/journal/joceah
Organic and Biomolecular Chemistry: http://www.rsc.org/Publishing/Journals/Ob/Index.asp
Organic Letters: http://pubs.acs.org/journal/orlef7
Organic Syntheses: http://www.orgsyn.org/
Synthesis: http://www.thieme-connect.de/ejournals/journal/10.1055/s-00000084
Synlett: http://www.thieme-connect.com/products/ejournals/issue/eFirst/10.1055/s-00000083
Tetrahedron: http://www.sciencedirect.com/science/journal/00404020
Tetrahedron Letters: http://www.sciencedirect.com/science/journal/00404039%20

Web sites of interest

http://cheminf.cmbi.ru.nl/cheminf/ira/
http://www.internetchemistry.com/chemistry/retrosynthesis.htm
http://old.iupac.org/publications/compendium/index.html
Quiored: Recursos educativos en Química Orgánica: http://www.ugr.es/~quiored/
Organic Chemistry Portal: http://www.organic-chemistry.org/
Organic Resources Wordwide: http://www.organicworldwide.net/

Universidad del País Vasco Euskal Herriko Unibertsitatea

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GINQUI30 - Bachelor`s Degree in Chemical Engineering	Year	First year

COURSE

26111 - General Chemistry	Credits, ECTS:	6

COURSE DESCRIPTION

"General Chemistry I" is a mandatory course from the first year of the Degree in Chemistry and the Degree in Chemical Engineering. It is taught in the first semester and together with the subject of the same course "General Chemistry II" (second semester), it is the basis of the chemistry courses of the basic module.
Building upon the knowledge and capabilities already acquired by the student in his/her previous studies; this course focuses on the atoms and the classification of the elements in the periodic table, micro- and macroscopic properties of the elements and their compounds as well as on the different theories of the chemical bond and reactivity. The student will also learn the rules of nomenclature and formulation of both organic and inorganic compounds as well as basic concepts of isomerism in organic materials and the reactivity of the most important functional groups in organic chemistry.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIES
In this subject, the aim is that the student
1. Learns and uses the language of chemistry related to the designation and formulation of chemical elements and compounds.
2. Has a clear notion of the most basic aspects of Chemistry that are related to the laws of chemical combination, and the stoichiometry of chemical reactions.
3. Masters the basic concepts related to the composition, structure bonds in the subject.
4. Can handle the basic knowledge related to the structure and reactivity of the most common inorganic and organic chemical compounds.
5. Uses and relates the different experimental sciences for an understanding of chemical phenomena or conversion processes.
6. Knows the most common sources of information and documentation in experimental sciences.

LEARNING OUTCOMES
Students who have completed the requirements will
-Use correctly the chemical language related to the designation and formulation of inorganic and organic chemical elements and compounds, in accordance with the standard rules from the IUPAC.
-Identify the type of bond present in different chemical compounds and will be able to predict their structures and some of their micro- and macroscopic properties: acidity/basicity, states of aggregation, mechanical, electrical or magnetic properties...
-Recognize the main characteristics of atoms as constituent units of matter, the classification of the elements in the periodic table and their periodic properties.
-Evaluate and analyse both conformational and configurational isomerism in organic compounds with special emphasis on chiral compounds.
-Analyse the main types of organic reactions from an energetic and mechanistic point of view.

Theoretical and Practical Contents

1. Nomenclature in Inorganic Chemistry
Binary compounds of metals and non-metals. Acids. Oxoacids. Salts. Oxysalts. Coordination compounds.

2. Atomic structure.
Quantum Mechanics historical background. Wave-particle duality. Uncertainty principle. Schrödinger's equation. The Hydrogen atom. Quantum numbers. Atomic orbitals. Multielectronic atoms. Pauli's exclusion principle and orbital occupation. Hund's rules.

3. The Periodic Table of the Elements.
Atomic properties and their evolution across the Periodic Table. Periodic classification of the elements. The Periodic System. Size of atoms and ions. Ionization potential. Electronic affinity.

4. The chemical bond: theories and types of bonds.
Covalent bond: Valence bond theory. Lewis model. Hybridization. Molecular orbitals theory. Metallic bonding: Band theory. Ionic bond: Lattice energy; the Born-Haber cycle. Polarity. Intermolecular forces: Dipole-dipole interactions. Hydrogen bonds.

5. States of aggregation of matter.
Solids: properties, classification and structural models. Gases: Ideal gases. Kinetic-molecular theory. Maxwell-Boltzmann distribution. Real gases. Liquids: Properties; Brownian motion; kinetic theory; transport properties.

6. Nomenclature in Organic Chemistry
Hydrocarbons. Alcohols and ethers. Aldehydes and ketones. Carboxylic and acids and their derivatives. Nitrogen compounds. Heterocycles.

7. Structure and bond in organic molecules.
Lewis structures and formal charges. Molecular models. Structure and physical properties.

8. Isomerism in Organic Chemistry.
Concept and types. Constitutional (structural) isomerism. Stereoisomerism. Configurational isomerism. The concept of chirality. Enantiomers. Optical activity. Different types of chiral molecules. Organic molecules projection. Absolut configuration: sequential rules. Diastereoisomers. Racemates.

9. Main reaction types in Organic Chemistry.
Homolytic and heterolytic cleveage. Inductive and resonance effect / mesomers. Reaction intermediates. Nucleophiles and electrophiles. Acid-base nature of organic compounds.

TEACHING METHODS

The teaching will be given as lectures (M, 30 hours) which consist in theoretical lessons, classroom practices - consisting of solving problems and answering questions - (GA, 25 hours) and seminars (S, 5 hours), which delve into various key aspects of the subject.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	5	25						
Horas de Actividad No Presencial del Alumno/a	45	7,5	37,5						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

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

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The assessment tools used will be:
- Work done in the classroom, as well as the grading of the problems and assignments handed in: 30% of the final grade (minimum grade 4.0/10).
- Theoretical-practical written test: 70% of the final grade (minimum grade 4.0/10. This grade needs to be balanced all along the test).
- There will also be a formulation test that the student will have to pass in order to pass the whole subject.

The following aspects are evaluated in all the activities:
- Good formulation of questions
- Precision and coherence of the answers
- Clarity and reasoning

In this assessment system (30/70), the performance of the exercises proposed by the professor throughout the course will be compulsory.

If the student does not wish to be assessed in this modality, he/she may take a final test (100%) in the January call. To do this, he/she should present his/her withdrawal in writing to the professor before week 9.

Non-presentation at the final exam for the subject will be considered as withdrawal from the call.

Academic Ethics Protocol
During the evaluation tests, the use of books, notes or diagrams, as well as the use of telephones, computers or other electronic devices by the students will be prohibited [Only a calculator is allowed]. In the event of any dishonest or fraudulent practice, the protocol on academic ethics and prevention of dishonest or fraudulent practices in evaluation tests and academic works at the UPV/EHU will be applied.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The grade for the extraordinary call will be taken in its entirety from the grade obtained in the exam (100% exam).

Non-presentation at the final exam for the subject will be considered as withdrawal from the call.

Academic Ethics Protocol
During the evaluation tests, the use of books, notes or diagrams, as well as the use of telephones, computers or other electronic devices by the students will be prohibited [Only a calculator is allowed]. In the event of any dishonest or fraudulent practice, the protocol on academic ethics and prevention of dishonest or fraudulent practices in evaluation tests and academic works at the UPV/EHU will be applied.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

- R.H. Petrucci, F.G. Herring, J.D. Madura and C. Bissonnette. "General Chemistry: Principles and Modern Applications", (11th ed.), Pearson Prentice Hall, Upper Saddle River, NJ. 2011.
- P. Atkins, L. Jones and L. Laverman. "Chemical Principles", (7th ed.), W. H. Freeman Ed., New York, 2016.

Detailed bibliography

- Chang, R. and Goldsby, K. "Chemistry", (11th ed.) McGraw-Hill Education, New York, 2014.
- "Chemsitry. A project of the American Chemical Society". W. H. Freeman Ed., New York, 2004.
- D.W. Oxtoby and N.H. Nachtrieb. "Principles of Modern Chemistry", (5th ed.), W. H. Freeman Ed., New York, 2010.
- J.C. Kotz, P.M. Treichel and J.M. Townsend. "Chemistry and Chemical Reactivity" (7th ed.), Brooks/Cole Publishing, Salt Lake City, UT, 2009.
- M.S. Silberberg. "Principles of General Chemsitry" McGraw-Hill Education, New York, 2006.
- K. P. C. Vollhardt "Organic Chemistry" (4th ed.), W. H. Freeman Ed., London, UK, 2002.
- L. G. Wade. "Organic Chemistry" (6th ed.) Pearson Prentice Hall, Upper Saddle River (NJ), USA. 2006.
- N.G. Connelly and T. Damhus. "Nomenclature of Inorganic Chemistry: IUPAC Recommendations ". IUPAC Red Book; RSC Publishing, London, 2005.
- H. A Favre and W. H Powell. "Nomenclature of Organic Chemistry: IUPAC Recommendations ". IUPAC Blue Book; RSC Publishing, London, 2014.

Journals

Journal of Chemical Education

Web sites of interest

http://webbook.nist.gov/chemistry
http://www.chem.ox.ac.uk/vrchemistry/
http://www.800mainstreet.com/1/0001-000-TOC.html
http://www.webelements.com/

OBSERVATIONS

Universidad del País Vasco · Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GINQUI30 - Bachelor`s Degree in Chemical Engineering	**Year**	First year

COURSE

26135 - General Chemistry II	**Credits, ECTS:**	6

COURSE DESCRIPTION

"General Chemistry II" is a basic subject of the first year of the Degree in Chemistry and the Degree in Chemical Engineering. It forms part of the fundamental module and is a complement to the subject of the same course "General Chemistry I" (first semester). These two subjects are the basis of the chemistry subjects of the basic module.

The theoretical contents of "General Chemistry II" are put into practice in the subject of the first year of the Degree in Chemistry "Experimental Methodology in Chemistry".

The first part of the subject begins with the study of two of the main fields of Chemistry such as Kinetics and Thermodynamics. Regarding the first one, the necessary knowledge about the rate of reactions is acquired, which allows carrying out experimental studies on this subject. Thermodynamics is the main tool to carry out studies on the energetic changes that accompany chemical and physical processes, as well as to address the study of equilibrium and spontaneity of the processes. In fact, the study of the equilibrium state is deepened, which includes the chemical equilibrium itself and the equilibrium between phases in one-component systems. From a professional point of view, with these tools, we can find out how fast a product can be obtained industrially, what energy is needed to produce it, or what is the performance of the process in question. In addition, we can also determine which are the most appropriate conditions to optimize these parameters.
The second part of the subject deals with the study of equilibria in solution. As an introductory way, the dependence of the equilibrium constants with the ionic force is described, and the concentration constants are introduced, as well as the characteristic terminology of the different types of reactions involved in the equilibria. It then goes on to describe the four fundamental pillars on which chemistry in solution is based: acid-base reactions, complex formation, precipitation and finally oxidation-reduction reactions. For the four types of reactions, the numerical and graphical methodologies that allow solving the chemical problems of equilibrium in solution are explained.

"General Chemistry II" is the starting point for other subjects of higher courses. Specifically, in the Degree in Chemistry three subjects from the basic module of the second year: "Physical Chemistry I", "Experimentation in Physical Chemistry" and "Analytical Chemistry I" and also subjects from the third year of the same degree. In the case of the Degree in Chemical Engineering, it is important to control the contents obtained in "General Chemistry II" to study the subjects "Applied Thermodynamics" and "Kinetics of Chemical Processes" in the second year of the degree.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

In this subject, the bases of Chemical Kinetics and Thermodynamics are studied, as well as Ionic Equilibria in Solutions.

COMPETENCIES
In this subject, the student develops the following competencies:
1.Understanding and use of the principles and basic theory of the chemical reaction of different types of substances.
2.Understanding and use of mathematical tools and data analysis processes in a scientific environment.
3.Capacity for observation, analysis and presentation of results in the field of chemistry and other experimental sciences
4.Knowledge and use of reference styles of scientific literature in oral and written communication.
5. Know the most frequent sources of information and documentation in experimental sciences and demonstrate their efficient use.

LEARNING RESULTS
The student achieves the following Learning Results related to the afore mentioned competencies:

Chemical kinetics
-Adequately interpretS the experimental results of a chemical reaction to quantify the reaction rate and to predict the reaction mechanism.

Thermodynamics
-AnalyzeS, calculateS and interpretS the energy changes that occur in chemical processes.
-Using the entropy concept predicts the direction and extent to which chemical and physical changes occur

Chemical/physical Equilibrium
-Using thermodynamic concepts, quantitatively and qualitatively describes the chemical equilibrium and the effect of

external factors on it.
- Evaluates and analyzes the conditions for phase changes to occur in pure substances and for these phases to be in equilibrium.
- Identifies the relationships between the different chemical equilibria and the variables that can change the equilibrium conditions.
- Predicts the reactions that take place (neutralization, titration, masking, coprecipitation, etc...) when mixing different substances in solution and deduces the majority species present at equilibrium.
- Handles the appropriate methodologies to solve numerically and graphically the problems associated with equilibria in solution

Theoretical and Practical Contents

The contents of the course "General Chemistry II" are theoretical and are applied through problem solving. In the Chemistry Degree, the laboratory practices related to these theoretical contents are developed in the subject "Experimental Methodology in Chemistry"

I. CHEMICAL KINETICS.
REACTION RATE. Factors that affect the rate of reaction. Differential velocity equation. Reaction order. Experimental methods to determine the rate of reaction. Initial velocity method. Integrated rate equations. half-reaction period. Influence of temperature on the reaction rate.

MECHANISMS OF CHEMICAL REACTIONS. elementary processes. Complex processes. Obtaining the rate equation consistent with a given mechanism: Approximation of the limiting stage. Steady state approximation. Collision theory: activation energy.Transition state theory. Energy profile of an elemental reaction and a complex reaction. Catalysis.

II. CHEMICAL THERMODYNAMICS.
THERMOCHEMISTRY. Job. Heat. First Law of thermodynamics. Internal energy and enthalpy. Experimental determination of heats of reaction. Calorimetry Enthalpies of reaction and standard formation. Link energies. Effect of temperature on the enthalpy of a reaction.

CHEMICAL THERMODYNAMICS. ENTROPY AND FREE ENERGY. Entropy concept. Calculation of entropy. Second principle of thermodynamics. Criterion of spontaneity and balance in a closed system. Entropy calculations for different types of processes. General condition of spontaneity and equilibrium: Gibbs free energy. Helmholtz free energy. Entropy at the molecular level. Third Principle. Gibbs free energy change of a reaction.Coupled reactions.

III. CHEMICAL EQUILIBRIUM. Chemical potential and material equilibrium. The equilibrium constant. Influence of temperature on the equilibrium constant. Modification of the equilibrium state. Chemical equilibrium in non-electrolytic solutions. Chemical equilibrium in electrolyte solutions.

IV. PHASE EQUILIBRIUM IN PURE SUBSTANCES. Liquid-vapour balance. Vapor pressure. Dependence of Pv with temperature. Solid-vapor equilibrium. Solid-liquid balance. Thermodynamic treatment of phase equilibria. Phase diagram. Critical state. Phase rule.

V. EQUILIBRIA IN DISSOLUTION. Types of equilibrium constants. Ionic force. Activity coefficients. Debye-Hückel theory.

ACID-BASE EQUILIBRIA. The role of the solvent. Acid-base behavior of water. Strength of acids and bases. Acid-base balance calculations. The mass balance. Electroneutrality equation. Proton balance equation. Numerical and graphic resolution of the acid-base balance. Weak monoprotic and polyprotic protoliths. Buffer solutions. Buffer capacity.

VI. COMPLEX FORMATION EQUILIBRIA. Description of the balance. Types of complexes. Monodentate and polydentate ligands. Addition complexes and chelates. Stability and inertia. Equilibrium constants: successive and global. Mass balance equations. Balance calculations. logarithmic diagrams. Influence of pH. Applications: Masking.

VII. PRECIPITATION EQUILIBRIA. Description of heterogeneous equilibrium. Solubility product. Solubility. Factors that affect solubility. saline effect. Common ion effect. parasitic reactions. logarithmic diagrams. Fractional precipitation. Influence of pH. Influence of complex formation reactions. Applications.

VIII. OXIDATION-REDUCTION EQUILIBRIA. Introduction. Standard electrode potential. Types of redox processes. Nersts equation. Equilibrium constant. Equilibrium potential. Redox system of water. Factors on the electrode potential. dismutation.

IX. SOLUTIONS. Types of solutions. Partial molar properties. Multicomponent systems and chemical potential. Thermodynamic properties of ideal solutions. non-ideal solutions. electrolyte solutions. Colligative properties.

TEACHING METHODS

The course includes master classes (M) where the theoretical concepts of each content are given. Group or individual activities can also be carried out so that the student can discuss the given contents.

In order to achieve the learning results of the subject, the master classes are complemented with classroom practices (GA) where in a reasoned way and analyzing data and results, practical problems are solved. The problems can be solved individually or in groups and the results are obtained together, always guided by the teacher. These problems constitute a model for the student on their own or in a group to solve similar situations that can be evaluated.

Likewise, seminars are held where doubts are resolved and unknown situations are evaluated, using the knowledge that the students are acquiring in their learning process and reasoning the ideas.

In the second part of the course, classes are taught in computer rooms (GO). Through the MEDUSA program, acid-base equilibria, complex formation, precipitation and oxidation-reduction exercises are solved graphically.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	5	20		5				
Horas de Actividad No Presencial del Alumno/a	45	7,5	30		7,5				

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

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

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The general evaluation criteria are:
- Degree of knowledge of the contents
- Data analysis and critical achievement of results
- Use of scientific language
- Clarity in reasoning

The evaluable tasks required during the course are obligatory and consist of:
- Individual or group reports on the quantitative resolution of problems about chemical reactions and chemical equilibrium situations
- Individual or group questionnaires carried out both in person and on-line, focused on the development of the analysis and diagnosis of unknown situations.

The sum of the grade obtained in these two tasks will constitute 25% of the final grade.
- Final test, whose grade will account for 75% of the final grade.

Likewise, active attendance in face-to-face classes and participation in required tasks are taken into account.

For non-face-to-face evaluable tasks, the corresponding feedback is provided to promote the learning process. The tasks carried out in the face-to-face sessions, the feedback will be collective in said sessions.

To pass, 5 points out of 10 are required and it is a requirement to obtain a minimum of 4 points out of 10 in the final test, this score being balanced between all parts of the test.

If the minimum required grade is not achieved in the final test, the grade for the subject is the one obtained in said test.

If the final test grade is greater than or equal to the minimum required grade, the final grade constitutes 75% of the final test grade and 25% of the grade for the evaluable tasks carried out during the course.
If a student cannot perform the evaluable tasks scheduled during the course, the grade for the subject is the one obtained in the final test. If this is the case, the teaching staff must be notified in writing within the period stipulated by the evaluation regulations.

Universidad del País Vasco / Euskal Herriko Unibertsitatea

Failure to take the scheduled test means renunciation of the call.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

It consists of a written test and it is necessary to obtain a minimum of 5 points out of 10, this score being balanced between all the parts of the test.
If the grades obtained throughout the course are positive, they are taken into account and the final grade consists of 75% of said test and 25% of the tasks. On the contrary, if the grades for the tasks are negative, it is not taken into account in the final grade for the subject and this is 100% of the grade for the final test.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

- R.H. Petrucci, W.S. Harwood ,F.G. Herring, "Química General", (8. ed.), Prentice Hall, Madrid, 2003
- UEUko Kimika Saila, "Kimika Orokorra", Udako Euskal Unibertsitatea, 1996.
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- M.S.Silberberg, "Química General", McGraw Hill, México, 2002.
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-- M. Silva, J. Barbosa, "Equilibrios Iónicos y sus Aplicaciones Analíticas", Síntesis, 2002.

Journals

Web sites of interest

http://webbook.nist.gov/chemistry/
http://www.chem1.com/acad/webtext/virtualtextbook.html
http://www.buruxkak.org

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GINQUI30 - Bachelor`s Degree in Chemical Engineering	**Year**	Fourth year

COURSE

26738 - Risk & Safety Analysis in Industrial Plants	**Credits, ECTS:**	4,5

COURSE DESCRIPTION

All around the world, the chemical industries have to implement Safety Management Systems in order to evaluate the risks of the process and equipment. The students receive training in the methodology of identification, evaluation and minimization of safety risk at work. The students also receive training on chemicals safety, basic biological safety, and management of accident and chemical emergencies.
The subject is structured in three segments:
i)risk evaluation methods,
ii)specific risks of fires and explosions, and spillage of chemical agents and biological agents.
iii)preparation of emergency plans and implementation of Sfaety Management Systems.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCES:

Basic knowledge of the safety aspects of chemical process industries and risk analysis. Both design step and operational step are covered. Detailed competences are as follows:

1. Deployment of Safety Management Systems as per world standard ISO-45001 (supersedes OHSAS-18001).

2. Development the risk evaluation and analysis of chemical processes. Planning and implementation of audits to carry out the risk assessment of the industrial sites and to establish preventive actions as necessary to eliminate or minimize the risk of having an accident.

3. Selection of Personal Protective Equipment (PPE) and collective protection equipment (CPE).

Theoretical and Practical Contents

LESSON-1. INDUSTRIAL SAFETY TECHNIQUES. Concept and definition of industrial safety. Safety techniques. Health conditions at work. Signalling.
LESSON-2. ACCIDENTS IN INDUSTRIAL PLANTS. REAL CASES. Methodology of accident investigation. Statistical indicators of accidents. Notification and file of accidents. Analysis of effects and causes of mayor accidents.
LESSON-3. RISK ANALYSIS OF PROCESSES. Professional risks. Techniques for risk identification. Comparative methods, risk indexes and HAZOP method. Risk of chemical substances.
LESSON-4. INDUSTRIAL SAFETY AT PLANTS: FIRES AND EXPLOSIONS. Flammability. Confined explosions. Unconfined explosions. Storage tanks. Fires in liquids. Fire in dards. BLEVE processes and fire spheres.
LESSON-5. INDUSTRIAL SAFETY AT PLANTS: SPILLAGE OF DANGEROUS SUBSTANCES. Flow of spillage. Evaporation. Dispersion of gases and vapours. Risk in charging / discharging operations.
LESSON-6. HEALTH AT WORK: CHEMICAL, BIOLOGICAL AND PHYSICAL RISKS. Identification of contaminants. Measurement of exposition and assessment. Active and pasive systems. Individual and collective protection systems.
LESSON-7. EMERGENCY PLANS. Selfprotection Handbook. Preparation of emergency plans. Safety inspections. Safety Management Systems under ISO-45001.

TEACHING METHODS

The subject is structured in three segments with three topics in each segment. The whole content covers the risk evaluation and minimization together with the safety measures to avoid risk of fire, explosion and spillage of chemicals. Finally, the content explains the development of emergency plans and the deployment of Safety Management Systems.

The overall goal of the subject include the following objectives:

1. Basic training in the methodology of risk evaluation in industrial sites of chemcial sector.
2. Basic knowledge of the risks coming from fire, explosion and spillage of chemicals, in order to set up the safety measures for different kind of industrial sites.
3. Basic training in the management tools for safety planning, emergency measures and implementation of safety management systems.

In the seminar classes, the student will simulate safety inspections to audit the risk evaluation in industrial sites (chemical sectors and other related industries). The students work in teams to reach the following goals:

- Assesment and scope of the risk evaluation.
- Non-conformities and deviations as per safety concepts.

- Eficacy of training plan, maintenance plan and other issues found as root-causes of the accidents.

TYPES OF TEACHING

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

Legend:

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 50%
- Teamwork assignments (problem solving, Project design) 50%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the ordinary call, the continuous assessment system is done as follows:

- Written exam: 80% (this examination must be done in the place and time as scheduled by the ZTF/FCT. This information is available on the Web).

- Team work and practical cases: 20% (to be done during the seminar classes). The main topics are the risk analysis of cases of accidents in industrial plants, together with related topics on safety issues. The root-causes, the risk factors, the chain of events, the preventive actions and the corrective actions in order to avoid the repetition of the accident.

The resignation of this continuous evaluation system must be submitted in writing to the teacher before the end of the 9th week of the course. The final evaluation system means that the exam has the total percentage (100%) of the mark (qualification).

The student who resigns from the call will have the mark (qualification) of "Not presented". This sentence is applicable to students in both continuous or final evaluation systems.

Given the circumstances that sanitary conditions would prevent from face-to-face evaluation, if any student cannot carry out the assessment in the terms described above due to sanitary conditions, they will have to follow the assessment guidelines issued by the Rectorate at the time of sitting the exam.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary call the mark (qualification) is determined by a single written exam that includes issues to develop and practical cases. The exam must be done in the place and time as scheduled by the ZTF/FCT. This information is available on the Web.
The percentage of the written exam is 100% as per the current Regulation on Evaluation of the Students (Normativa de Evaluación del Alumnado).

It is considered that the student waives the call if not attending the final exam.

Given the circumstances that sanitary conditions would prevent from face-to-face evaluation, if any student cannot carry out the assessment in the terms described above due to sanitary conditions, they will have to follow the assessment guidelines issued by the Rectorate at the time of sitting the exam.

MANDATORY MATERIALS

Slides provided by the teacher during the course.
The files are availbale in the on-line system (E-GELA) of the course.

BIBLIOGRAPHY

Basic bibliography

1. Standard ISO-45001:2018 (Occupational health and safety management systems. Requirements with guidance for use).

2. Bond, J., The Hazards of Life and All That, IOP Publishing (1996).

3. Dirección General de Protección Civil, Guía técnica: Metodología para el análisis de riesgos. I. Visión general. Madrid (1994).

4. Guidelines for Chemical Process Quantitative Risk Analysis, AIChE, New York (1989).

5. Kent, J.A. "Riegel´s Handbook of Industrial Chemistry". Chapman & Hall, New York (1992).

6. Lees, F.P., Loss Prevention in the Process Industries. Butterworth-Heinemann. Londres (1980).

7. Santamaría, J.M., Braña, P.A., Análisis y reducción de riesgos en la industria química, Mapfre, D.L, Madrid (1994).

8. TNO Environment, Energy and Process Innovation, The Yellow Book 2 vol., 820 pag., 3rd edition, Holland (1997).

9. Gómez, G.; Manual para la formación en prevención de riesgos laborales: especialidad de seguridad en el trabajo; Editorial CISS (2003).

10. Haddow, G. D.; Introduction to emergency management; Butterworth Heinemann Ed. (2006).

Detailed bibliography

Legislation (applicable in Spain)
1. REAL DECRETO 948/2005, de 29 de julio, por el que se modifica el Real Decreto 1254/1999, de 16 de julio, por el que se aprueban medidas de control de los riesgos inherentes a los accidentes graves en los que intervengan sustancias peligrosas. BOE núm. 181, de 30 de julio de 2005
2. REAL DECRETO 1254/1999, de 16 de julio, por el que se aprueban las medidas de control de los riesgos inherentes a los accidentes graves en los que intervengan sustancias peligrosas. BOE de 20 de julio de 1999.
3. REAL DECRETO 1196/2003, 19 de septiembre, Directriz Básica de protección civil para el control y planificación ante el riesgo de accidentes graves en los que intervienen sustancias peligrosas. BOE núm. 242 DE 9 DE OCTUBRE.
4. DIRECTIVA CE DEL CONSEJO, 96/82 de 24 de junio de 1982, relativa a los riesgos de accidentes graves en determinadas actividades industriales.
5. DIRECTRIZ BÁSICA para la elaboración y homologación de los planes especiales del sector químico. BOE 06/02/1991.
6. LEY 31/1995, de 8 de noviembre de Prevención de Riesgos Laborales. BOE 269, de 10 de noviembre.

Libros
1. "Perry´s chemical engineer´s handbook", Perry, R.H., y Green, D. W., McGraw-Hill, New York, 1997.
2. "Procedimiento para el Análisis de Riesgos de Operación.- Método HAZOP". Arístides Ramos Antón, COASHIQ,(APA.- revista Prevención, Julio-Septiembre 1987)
3. "Manual de seguridad industrial en plantas químicas y petroleras", Storch de Gracia, J.M., McGraw-Hill., Madrid, 1998.
4. "Análisis de Riesgos en Instalaciones Industriales", Edición UPC.- J. Casal, E. Montiel, E. Planas, J.A. Vilchez.- Septiembre 1999.

Journals

Acción Preventiva
Revista de prevención de riesgos laborales de la CEOE

PREVENCION
Revista técnica de seguridad y salud laboral, ISSN: 0034-8732

Web sites of interest

http://osha.europa.eu
http://www.cdc.gov/niosh
http://www.osalan.net
http://www.insht.es

OBSERVATIONS

This subject covers horizontal training topics that are applicable in early every industrial sector. In particular, is applicable to industries of chemical and biotechnology sector where legal requirements are mandatory concerning risk evaluation and emergency plans.

Academic ethic. During the examinations in classroom (ordinary and/or extraordinary calls) the use of any book, paper, slide or text is strictly forbidden for the students. The use of electronic equipment and/or transmission equipment of any type is also strictly forbidden. In the event of dishonest or fraudulent action done by any student, the protocol of UPV/EHU on academic ethic during exams will be applied.

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25

Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GINQUI30 - Bachelor`s Degree in Chemical Engineering	**Year**	Second year

COURSE

26750 - Numerical Methods for Chemical Engineering	**Credits, ECTS:**	9

COURSE DESCRIPTION

This is a compulsory 2nd year 9 ECTS subject with the objective to provide the student with the necessary calculation tools for solving complex mathematical equations. Design, analysis, synthesis and simulation of processes and operations in the Chemical and related Industries, which require solving complex mathematical equations, are among the usual works a Graduate in Chemical Engineering is supposed to carry out. Thus, the knowledge and correct management of the calculation tools acquired after taking this course is fundamental for working as a Chemical Engineer.

The subject is related to many others in the Chemical Engineering Degree, in particular with Chemical Kinetics, Fluid Mechanics, Heat Transfer, and Experimental Methods in Chemical Engineering I (also in the 2nd year), or Mass Transfer, Reactor Design, Separation Processes, and Experimental Methods in Chemical Engineering II (in the 3rd year). Abilities acquired in Numerical Methods in Chemical Engineering are necessary to solve the most complex problems in the mentioned subjects.

Before taking this course, the student should dominate the basic mathematical operations in engineering: differentiation and integration, one-dimensional and multidimensional algebra, array algebra, scalar product, vector operations, surface integrals, gradients, Taylor’s theorem, analytical solution of ordinary and second level differential equations, and algorithmic and basic programming in one language (Scilab or Matlab). Besides, the student should be able to raise mass and energy balances in simple chemical processes, particularly in the steady state.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

EXPECTED LEARNING OUTCOMES
The goal of this subject is for the student to learn how to handle calculation tools for solving complex numerical problems in Chemical Engineering, which means:
- The student acquires a general knowledge of numerical methods
- The student is able to choose the most adequate method or tool for each situation
- The student is able to adapt the calculation tool in order to solve a particular numeric problem

Thus, after taking this course, the student should be able to:
- identify the necessary calculation tool for solving a given problem in Chemical Engineering (particularly those related to steady and unsteady state mass and energy balances).
- select the most appropriate calculation method to solve each problem type
- know the calculation sequence followed by each method, and its advantages and disadvantages
- implement the method in an algorithm by using an appropriate calculation software
- communicate the computational sequence of an algorithm by means of a flowchart.
- modify the algorithms so that they become adequate to solve new problems
- solve the problem by using the adequate calculation method, and to reach a solution
- communicate results graphically and in a written form

COMPETENCES
For the above goals to be reached, the student develops the following competences, corresponding to Module I (Basic Formation), listed in the Official Document for the Chemical Engineering Degree at the University of the Basque Country (UPV/EHU):

Specific competences:
- M01CM02: Apply knowledge of the basic subjects to facilitate understanding of the fundamentals of Engineering in general and Chemical Engineering in particular ***
- M01CM03: Identify and solve the problems of Chemical Engineering by integrating the knowledge of the basic subjects ***
- M01CM05: Handle the computing and graphic design tools commonly used in Chemical Engineering at present ***

Cross-cutting competences:
- M01CM06: Use information and communication technologies in the context of learning (web sites to support classroom teaching, computer office tools, e-mail, etc.) at basic level ***
- M01CM07: Communicate and transmit in writing, to a basic level, acquired knowledge, results, abilities and skills, in a multidisciplinary and multilingual environment **
- M01CM08: Plan activities, being aware of diversity and multiculturality, and improving interpersonal relationship abilities **
- M01CM09: Adapt to working groups, with critical reasoning and constructive attitude **

- M01CM10: Solve problems of the basic subjects, with quality criteria, environmental concern, sustainability, ethical criteria, instilling the need for personal work and promoting peace *
Key to competence development: (***) intensely, (**) moderately, (*) slightly or not at all

Theoretical and Practical Contents

Lesson 1. Introduction:
Goals, calculation tools and their utility for solving different problems in Chemical Engineering with complex mathematical models are explained. The concept of convergence (necessary for iterative calculations) is introduced, and the different errors associated to approximate solutions are defined.

Lesson 2. Numerical methods and computers:
Basic programming concepts acquired in first level "Introduction to computing" are recalled. The basic structures for creating a calculation algorithm (sequence of calculations, decision-making and repetition structures) are described and how to design and schematically represent (flux diagrams and/or pseudo-codes) calculation algorithms is shown.

Lesson 3. Software:
The basic aspects of the two software packages used along the subject for calculation and programming are described: 1) Excel spreadsheets (environment, data introduction, format, basic calculation, special functions, etc.) and 2) Scilab (environment, vectors and arrays, basic calculation, programming, functions, etc.); emphasizing the tools for correct presentation of the results both numerically and graphically.

Lesson 4. Root calculation:
The utility of root calculation methods and their fundamentals are described for the student to be able to implement them in different calculation algorithms, grouped as closed (bisection and Regula-Falsi) and open (fixed-point single iteration, Newton-Raphson and secant) methods, as well as methods for calculation of multiple roots (polynomials), with typical examples. Solver Excel tool and Scilab tools (fsolve and roots) are also used for root calculation of equations and polynomials.

Lesson 5. Equation systems:
Linear and non-linear equation systems are identified, with typical examples. Fundamentals of calculation methods to solve linear equation systems (based on array calculation, such as Gauss, LU decomposition or Gauss-Seidel methods) or non-linear equation systems (which imply previous linearization of the equation system) are presented, so that they can be implemented in algorithms self-designed by the students to solve this kind of problems. Specific Excel (minversa, mmult) and Scilab (inv(A)*B, A\B, linsolve, fsolve) array functions to solve equation systems are also presented.

Lesson 6. Differential and integral calculation:
The kind of problems requiring numeric integration or differentiation is described. Fundamentals of integration of both mathematical functions (continuous systems) and discreet data (tabulated) are presented, as well as the different methods to calculate first and second-order numerical derivatives. Algorithms implementing both methods are developed. Specific Scilab functions for integration (intg, inttrap) and differentiation (numderivative) are also presented.

Lesson 7. Ordinary differential equations (ODE):
The kind of problems which require solving one or several ordinary differential equations with known initial conditions and the fundamentals for their solution (Euler, Runge-Kutta, predictor-corrector methods) are described, and self-developed algorithms are implemented by the students. Specific Scilab functions (such as ode) to solve this kind of problems are also described and used.

Lesson 8. ODE with border constraints:
Ordinary differential equation problems with border constraints (one or more initial conditions remain unknown) are identified with typical examples. Fundamentals for implementing algorithms to solve this kind of problems are presented.

Lesson 9. Curve fitting:
Typical examples which require data fitting to mathematical equations are presented, and the fundamentals of linear fitting, multiple linear fitting and non-linear fitting are described. Specific commands and functions of Excel (linest, slope, intercept, rsq) and Scilab (reglin) are also described and used.

Lesson 10. Interpolation:
Interpolation of tabulated data with typical examples and the fundamentals of several interpolation methods (Newton, Lagrange, by sectors, reverse interpolation) are described, and the specific functions and commands of Excel (trend) and Scilab (interp1, interp2d) to interpolate are explained and used.

Lesson 11. Optimization:
The fundamentals of optimization (maximum and minimum search) methods both in one and multiple dimensions are described, including the introduction of restrictions when searching for the optimum (restricted optimization). Typical

examples of the different situations are presented, as well as specific Excel (solver) and Scilab (fminsearch, optim) functions to search for the optimum value of a function.

Lesson 12. Partial differential equations (PDE):
The different types of partial differential equations (elliptical, parabolic, etc.) are described, emphasizing those with the highest applicability to typical Chemical Engineering problems.

TEACHING METHODS

Practical program (exercises, works):
The students will be proposed, along the year, several problems related to Chemical Engineering, in two levels of difficulty:
- Simple problems, to be solved by a single numerical method (named "exercises")
- Complex problems, where the use of more than a numerical method or the systematic solution of a single problem in different conditions is required (named "works"), which requires the use of adequate programming tools (M01CM02, M01CM03).

Complex problems and some simple problems will be solved by the students in groups (thus, cooperative learning: M01CM08, M01CM09)
The list of complex problems, associated to lessons, along the year is distributed in the following:
- Lesson 4. Work # 1
- Lesson 5. Work # 2
- Lesson 6 and 7. Work # 3 (part 1)
- Lesson 11. Work # 3 (part 2)

METHODOLOGY
The subject is totally practical and the students learn by solving problems and designing algorithms. The students use former knowledge to create their own materials for calculation while generating new knowledge (M01CM02). Using information from the literature, they design algorithms for different calculation methods in Scilab and Excel (M01CM05, M01CM08) and, afterwards, they use the algorithms for solving mathematical problems associated to Chemical Engineering (M01CM03).

Teaching methodology includes lectures, classroom practices and computer practices, distributed as indicated at the beginning of this guide. The hours of presence are three per week distributed in two sessions: one hour session of lecture-classroom practice, and two hours session of computer practices. The activities to be carried out at each session are:
- Lectures: Basics and fundamentals of calculation methods are discussed, after the students have read the proposed materials (available at eGela, the virtual classroom) at home (non-presence hours).
- Classroom practices: Algorithms and their implementation to solve specific problems are developed by the students guided by the teacher. The students have the statements of the problems in advance, through eGela.
-Computer practices: Two kind of activities are carried out by the student on a computer:
  o Learning how to use calculation tools (Excel and Scilab commands), guided by the teacher (seminar classes).
  o Use of calculation tools to develop algorithms, and solving problems with those calculation tools and algorithms, following the methods proposed in classroom practices. Here, the teacher supervises the work of the students, and helps them to solve their doubts.

Non-presence activities include: previous reading and understanding of the materials to be discussed at the lectures, previous reading and planning of the problems and algorithms to be developed and solved during classroom practices, identifying and describing numerical methods associated to the proposed exercises/works, solving the proposed exercises/works, and preparing a report of the works.

Cooperative learning favors learning by generating a positive interdependence, although each student must reach the objectives of learning. Thus, although much of the work is carried out in groups, mechanisms to assure individual enforceability are used (M01CM07). Assistance to presence sessions is compulsory/essential.

Exercises and works (individual/groups) will be a part of continuous evaluation. Because of that, they must be presented and explained in writing in a clear, organized way (M01CM07, M01CM10). Other cooperative activities (glossary, forums, etc.) will be carried out through eGela virtual platform (M01CM06).

Virtual classroom of the subject (eGela):
The following contents can be found ordered at the virtual classroom:
Block Contents
Top Teaching guide
 News forum (for communicating events or reminding of activities along the course)
 Detailed calendars (planned daily activity) so that the student can prepare the non-presence work in advance
 Two glossaries, for Excel and Scilab, so that the students can add and explain commands, which will be available during exams
Per lesson Written chapter in full and summary of the lesson in slides, to be read and understood before the lecture

Collection of problem statements
Evaluable activities (exercises/works/tests), with indications and delivery term
Complementary material Questions and comments forum, where the students can raise their doubts on exercises/works, which could be solved by other students (cooperative work) or the teacher
Link to free downloading Scilab software
Scilab manual

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	20		10		60				
Horas de Actividad No Presencial del Alumno/a	20		25		90				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Exercises, cases or problem sets 30%
- Active participation (class discussion, glossaries, forum, tutorials, etc.) 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Taking into account that evaluation is continuous, a series of evaluable activities are proposed along the course, in order to facilitate progressive understanding and development of the learning outcomes to be reached.

- Exams (60-70%, individual)
Four individual exams are proposed and distributed along the year. Each one will be used to determine to which extent the students have reached the learning outcomes from the beginning (and thus the last exam will include all the lessons). The specific weight of each exam is:
o 1st exam, by the middle of the first semester: 10%
o 2nd exam, by the end of the first semester: 25%
o 3rd exam, by the middle of the second semester: 25%
o 4th exam, by the end of the second semester: 40%
If a clear, sustained improvement in the results obtained by the student in the successive exams is observed, the final grade may be directly the one obtained in the 4th exam.
The minimum qualification mark is 4.5/10.

Evaluation criteria:
o Results and approach (80%): correct identification of the problem, approach to the solution, choice of the most adequate calculation tool (the quickest and most precise for the proposed problem), minimum number of operations required, and correct solution reached.
o Clarity of the explanations (20%): clarity and understandability of the explanations given to identify the kind of problem and the solving procedure.
The student should show an adequate use of the calculation tools both in Excel and Scilab (each software package should comprise at least 25% of the exam).

- Exercises and works (30%)
o At least one exercise (simple problem) is asked to be solved by the end of each lesson (individually in lessons 1, 2 and 3, and in groups in the rest).
Evaluation criteria: approach and clarity of the solution, selection of the most appropriate method, originality and personal contribution, accuracy of the result (80%); adequacy and clarity of the explanation on how the exercise is solved (20%), compliance with delivery deadlines.
o At the end of the corresponding lesson, the works above mentioned will be distributed to be solved in group. Evaluation criteria: results and approach (80%, selection of the adequate numerical methods, development of specific programs and functions to solve the works, obtained results), quality of the report (20%, organization, writing, grammar, orthography, literature), compliance with delivery deadlines.

- Active participation (0-10%, individual):
Including: participation in questions and commentaries forum, in glossaries of terms (introduction of Excel and Scilab command description), in classroom discussions and problem-solving, etc.
All activities should be delivered trough the virtual classroom (eGela) of the subject, which will be also used to

communicate evaluations and comments (M01CM06).
Resigning a final call will entail a final mark of "not taken" (Art. 12.1 UPV/EHU Student Assessment Regulations).

Procedure to give up continuous evaluation: The students can give up continuous evaluation by sending a written request to any of the teachers in charge for the subject not later than week 28 in the course (end of April; Art. 12.2 UPV/EHU Students Assessment Regulations). Also, failure to participate regularly in the evaluable activities will be considered as a resignation to continuous evaluation. If this is the case, final evaluation will consist of a single exam (100%) of the whole matter, with a minimum qualification mark of 5/10.

Procedure to resign the ordinary call: While in continuous evaluation, the student can resign the ordinary call until one month before classes are over. In this case, the student must send a written resignation to any of the teachers in charge for the subject. When in final evaluation, not attending the final exam will be automatically considered a resignation (Art. 12.3 UPV/EHU Student Assessment Regulations).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Extraordinary evaluation will consist of an individual exam (100%), comprising the whole subject. The minimum qualification mark is 5/10.

MANDATORY MATERIALS

Scilab package (http://www.scilab.org/)
Excel Microsoft package

BIBLIOGRAPHY

Basic bibliography

Chapra, S.C., Canale, R.P.; "Numerical Methods for Engineers", 7th edition; McGraw-Hill Education, 2015

Detailed bibliography

Billo, E.J.; "Excel for Scientist and Engineers", Wiley Interscience, 2007
Mathews, J.H., Fink, K.D.; "Numerical Methods using Mathlab", 4th edition, Prentice-Hall Pub. Inc., 2004
Finlayson, B.A.; "Introduction to Chemical Engineering Computing", Wiley Interscience, 2006
Gerald, C.F, Wheatley, P.O.; "Applied Chemical Analysis", 7th edition, Pearson/Addison-Wesley, 2004

Journals

Web sites of interest

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GINQUI30 - Bachelor`s Degree in Chemical Engineering	**Year**	Second year

COURSE

26752 - Experiments in Chemical Engineering I	**Credits, ECTS:**	9

COURSE DESCRIPTION

It is a fundamentally practical subject, and therefore it will be oriented to the student acquiring skills in the laboratory of theoretical knowledge introduced in other subjects of the degree, such as fluid mechanics, heat transfer, kinetics of chemical processes and applied thermodynamics.
At any level, either at the laboratory level to a pilot plant or industrial level, a chemical engineer needs to be able to experiment, sometimes to understand the process and know what the variables that affect it are, others to determine the optimal values of the variables of operation and sometimes simply to obtain data for the design of other plants. In any case, any engineer who designs or operates chemical processes must have basic knowledge of experimentation.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

PREREQUISITES: In order to sign up for this course, students must have been enrolled, at least once, in the following subjects:
- Fluid mechanics
- Heat transfer
- Kinetics of chemical processes
- Applied thermodynamics

SPECIFIC SKILLS:
M03CM01. Analyze, using material and energy balances, facilities, equipment or processes in which the material undergoes changes in composition.
M03CM02. Integrate the basics of Chemical Engineering and Biotechnology with the basic and common fundamentals of engineering.
M03CM04. Analyze, model and calculate chemical and biochemical reactors based on applied thermodynamic and kinetic fundamentals.
M03CM06. Manage techniques of the Chemical Industry, measuring and calculating properties of raw materials, process units and products.
M03CM07. Materialize, making visible in the laboratory, fundamental principles of chemical engineering concerning mass transfer, energy and amount of movement.
M03CM09. Compare theoretical models and simulation results with real results obtained in real units.

CROSS-CURRICULAR SKILLS:
M03CM11. Skilfully manage the information and communication technologies applied to learning, information sources and specific databases of Chemical Engineering, as well as tools to support oral presentations.
M03CM12. Communicate and transmit, effectively in writing and basically orally, the knowledge, results, skills and abilities acquired in a multidisciplinary and multilingual environment.
M03CM13. Organize and plan activities in working groups, with recognition of diversity and multiculturalism, critical reasoning and constructive spirit, beginning in the leadership of groups.
M03CM14. Development of the leadership of working groups, with assignment of tasks, establishing structures with recognition of the diversity of the group.
M03CM15. Solve problems of the subjects corresponding to Chemical Engineering, raised with criteria of quality, sensitivity for the environment, sustainability and ethical criteria.

Theoretical and Practical Contents

1. HYDRAULICS: Operation of a hydraulic system. Evaluation of pressure drop in a hydraulic installation.
2. PNEUMATICS: Operation of a pneumatic system. Evaluation of pressure drop. Calibration of flow meters in a pneumatic circuit.
3. CENTRIFUGAL PUMPS. Operation of two-pump-systems, in series and in parallel. Power. Performance. Characteristic curves.
4. TURBINES: Operation of a turbine to obtain mechanical energy. Calculation of the performance curve, brake horsepower and engine torque.
5. FILTRATION: Filtration at constant pressure. Filtering kinetics. Resistance of the medium and the cake. Compressibility of the cake.
6. FLUIDIZED BEDS: Study of the fluid flow through beds of fixed and fluidized solid particles. Pressure drop in a fixed bed: Ergun equation. Calculation of the minimum fluidization velocity.
7. SEDIMENTATION: Study of the basic physical processes related to sedimentation.

8. HEAT EXCHANGERS: Newton's Law. Convection coefficient. Overall heat transfer coefficient. Heating efficiency. Heat transfer units.
9. HEAT TRANSFER BY CONDUCTION IN ONE AND TWO DIRECTIONS: Fourier's Law. Conductivity. Stationary state. Microscopic balance of heat. Solving systems of equations.
10. KINETIC EQUATION OF HOMOGENEOUS REACTIONS IN ISOTHERMAL DISCONTINUOUS REACTORS: Saponification of ethyl acetate. Integral and differential method of data analysis. Activation energy.
11. KINETIC EQUATION OF CATALYTIC HOMOGENEOUS REACTIONS IN DISCONTINUOUS REACTORS: Bromination of butanol catalysed by a protonated acid.
12. HYDRAULIC ANALOGIES OF COMPLEX REACTIONS: First-order complex reactions are simulated by means of the arrangement of test tubes fed by water, in continuous regime, in series, parallel and series-parallel modes, regulating the flow rate independently with needle valves, whose aperture simulate the value of the kinetic constant.

TEACHING METHODS

The subject is organized on the basis of three main activities: i) planning an experiment, ii) conducting the experiment in the laboratory, iii) making a report on results and conclusions. Students will work in groups of three, in order to properly distribute the tasks. The tasks are designed so that all the constituents of the group must work in all the practices.
Main activities:
i) Planning of the experiments
It consists of establishing a work plan for the execution of each experiment (the number of experiments required, the experimental conditions: temperature, concentration, pressure, volume, flows, etc.) based on the objectives determined by the teachers. The planning will be presented to the teachers of the subject orally. What is established in the planning, once received the approval of the professor, is what is going to be executed in the laboratory.
ii) Laboratory experimentation
Once the approval of the planning has been achieved by the teacher in charge, the laboratory practice will be carried out to obtain and validate experimental results.
iii) Report on results and conclusions
The final report requires the treatment and obtaining of results (according to the established objectives) from the experimental data acquired in the laboratory, from which the pertinent conclusions will be obtained.

Throughout the course there are 2 sets of experiments (one during the first semester and in the second one). Each group has to perform 4 experiments in the first round and 5 in the second. There are in-class activities (in the classroom or in the laboratory) and other out-of-class ones.
In each laboratory session, the next procedure is going to be followed:
1. Planning
1.1. Once the required information to carry out the planning of the experiments of that set has been gathered, the laboratory is visited in order to make the first contact with the experimental equipment and the products and reagents to be used.
1.2. Students have approximately 2 hours to exercise with each practice, in order to see the operation intervals, sizes, specifications of the reagents, etc., with the presence of the teacher (2 hours / practice, in-class, group work, 6 hours).
1.3. Carry out the planning of each practice (6 hours / practice, out-of-class, 18 hours, group work).
1.4. Oral presentation of the planning to the teacher in charge in the established day.

2. Carrying out the laboratory experiment.
2.1. Once the planning has been approved by the teacher in charge, the laboratory experiment will be carried out to obtain and validate experimental results. Each group has a session of 4 laboratory hours to perform the corresponding experiment, according to a timetable. In each laboratory session, there will be a teacher in charge, who will evaluate the work of the students in the laboratory through a rubric that will be included in the final assessment.

3. Preparation and delivery of the results and conclusions report.
3.1. The final report requires the treatment and obtaining consistent results and conclusions (according to the established objectives) from the experimental data obtained in the laboratory. There will be a week to deliver the results report via e-gela.

4. Presentation of results.
4.1. There are several sessions during the second semester in which the results obtained will be presented. Each group will make an oral presentation (with the help of tools to support oral presentations such as Power Point or similar) explaining the results obtained in the experiments.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching			10	80					
Horas de Actividad No Presencial del Alumno/a				135					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 15%
- Exercises, cases or problem sets 85%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS ASSESSMENT
The minimum work requested is specified in the outlines delivered for each experiment. As described in the methodology section, in each experiment 3 tasks are to be performed, which in chronological order are: planning, execution in the laboratory and report. The three tasks will have the same weight in the assessment of each experiment and each experiment will have the same weight in the final assessment. The accomplishment of the 9 practices will suppose the 90% of the final evaluation. The 10% of the final evaluation will be the corresponding to the presentation of works at the end of the course.
In case of not passing the continuous assessment, a written examination will be carried out with questions related to the experiments carried out during the course.
Students that would like to renounce the continuous assessment system will have to present a written notification to the teacher in charge before week 18 of the academic year.
FINAL ASSESSMENT
Students who have renounced the continuous assessment will be entitled to a final written exam in which questions related to the experiments carried out during the course will be formulated. The requirements to take this final exam are to have done the laboratory practices and deliver all the corresponding reports.
To renounce this evaluation system, it is sufficient not to go in for the exam.

In the event that the sanitary conditions prevent the realization of a face-to-face evaluation, a non-face-to-face evaluation will be activated, of which the students will be informed in due course.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

A written exam in which questions related to the experiments carried out during the course will be formulated. The requirements to take this final exam are to have done the laboratory practices and deliver all the corresponding reports.
To renounce this evaluation system, it is sufficient not to go in for the exam.

MANDATORY MATERIALS

e-gela virtual classroom

BIBLIOGRAPHY

Basic bibliography

The one corresponding to the subjects Fluid mechanics, Heat transfer, Kinetics of chemical processes, Applied thermodynamics and Numerical Methods in Chemical Engineering.
Kirkuk, L. "Experimental Methods: An Introduction to the Analysis and Presentation of Data", Wiley, Melbourne, 1994.

Detailed bibliography

Guiteras, J., Rubio, R. eta Fonrodona, G. "Curso Experimental en Química Analítica", Síntesis, Madrid, 2003. Perry, R.H. eta Green, W. "Perry's Chemical Engineers Handbook", 7. ed., McGraw-Hill, New York, 1997.

Journals

Web sites of interest

Libro web de Química del NIST (National Institute of Standards and Technology): http://webbook.nist.gov/chemistry/

OBSERVATIONS

En los informes de resultados no se admitirán fraudes, copias o plagios. Además, en las pruebas de evaluación de la signatura los alumnos tendrán prohibido la utilización de libros, notas o apuntes, así como la utilización de dispositivos telefónicos, informáticos, electrónicos u otros. En caso de mostrar prácticas deshonestas o fraudulentas, se aplicará lo establecido en el protocolo sobre ética académica y prevención de las prácticas deshonestas o fraudulentas en las pruebas de evaluación y en los trabajos académicos en la UPV/EHU (https://www.ehu.eus/es/web/estudiosdegrado-gradukoikasketak/akademia-araudiak).

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GINQUI30 - Bachelor`s Degree in Chemical Engineering	**Year**	Second year

COURSE

26754 - Applied Thermodynamics	**Credits, ECTS:**	6

COURSE DESCRIPTION

The subject Applied Thermodynamics is a compulsory subject of the first semester of the 2nd year of the Degree in Chemical Engineering. The student requires certain basic knowledge of Physics, Chemistry and Mathematics acquired during the first year of the Degree.
The focus of the subject for the Graduate in Chemical Engineering is directed to (i) the determination of the heat and work needs involved in physical and chemical processes and (ii) the adequate application of thermodynamic laws for the study of substances pure, of mixtures, of phase equilibrium and chemical equilibrium. Initially, single monocomponent systems will be approached from the thermodynamic point of view. Next, multicomponent systems of greater complexity that are common in the field of Chemical Engineering will be studied.
In this course, concepts and thermodynamic properties are learnt (heat, work, internal energy, enthalpy, Gibbs energy, phase and chemical equilibrium, equilibrium composition, among others), which are essential for other subjects of the Degree in Chemical Engineering related to the design of equipment and facilities.

The descriptors are:
Thermodynamic magnitudes. The first principle. Volumetric properties of pure fluids. Heat and thermodynamics. The second and third principles. Thermodynamic properties of fluids. Energy from heat. Thermodynamics of solutions. Equilibrium.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Specific competences:
- Know the variables and thermodynamic concepts necessary for Chemical Engineering.
- Understand and deduce the Principles of Thermodynamics and their application to the study of pure substances and mixtures.
- Know and calculate the thermodynamic variables by different methods: PVT data, state equations, correlations and thermodynamic diagrams and tables.
- Use thermodynamic laws for the study of pure substances, mixtures, phase equilibrium and chemical equilibrium.
- Define the heat and work needs involved in physical and chemical processes.
- Know the thermodynamics of multicomponent systems, establishing their physical and chemical equilibrium.

Transversal competences:
- Use ICTs applied to advanced level learning, and handle in a basic way the sources of information and specific databases of the modules, as well as office tools to support oral presentations.
- Communicate and transmit, basically, in writing and orally, knowledge, results and acquired skills.
- Solve problems of the common matters of the industrial branch, raised with quality and ethical criteria.

Once these competences have been achieved, the student will be able to apply the essential thermodynamic concepts in the labor world and in other subjects of the Degree in Chemical Engineering. In this sense, Applied Thermodynamics is essential in the following subjects:
2nd course: Kinetics of Chemical Processes, Heat Transmission, Practice in Chemical Engineering I.
3rd course: Separation Operations, Reactor Design, Process and Product Engineering
4th course: Energy Engineering
With the passing of this subject, the student will be able to understand and design any physical process from the thermodynamic point of view, thus calculating the thermodynamic properties of ideal and non-ideal systems. In addition, he/she will be able to calculate the equilibrium composition of any chemical system, and establish the dependence of this composition with temperature and pressure.

Theoretical and Practical Contents

LESSON 1. The scope of thermodynamics. The scope of Thermodynamics. Fundamental and derived quantities. Dimensions and units. Thermodynamic magnitudes: strength, pressure, temperature, volume, work, energy and heat.
LESSON 2. The first principle of thermodynamics. Other basic concepts Joule's experiments. Internal energy. The first principle Thermodynamic state and state functions. Enthalpy. Steady-state flow processes equilibrium. The phase rule. Reversible and irreversible processes. Constant-V and constant-P processes. Heat capacity.
LESSON 3. Volumetric properties of pure fluids. PVT behavior of pure substances. Virial equations. The ideal gas: isochoric, isobaric, isothermal, reversible adiabatic and polytropic processes. Cubic state equations: Van der Waals, Redlich-Kwong and other cubic equations. Generalized correlations for gases.
LESSON 4. Heat and thermodynamics. Sensitive heat Latent heat of pure substances. Standard reaction and training heat. Standard heat of combustion. Dependence of the heat of reaction with temperature. Calorific effects in industrial reactions.

LESSON 5. The second and third principles of thermodynamics. The second principle of Thermodynamics. Thermal machines. Carnot cycle for an ideal gas. Entropy Changes in entropy in an ideal gas. Mathematical statement of the second principle. The third principle of Thermodynamics.
LESSON 6. Thermodynamic properties of fluids. Relations between thermodynamic properties for homogeneous phases. Residual properties Two-phase systems. Thermodynamic diagrams Thermodynamic properties tables. Thermodynamics of flow processes.
LESSON 7. Obtaining energy from heat. Refrigeration. The steam power plant. Refrigeration cycles. The Carnot cooler. Vapor compression cycle.
LESSON 8. Thermodynamics of solutions. The chemical potential as a criterion for the equilibrium between phases. Partial properties. Ideal gas mixtures. Fugacity and fugacity coefficients for pure substances and mixtures. The ideal solution. Properties in excess. Activity coefficients.
LESSON 9. Equilibrium between phases. Equilibrium and stability between phases. Liquid-vapor equilibrium. Equations for the equilibrium LV. LV equilibrium in binary systems with ideal and non-ideal behavior of the liquid phase. Liquid-liquid equilibrium. Steam-liquid-liquid equilibrium. Solid-liquid equilibrium. Solid-vapor equilibrium. Multi-component systems.
LESSON 10. Chemical equilibrium. The reaction coordinate. Application of equilibrium criteria to chemical reactions. Changes in standard free energy and constant equilibrium. Effect of temperature on the equilibrium constant. Equilibrium conversion for simple reactions. Relationship of the equilibrium constant with the composition.

TEACHING METHODS

Types of classroom teaching activities and student work:
Magisterial or Theoretical Class (20 hours, face-to-face): The professor explains the most relevant thermodynamic objectives and aspects of each topic. For a good assimilation of the concepts and its application, it provides information, bibliography and documentation for the development of the topic. The student assimilates the concepts, takes notes and plans the preparation of the topic. In addition, a proactive attitude is expected in class, raising doubts and complementary questions and answering the questions posed by the teacher. This participation will be taken into account in the final evaluation.
Classroom practice - problems (30 hours, face-to-face): The teacher selects works and model exercises to illustrate the concepts corresponding to the subject. Supervises and supports the problem solving work that the student develops. The student solves selected problems or the proposed works. Present the results on the blackboard or through written reports.
Seminars - classroom tutorials (10 hours, face-to-face): The teacher solves doubts and raises questions to discuss. Analyze the student's progress and consistency. Recommends work methods in the subject. Proposes work to the group. Guide and moderate the discussion of the results. The student participates actively in this teaching task, raising doubts arising in the scheduled tasks. In addition, it exposes and discusses the results of assignments / problems assigned, orally or in writing, individually or in a group, about the assignments. Your profitable involvement in the seminars will be part of your final mark.

Types of non-classroom teaching activities and student work:
Work, at home or in the library, personal and sometimes in groups using the available resources (theoretical classes, practical classes, bibliographical resources). Assimilates the fundamental concepts of each topic.
Solve the questions raised in the practical classes and tutoring. Resolve the issues raised in the Information Platform. Acquire the necessary knowledge for his training as a Chemical Engineer and applies them in a rationalized manner to practical situations.
Search in the library or in other sources, preferably within the recommended bibliography, the necessary information for the expansion of the topics exposed in the theoretical classes and for the resolution of theoretical questions and / or problems. The student acquires skills and abilities in the management of bibliographical resources to complement and strengthen knowledge, striving in the discrimination between issues with basic or secondary importance (ability to synthesize and analyze).
Dedication: 90 hours, 6 hours / week, 1.2 hours / day

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	20	10	30						
Horas de Actividad No Presencial del Alumno/a	35	20	35						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 50%
- Exercises, cases or problem sets 50%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the ordinary call, there are two evaluation possibilities: Continuous evaluation and final evaluation.
It is highly recommended to follow the continuous evaluation.

A) CONTINUOUS EVALUATION
In the continuous evaluation, the following tasks must be fulfilled:
Problem solving and questionnaires, individual or group formal. Presentations and individual or group work. Short tests (with theoretical and applied contents). Active and profitable participation in the seminars. Use of the egela computer platform. These activities constitute 50% of the final mark. Minimum required mark: 4.
Test on the date of the official ordinary call: The test will be about the contents of the subject, differentiating the theoretical contents and the problems. These activities constitute 50% of the final mark. Minimum required mark: 4.
To pass (pass) the subject requires a minimum mark of 5.
In the continuous evaluation, the following aspects will be taken into account:
Clarity in the development and adaptation of theoretical responses. Originality in the approach to solving both theoretical and practical issues. Adequacy of the theoretical concepts used to solve the problem. Clarity in the exposition and the reasoning followed in the resolution of the problem. Validity of the final result in the solving of problems. Participation and follow-up in teaching activities.

B) FINAL EVALUATION
Students will have the right to be evaluated through the final evaluation system, regardless of whether or not they have participated in the continuous assessment system. To do this, students must submit in writing to the faculty responsible for the subject the waiver of continuous evaluation. For this, the deadline will be week 11, from the beginning of the semester, according to the academic calendar of the center.
If the student chooses the final evaluation system, he will take an exam that covers the whole subject, on the same date set for the ordinary call test. In this exam, theoretical and practical knowledge will be evaluated, with the minimum score reaching 5 to pass the subject. The following aspects will be taken into account in the final mark: clarity in the presentation of the answers and their validity, providing original answers to the theoretical and practical questions and using appropriate procedures in the resolution.

For this subject, in both continuous and final evaluation cases, not attending the final test will involve that the final mark will be not presented.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Students who do not pass the subject in the ordinary call, regardless of the chosen evaluation system, will have the right to take exams and assessment activities that make up the final evaluation test of the extraordinary call.
The evaluation of the subject in the extraordinary call will be made exclusively through the final evaluation system, which will mean 100% of the mark of the subject.
The final evaluation test of the extraordinary call will consist of exams and evaluation activities, which are necessary to be able to evaluate and measure the defined learning results, in a comparable manner to how they were evaluated in the ordinary call. The positive results obtained by the students during the course can be taken into consideration. In the case of having obtained negative results through the continuous assessment carried out during the course, these results cannot be maintained for the extraordinary call, in which the students will be able to obtain 100% of the mark.
Resignation of the extraordinary call
Failure to take the test set on the official exam date will automatically waive the corresponding call.

MANDATORY MATERIALS

Thermodynamic tables and diagrams.

BIBLIOGRAPHY

Basic bibliography

Smith J.M., Van Ness H.C., Abbot. M.M., Introduction to Chemical Engineering Thermodynamics, 7th Edition 2007.

Detailed bibliography

Sandler, S.I., Chemical, Biochemical and Engineering Thermodynamics, Ed. John Wiley and Sons, 4ª edición, 2006.
Rodríguez Renuncio, J.A., Ruiz Sánchez, J.J., Urieta Navarro, J.S., Termodinámica Química, Ed. Síntesis, Madrid, 1998. (in spanish)
Rodríguez Renuncio, J.A., Ruiz Sánchez, J.J., Urieta Navarro, J.S., Problemas Resueltos de Termodinámica Química, Ed. Síntesis, Madrid, 2000. (in spanish)
Potter, M.C., Somerton, C.W., Schaums Outline of Thermodynamics for Engineers, 3rd Edition (Schaum's Outlines) 3rd Edition , McGraw Hill, 2004.
Moran, M.J., Shapiro, H.N., Fundamentals of Engineering Thermodynamics, Ed. John Wiley and Sons, 5th edition, 2004.
Cengel, Y.A., Boles, M.A., Thermodynamics McGraw Hill, 2002.
Levenspiel, O., Fundamentos de Termodinámica, Prentice-Hall, 1997.
Winnick, J., Chemical Engineering Thermodynamics, John Wiley and Sons, 1997.

Journals

Journal of Chemical Thermodynamics
Journal of Chemical and Engineering Data
Fluid Phase Equilibria
Thermochimica Acta

Web sites of interest

http://www.biopsychology.org/apuntes/termodin/termodin.htm
http://www.sc.ehu.es/sbweb/fisica/estadistica/termo/Termo.html
http://www.psigate.ac.uk/newsite/reference/plambeck/chem2/ua102.html
http://thermodex.lib.utexas.edu/

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GINQUI30 - Bachelor`s Degree in Chemical Engineering	Year	Second year

COURSE

COURSE	Credits, ECTS:
26755 - Chemical Process Kinetics	6

COURSE DESCRIPTION

The subject introduces the basic concepts of chemical kinetics and the design and analysis of the chemical reactor to obtain kinetic data. Models for homogeneous reactions in batch, piston flow and perfect mixture flow reactors are developed. Different methods of analysis of data obtained in these reactors are proposed and applied to determine rate equations and calculate kinetic parameters. Catalytic reactions are also introduced.
It is a basic subject for the later development of the subject "Reactor Design", in the third course.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

A. To know the principles of the kinetics of chemical reactions, both in homogeneous systems and in different heterogeneous systems, in the absence and presence of catalysts.
B. To know the basic reactors for obtaining kinetic data.
C. To understand and apply the methods that allow the establishment of kinetic equations and the determination of kinetic parameters.

At the end of the subject, the student should be able to develop works that require the following tasks/activities:
- Perform balances of matter in systems with chemical reaction.
- Calculate the conversion in batch and flowing systems.
- Establish the design equations for batch, continuous perfect mix and piston flow reactors.
- Develop reaction rate equations from mechanisms and experimental data.
- Apply differential and integral methods of data analysis.
- Maximize product selectivity in systems with multiple reactions.
- Understand the physical and chemical steps that occur in catalytic systems.
- Apply the reaction controlling steps and quantify the limitations of matter transfer in heterogeneous systems (catalytic and non-catalytic).
- To know the causes for the deactivation of solid catalysts and the possible strategies for their minimization.

Transversal or generic competences to be developed in the subject and in the degree:
Communication:
1. Ability of engineering language and scientific and technical terms.
2. Capacity for oral communication of results.
3. Ability to write technical reports and projects.
4. Participation and leading role in forums for debate/discussion of results.
Training:
5. Ability to face new problems and search for new solutions.
6. Interrelation of concepts between subjects.
7. Self-evaluation of results.
8- Critical and reasoning capacity.
9. Acquisition of ethical values.
Tools:
10. Use of bibliographic resources.
11. Computer and programming skills.
a. Use of general software: browsers, editors, spreadsheets, graphics, etc.
b. Programming and use of engineering specific software.
Organization:
12. Adaptation to group work.
13. Skills to organize work groups.
14. Planning and organization of personal work and time management.

Theoretical and Practical Contents

1. INTRODUCTION TO KINETICS
The chemical reaction. Reaction rate. The kinetic equation. Influence of temperature on the reaction rate. Kinetic theories.
2. ELEMENTARY AND NON-ELEMENTARY REACTIONS
The reaction mechanism. Controlling stage. Kinetics of elementary reactions. Concentration evolution in elementary reactions of zero, one, two and n order. Elemental reactions with more than one reactant. Reaction mechanisms in non-elementary reactions: series, parallel and autocatalytic reactions. Mechanisms of chain reactions. Determination of the reaction mechanism.
3. DIFFERENTIAL METHODS FOR THE ANALYSIS OF KINETIC DATA
Obtaining experimental data. The discontinuous reactor. Reactions with a single reactant: methods of scoring, linear

regression and nonlinear regression. Reactions with more than one reactant: excess and stoichiometric quantity methods. Reversible reactions. Series and parallel reactions. Other reactors to obtain kinetic data.
4. INTEGRAL METHODS FOR THE ANALYSIS OF KINETIC DATA
Reactions with a single reactant: linear regression, fractional lifetimes, half-life. Reactions with more than one reactant: excess and stoichiometric quantity methods. Reversible reactions. Series and parallel reactions. Discontinuous variable volume reactor. Fractional volume variation.
5. REACTIONS IN LIQUID PHASE AND IN SOLUTION
Effect of pressure in gas and liquid phase reactions. Reaction mechanisms in solution. Reaction rate in liquid phase.
6. HOMOGENEOUS CATALYSIS
The phenomenon of catalysis. Catalyst functions. Mechanisms and kinetic equations in homogeneous catalytic reactions. Catalysis by acids and bases. Specific and general catalysis.
7. SOLID CATALYSTS
Structure of a solid catalyst. Catalytic materials. Physical, chemical and catalytic properties. Preparation and characterization of solid catalysts. Reaction mechanisms on solid catalysts. Physical and chemical stages in the reaction mechanism. Controlling stage. Concentration and temperature gradients. Strategies for the determination and verification of the reaction mechanism.
8. KINETIC METHODS IN HETEROGENEOUS CATALYSIS
Reactors for data acquisition: basket reactor and fixed bed reactor (differential and integral). Calculation of kinetic parameters: initial velocities, differential method, integral method. Regression methods for parameter estimation.
9. DEACTIVATION OF SOLID CATALYSTS
Origin of deactivation: poisoning, aging, fouling (or deactivation by coking), loss of active material. Classification of deactivation processes. Calculation of the deactivation kinetic equation. Empirical and mechanistic deactivation equations.
10. NON-CATALYTIC HETEROGENEOUS REACTIONS
Non-catalytic heterogeneous reactions. Solid-fluid reactions in particles of constant size. Models for decreasing particle size. Experimental determination of the controlling stage.

TEACHING METHODS

Types of face-to-face teaching activities and student work:
Lecture or theoretical class (30 face-to-face hours): The professor exposes the objectives and most relevant kinetic aspects of each topic. For a good assimilation of the concepts and their application, he provides information, bibliography and documentation for the development of the teaching. The student assimilates the concepts, takes notes and plans the preparation of the subject. In addition, a proactive attitude is expected in class, raising doubts and complementary issues and responding to questions posed by the teacher. This participation will be taken into account in the final evaluation.
Classroom practice - problems (20 classroom hours): The professor selects model works and exercises to illustrate the concepts corresponding to the subject. He/she supervises and supports the problem solving work developed by the students. The student solves selected problems or the proposed works. He/she presents the results on the blackboard or through written reports.
Seminars - classroom tutorials (10 classroom hours): The teacher solves doubts and raises questions to be discussed. Analyzes the student's progress and perseverance. Recommends methods of work in the subject. Proposes work to the group. Guides and moderates the discussion of the results. The student actively participates in this teaching task, raising doubts arising in the programmed tasks. In addition, he/she exposes and discusses the results of the assigned works/problems, orally or in writing, individually or in group, on the assigned works. The participation in the seminars will be part of your final grade.

Types of non face-to-face teaching activities and student work:
Work, at home or in the library, personal and sometimes in groups using the available resources (theoretical classes, practical classes, bibliographic resources). Assimilates the fundamental concepts of each topic. Solves the questions raised in practical classes and tutorials. Solves the questions posed in the computer platform.
Acquires the necessary knowledge for his/her training as a chemical engineer and applies it in a reasoned way to practical situations.
Searches in the library or in other sources, preferably in the recommended bibliography, the necessary information for the extension of the topics exposed in the theoretical classes and for the resolution of theoretical questions and/or problems. The student acquires skills and abilities in the treatment of bibliographic resources to complement and reinforce the knowledge, making an effort in the discrimination between what is basic and what is of secondary importance (capacity of synthesis and analysis).
Dedication: 90 hours, 6 hours/week, 1.2 hours/day.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	10	20						
Horas de Actividad No Presencial del Alumno/a	45	15	30						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 50%
- Exercises, cases or problem sets 50%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The percentages indicated in the previous section are average values. The application intervals are indicated below.
The ordinary evaluation of the course is carried out through the continuous evaluation system. In any case, students will have the right to be evaluated through the final evaluation system, in accordance with the provisions of the UPV/EHU Evaluation Regulations (BOPV, March 13, 2017), regardless of whether or not they have participated in the continuous evaluation system. The final evaluation will consist of the number of tests necessary to demonstrate the acquisition of the competences of the subject and will be carried out in the official examination calendar.
In the case of continuous evaluation, the final grade will be established by weighting the grades obtained throughout the course:
Performance of teaching activities and exercises in seminars and non face-to-face assignments: 60-40%.
Written tests to be developed: 40-60%.
For this subject, in both continuous and final evaluation cases, not attending the final test will involve that the final mark will be not presented.
Additional details about the characteristics of the tests and evaluation system can be found in the virtual platform of the course (http://www.egela.ehu.eus).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation of the course in the extraordinary call will be carried out exclusively through the final evaluation system, which will account for 100% of the grade of the course. The final evaluation will consist of the number of tests necessary to demonstrate the acquisition of the competencies of the subject.
Failure to take the test on the official exam date will result in the automatic waiver of the corresponding call.

MANDATORY MATERIALS

Textbook for the subject:
González Velasco, J.R., González Marcos, J.A., González Marcos, M.P., Gutiérrez Ortiz, J.I., Gutiérrez Ortiz, M.A., Cinética Química Aplicada, Ed. Síntesis, Madrid, 1999.

Subject material in eGela.

BIBLIOGRAPHY

Basic bibliography

González Velasco, J.R., González Marcos, J.A., González Marcos, M.P., Gutiérrez Ortiz, J.I., Gutiérrez Ortiz, M.A., Cinética Química Aplicada, Síntesis ed., Madrid, 1999.

Detailed bibliography

Fogler, H.S., Essentials of Chemical Reaction Engineering, Prentice Hall, Boston 2011.
Smith, J.M., Ingeniería de la Cinética Química, CECSA, 3. ed., Madrid, 1992.
Izquierdo, J.F., Cunill, F., Tejero, J., Iborra, M., Fité, C., Cinética de las Reacciones Químicas, Universitat de Barcelona, Barcelona, 2004.
Izquierdo, J.F., Cunill, F., Tejero, J., Iborra, M., Fité, C., Problemas Resueltos de Cinética de las Reacciones Químicas, Universitat de Barcelona, Barcelona, 2004.
Pérez Báez, S.O., Gómez Gotor, A., Problemas y Cuestiones en Ingeniería de la Reacción Química, Bellisco ed., Madrid, 1998.
Soriano Costa, E., Alcaina Miranda, I., Cinética Química Aplicada. Problemas Resueltos, Universidad Politécnica de Valencia, Valencia, 1998.

Journals

Industrial & Engineering Chemistry Research

Universidad del País Vasco Euskal Herriko Unibertsitatea

International Journal of Chemical Kinetics
AIChE Journal
Applied Catalysis A: General
Journal of Catalysis

Web sites of interest

http://www.chm.davidson.edu/ChemistryApplets/kinetics/ (Definición de algunos conceptos cinéticos)
http://www.science.uwaterloo.ca/~cchieh/cact/c123/chmkntcs.htm(Definición de algunos conceptos cinéticos)
http://www.ems.psu.edu/~radovic/KineticsHistory.html (Breve historia de la cinética química)

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GINQUI30 - Bachelor`s Degree in Chemical Engineering	Year	Third year

COURSE

26757 - Process and Product Engineering	Credits, ECTS:	9

COURSE DESCRIPTION

The work of an engineer is multi-faceted, although its main aim is the development of new systems to convert materials and energy into useful products. Chemical engineers design processes to obtain all kinds of chemical products: pharmaceuticals, cosmetics, foodstuffs, construction materials, fibres, paper, etc. The design of processes and products is probably the most creative activity of the chemical engineer, as it allows him/her to develop new chemical and biochemical processes, introduce changes to existing processes to improve them from an environmental and/or economic point of view, etc. This activity requires creative capacity to solve problems, applying basic chemical engineering and economic principles together with aspects related to the environment, safety and health.
The aim of the subject is to learn strategies for the basic design of products and processes based on technical and economic criteria, which will serve to analyse (at a later stage) the major production process of the chemicals industry. These strategies are those applied prior to the detailed design of equipment, an aspect related to the specific subjects of the last year of the degree course.
It is a subject practically related to all the other subjects in the degree course, especially with the first three years, as it is necessary to integrate basic concepts and procedures such as:
- Proposing and solving material and energy balances in processes
- Solving the stoichiometry of chemical reactions and calculating the conversion and selectivity of the reactive agent.
- Using the first and second principles of thermodynamics.
- Using basic concepts of fluid-vapour balance.
- Using basic concepts of separation operations.
- Using basic equipment concepts for fluid transfer: pumps, compressors.
- Using the basis of heat transfer.
- Using basic equipment concepts for heat exchange.
- Using computer-assisted numerical calculations concepts.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Learning outcomes
1. Technical and scientific information search, including the literature in a foreign language (English) for the design of a chemical process to manufacture a chemical product on an industrial scale.
2. Use safety and environmental protection criteria in the design of an industrial chemical process.
3. Draw and interpret different flow diagrams (mainly Block Flow Diagram (BFD) and Process Flow Diagram (PFD)).
4. Design a base-case of a chemical process.
5. Prepare and solve the simulation of the process.
6. Use the most suitable heuristics for each design step.
7. Select the most suitable equipment for each operation unit and calcúlate the most appropriate design parameters.
8. Develop process heat integration using Pinch tecnology and design the heat exchanger network.
9. Estimate capital and manufacturing costs.
10. Perform the process profitability analysis.
11. Present the design results in a technical report.
12. Carry out the process design in a team: Contribute to group with ideas, suggestions and efforts; Participate in-group decision making; Give credit for others to contribution;Healthy communicate, actively listen and respect opinions, customs and individual preferences; Recognize collaborators strengths and weaknesses.
13. Plan activities for the design of a chemical process.
14. Analyse the processes for the production of the major chemical components in the chemicals sector, based on the above-mentioned design and operation strategies.
Students will develop the competences of the Specific Technology module, related to this subject: M03CM01, M03CM02, M03CM05, M03CM06, M03CM10 y M03CM15.
Besides, developing team work activities students will achieve the following competences: M03CM11, M03CM12, M03CM13 y M03CM14.

Theoretical and Practical Contents

1.- Process and product design. The nature of design. Steps in product and process design. Environmental protection. Safety considerations.
2.- Process synthesis. Preliminary database creation. Preliminary process synthesis. Development of the base-case design.
3.- Process simulation. Introduction. Principles of process simulators. Solution algorithms. Recycling streams.
4.- Process synthesis heuristics. Raw materials and chemical reactions. Distribution of chemicals. Separations. Heat

removal from reactors. Heat exchangers and furnaces. Pressure variation. Solid particle size and separation.
5.- Designo of reactors and reactor networks. Reactor evaluation. Ideal kinetic reaction models. Concentration, temperatura, pressure and phases. Real reactors. Reactor design for complex configurations. Reactor network design using the attainable region.
6.- Separation train synthesis. Overall configuration of separation system. de trenes de separación. Criteria for selection of separation methods. Selection of equipment. Sequencing of ordinary distillation columns. Sequencing for the separation of nonideal fluid mixtures. Separation systems for gas mixtures. Separation sequencing for solid-fluid systems.
7.- Heat integration in process plants. Minimum hot and cold utility requirements. Minimum number of heat exchangers. Heat-integrated distillation trains. Heat engines and heat pumps.
8.- Batch process design. Design of batch process units for non-continuous processes. Design of reactor-separator processes. Design of single-and multiproduct processing sequences.
9.- Estimating of costs. Investment, circulating capital and total capital cost. Types and precision of estimations. Manufacturing costs: raw materials, utilities, waste treatment, operating labor. Depreciation.
10.- Profitability analysis. Profitability criteria. Evaluation of risk. Comparing projects. Evaluation of equipment alternatives. Process modification analysis.
11.- Product design. Innovation maps. Product development process. Concept stage. Feasibility stage. Development stage. Manufacturing stage. Product- Introduction stage.
12.- The chemical industry: characteristics. Historic perspective of Chemical Industry. Evolution and trends.
13.- Energy, raw materials and products. Energy in the chemical industry. Utilities. Energy consumption and energetic efficiency. Raw materials and products. Environmental issues.
14.- Industry gases (oxygen, nitrogen and noble gases). Separation of air gases. Cold production. Distillation. Industrial installation. Noble gas production. Products.
15.- The Solvay process. Chemistry. Jaenecke diagram. Solvay plant. Electrolytic processes for chlorine-soda production. Diaphragm, mercury and membrane-cells. Procuts and applications.
16.- Sulphuric Acid. Raw materials. Production steps: combustion, catalysis and absorption. Products and applications.
17.-Construction materials, metalurgy and fertilizers.
18.- Petroleum refining. Fractionation. Catalytic and non-catalytic conversión processes. FCC. Hydrocracking. Delayed coking. Products and applications.
19.- Petrochemical industry. Raw materials. Basic petrochemical processes. Olefin and syngas production. Aromatics. Polymers.

TEACHING METHODS

1. Design of a base-case of an industrial process. Team work.
2. Reading and synthesis of reference textbooks.
3. Questionnaires
4. Case and problema solving (simulation, heat integration, cost estimation, profitability analysis, etc.).
5. Lectures
6. Bibliographic search.
7. Oral and written presentations.
8. Exams.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	50	12	18		10				
Horas de Actividad No Presencial del Alumno/a	75	24	26		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 methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 55%
- Teamwork assignments (problem solving, Project design) 45%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation system is continuous. Thus, periodically some assessments are scheduled, which are subjected to evaluation, in order to develop progressively the learning outcomes.

EXAM (40 - 60%). Individually. Two partial exams will be carried out in January and May/June. The first exam is focused on a chemical process design and the second one on manufacturing processes of the main products of the chemical industry. In both exams a minimum score of 5 is required. A second chance is given in the final exam (June) for those students who have not passed the partial exams.

INVIDIVUAL AND TEAM WORK (40-60%)

Withdrawing from the continuous assessment, the final evaluation (100%) will consist on some activities (including exams, individual and group works) that will allow the achievement of both competences and learning outcomes.
If you do not wish to participate in the continuous assessment system, you should present, by hand and in writing, your withdrawal from continuous assessment to the professor responsible for the subject. You will have 18 weeks to do this, starting from the beginning of the academic year, in accordance with the centre’s academic calendar (Article 8.3 of the Rules governing student assessment in official degree courses of the UPV/EHU).
Withdrawing from the call (continuous or overall assessment) will mean you will be graded as ‘not presented’. In the case of continuous assessment, the student may withdraw from the call in the period up to one month before the completion of the classes in the corresponding subject. This withdrawal must be presented, by hand and in writing, your withdrawal from continuous assessment to the professor responsible for the subject. If it is a case of overall (final) assessment, non-presentation at the final exam set in the official calendar (in June) will mean the automatic withdrawal from the corresponding call (Article 12 of the Rules governing student assessment in official degree courses of the UPV/EHU).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXAM(40 - 60%)
INVIDIVUAL AND TEAM WORK (40-60%)

MANDATORY MATERIALS

Software for Process Simulation PRO/II.
The information and material provided in eGela virtual platform.

BIBLIOGRAPHY

Basic bibliography

"Product & Process design principles: Synthesis, analysis and evaluation", 3ª ed.
Seider, W.D., Seader, J.D., Lewin, D.R., Widagdo, S., John Wiley & Sons, N.Y, (2010).
"Analysis, Synthesis, and Design of Chemical Processes", 3ª ed.
Turton, R., Bailie, R.C., Whiting, W.B., Shaeiwitz, J.A., Prentice Hall PTR (2009).
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"Survey of Industrial Chemistry". 3ª ed.
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"An introduction to Industrial Chemistry"
Heaton, C.A.(ed), Blackie Academic & Professional (London) 2º ed. (1991)
"Cryogenic Systems". 2ª Ed.
Barron, R. F., Oxford University Press. New York (1985).
"Sulfuric acid manufacture Analysis Control and Optimation".
Davenport, W.G and King, M.J., Elsewvier. Amsterdam (2006).

Detailed bibliography

"Chemical Product Design".
Cussler, E.L., Moggridge, G.D., Cambridge University Press, (2001).
"Chemical Engineering Design", 5ª ed.
Sinnot, R.K., Towler, G., Butterworth & Heinemann, Burlington, MA (2009).
"Plant Design and Economics for Chemical Engineers"
Peters, M.S., Timmerhaus, K.D., West, R.D., 5ª ed., McGraw-Hill, Nueva York (2002).
"Systematic Methods of Chemical Process Design"
Biegler, L.T., Grossman, I.E., Westerberg, A.W., Prentice Hall, N.J. (1997).

"Encyclopedia of Chemical Processing and Desing",
McKetta, John J. (Ed.)., Marcel Dekker, INC. New York (1977-).
"Inorganic Chemistry - An Industrial and Environmental Perspective",
Swaddle T.; Elsevier, (1997)
"Industrial Organic Chemistry". 3ª ed.,
Weissermel K. & Arpe J., VCH Publishers, Inc. New York (1997).
"Handbook of Industrial Chemistry",
Farhat A., Bassam M.A. and Speight, J.G.; Chauvel A., Lefebvre G., Editions Technip, Paris (1989)

Journals

Web sites of interest

http://www.cheresources.com/process_design.shtml
http://www.process-design-center.com/
http://www.ingquimica.com/
http://www.aiche.org/
http://www.icheme.org/
http://www.sener.es/SENER/index.aspx
http://www.trsa.es/spanish/index.asp

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GINQUI30 - Bachelor`s Degree in Chemical Engineering	**Year**	Third year

COURSE

26759 - Experiments in Chemical Engineering II	**Credits, ECTS:**	9

COURSE DESCRIPTION

Prerequisites: In order to enroll in this subject, the students must have passed the subject Experimentation in Chemical Engineering I, and they must have enrolled at least once in the following subjects:
- Mass Transfer
- Separation Processes
- Reactor Design
- Control and instrumentation of chemical processes

Aims: Practical development in the laboratory of the concepts related to the 3rd year chemical engineering subjects.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Skills:
- To understand how the different pieces of equipment work and the phenomena that take place in the units of the process that are analyzed, as well as becoming familiar with the data collection and their posterior treatment in order to determine the effect of the parameters of interest or to analyze the influence of specific variables on the process.
- The application of the experimental results obtained for the design of process installations.

Results:
- Design and management of applied experimentation procedures regarding mass transfer, chemical reactors, separation processes, and control of processes.
- Write reports professionally

Theoretical and Practical Contents

List of topics:

Section A) Mass Transfer
Experiment 1. Calculation of the diffusivity: Winkelman’s experiment.
Experiment 2. Calculation of the individual mass transfer coefficient: Air-water mass-transfer in a wet wall and in a dripping column.
Experiment 3. Calculation of the overall mass transfer coefficient: ion-exchange in a stirred tank.

Section B) Reactor design
Experiment 4. Study of the operation variables on gas-solid catalytic reactions over an acid catalyst.
Experiment 5. Design of an isothermal continuous reactor (continuously stirred tank, battery of reactors, and plug flow) for a second order reaction in liquid phase.
Experiment 6. Non-ideal circulation in homogeneous reactors. Measurements of residence time distribution. Application of the dispersion model and that of tanks in series.

Section C) Separation Processes
Experiment 7. Ammonia stripping from an aqueous solution.
Experiment 8. Distillation of a binary mixture.
Experiment 9. Liquid-liquid extraction.
Experiment 10. Ion-exchange in a fixed bed.

Section D) Control of chemical processes
Experiment 11. Identification and dynamic modelling of a single-loop controlled process. Analysis of several PID controllers’ tuning methods. Application of the models.
Experiment 12. Analysis of a cascade control system. Tuning of controllers. Tuning right on the installation.
Experiment 13. Multivariable control of a double-loop control system. Analysis of the interaction. Tuning of the controllers.

TEACHING METHODS

Students are organized in groups of 3 or 4 people to carry out the experiments and to complete the reports. Nevertheless, the exam is individual.
The students carry out the experiments corresponding to two sections in each midterm: Mass-Transfer and Reactor Design in the first midterm and Separation Processes and Control of Chemical Processes in the second one.

In each midterm, master classes are given to explain the theoretical concepts related to the corresponding experiments. Subsequently, explanations of the specific procedures for each experiment are given in seminar classes. These seminars include viewings of the laboratories for checking the pieces of equipment that will later be used. After the experiments of each midterm are completed, more seminar sessions take place to clear up possible questions that may arise during the preparation of reports. The students have around two more weeks to finish their assignments and upload their final reports.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	12	24		54					
Horas de Actividad No Presencial del Alumno/a	12	33		90					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 40%
- Multiple choice test 10%
- Exercises, cases or problem sets 10%
- Teamwork assignments (problem solving, Project design) 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Exam: 40%
Completion of written reports (lab report): 40%
Laboratory practice (attendance, equipment handling, laboratory notebook, etc.): 20%

Continuous assessment:
There will be two midterm exams during the school year. Students will be exempt from the final exam if they obtain at least a 5/10 in each of the exam sections of the midterm exams. During the final exam, students will have to answer the questions related to the sections that they did not pass on the midterm exams. If the mark obtained in each of the sections of the final exam is higher than the one previously obtained in the corresponding midterm exam, the mark of the final exam is the one that will be taken into account to calculate the mean mark. On the contrary, if the mark obtained in a section of the final exam is lower than the one obtained in the midterm exam for that section, the average value of the two marks will be considered for that section in order to calculate the overall mean value of exams. In order to pass the subject, a minimum mark of 3.5/10 will be required in each of the exam sections after the final exam. Moreover, the mean value of the exam mark will have to be at least 4.5/10. Furthermore, the completion of all the laboratory experiments, to be an author or coauthor of the lab reports of all experiments, and to have obtained at least 5/10 on the parts corresponding to laboratory reports and lab practice will also be necessary.

Final assessment:
Students will have 18 weeks from the beginning of the school year to deliver by means of a written message their refusal of the continuous assessment to the professors of the subject. Hence, students will be allowed to be evaluated by the final exam. In order to pass the subject, the following will be required: at least a 3.5/10 in each of the sections of the final exam; and at least an average mark of 4.5/10 on the exam. Moreover, the mean value of the exam mark will have to be at least 4.5/10. Furthermore, the completion of all the laboratory experiments, to be an author or coauthor of the lab reports of all experiments, and to have obtained at least 5/10 on the parts corresponding to laboratory reports and lab practice will also be necessary

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

In the event that the sanitary conditions prevent the realization of a face-to-face evaluation, a non-face-to-face evaluation will be activated, of which the students will be informed in due course.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Students who have to sit the extraordinary call exam will have to answer questions related to all the sections and obtain at least a 3.5/10 on each of them. Furthermore, the mean mark of the exam will need to be at least 4.5/10. The marks

obtained on the exams of the ordinary call will not be taken into account.
The marks of the reports and lab practice will be kept, whenever they were passed. Otherwise, students will have to complete the reports and laboratory experiments that were considered as failed.

In the event that the sanitary conditions prevent the realization of a face-to-face evaluation, a non-face-to-face evaluation will be activated, of which the students will be informed in due course.

MANDATORY MATERIALS

Manual of experiments
Laboratory notebook

BIBLIOGRAPHY

Basic bibliography

Lide, D.R. Ed. CRC Handbook of Chemistry and Physics, 89th Edition, CRC press, London, 2008
Perry, R.H., Manual del Ingeniero Químico, (4 vol), 7ª Ed, McGraw Hill, México, 2002.
Treybal, R.E., Mass Transfer Operations, 3ª Ed., McGraw Hill, Nueva York, 1980.
Levenspiel, O., Ingeniería de las Reacciones Químicas, Reverté, Barcelona, 1990.
Stephanopoulos, G., Chemical Process Control: An Introduction to Thery and Practice, Prentice Hall Int., Englewood Cliffs, N.J., 1984.

Detailed bibliography

Seader, J.D., Henley, E.J., Separation Process Principles, John Wiley & Sons, Nueva York, 1998.
Jacobsen, H.A., Chemical Reactor Modeling, Springer Berlin Heidelberg, Berlin, 2008
Seborg, D.E., Edgar, T.F., Mellichamp, D.A. "Process Dynamics and Control", John Wiley and Sons, Nueva York (1989). (2º Ed 2004)

Journals

Chemical Engineering Education,
Ingeniería Química

Web sites of interest

http://www.vrupl.evl.uic.edu/vrichel/ (Virtual Reality in Chemical Engineering Laboratory)
http://www.che.iitb.ac.in/courses/uglab/manuals/labmanual.pdf (Chemical Engineering Laboratory Manual)
http://www.che.boun.edu.tr/che302/Chapter%201.pdf (Chemical engineering laboratory I)

OBSERVATIONS

Oharra: Laborategiko ekipoak gaizki erabiltzeak irakasgaiaren suspentso automatikoa ekar lezake.

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GINQUI30 - Bachelor`s Degree in Chemical Engineering	**Year**	Fourth year

COURSE		
26763 - Mechanical Design of Process Equipment	**Credits, ECTS:**	6

COURSE DESCRIPTION

Codes and rules. Structural design criteria. Design of cylindrical, spherical, heads and covers.
Design of nozzles and openings. Fatigue in pressure vessels. Design of bolted flange connections and vessels supports.
Mechanical design of heat exchanger and other equipments.
This course requires the knowledge acquired in Material Resistance course studied in the third year of Chemical Engineering degree (second term). The course provides knowledge, in the professional field, appropriate to perform engineering work in the metal sector.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Specific skills:
- Analyze, model and calculate equipment and installations for the handling of solid and fluids materials, and for heat transmission.
- Establish, considering the basic principles of engineering and material resistance, the specifications and the design of the equipment and installations suitable for a process.

Cross curricular skills:
- Compare and select technological alternatives integrating technical, economic, environmental and social impact criteria.
- Use information and communication technologies applied to advanced learning, and handle basic information sources, including specific databases of the modules, as well as office tools to support oral presentations
- Communicate and transmit, basically, in writing and orally, the knowledge, results, skills and abilities acquired in a multidisciplinary and multilingual environment.
- Participate and lead, where appropriate, working groups with critical reasoning and constructive spirit
- Solve problems of the common subjects of the industrial sector, raised with quality criteria, sensitivity for the environment, sustainability, ethical criteria and peace promotion.

Theoretical and Practical Contents

1. Pressure vessel codes and rules. Development of pressure vessel construction codes. Structural and material considerations.
2. Elasticity and plasticity. Design parameters. Stress-strain. Iron and steel production process in the industry. Hot and cold rolling-extrusion-refiling.
3. Structural design criteria for pressure vessels. Modes of failure. Theories of failure. Stress types. Allowable stress limits. Service limits. 3. Fracture. Fracture types. Ductile fracture. Brittle fracture. Brittle fracture mechanisms. Fracture mechanics.
4. Design for cyclic loading. Pressure vessels fatigue. Design of fatigue S - N. Fatigue mechanisms. Fatigue limit. Fatigue limit determination. Fatigue life. Design stress. Cumulative damage. Fatigue evaluation procedure.
5. Design at low temperatures. Fracture toughness. Standardized tests. Ductile-to-brittle transition temperature. Fracture toughness testing. Tough materials.
6. Design at high temperatures. Creep. Factors that affect creep. Design of creep curves. Mechanism of the creep process. Resistant materials under extreme temperature conditions.
7. Choice of design material for pressure vessel. Design by successive properties. Design by multiple properties. Corrosion and types of corrosion.
8. Design of pressure vessels. Part 1: Design of cylindrical and spherical vessel shells. Loads assessment. Thin-shell vessels. Thick-shell vessels. Approximate equations. Buckling of cylindrical shells. Safety factor. Part 2: Design of heads and covers. Hemispherical heads. Ellipsoidal heads. Torispherical heads. Conical heads. Toriconical heads. Flat heads and covers.
9. Design of nozzles and openings. Stress concentration about a circular hole. Cylindrical shell with a circular hole under internal pressure. Spherical shell with a circular hole under internal pressure. Reinforcement of openings. Nozzles.
10. Pipelines. Disposal of pipes in plant. Mechanical engineering of pipeline. Pipelines support systems. Maintenance and repairs. Design of vessel supports and bolted flange connections. Lug supports. Support skirts. Saddle supports

TEACHING METHODS

In the Lectures the relevant theoretical information of each topic will be provided, highlighting the fundamental aspects of them. This information must be complemented with the specific bibliography, whose reference is supplied in the virtual classrooms and at the end of each topic.
In the Computer classes, problems of mechanic design of equipment will be solved, using programs of general use in the resolution of problems. The problems will be developed individually or in groups of students. In the last case, one of the students will be leader and responsible for each of the stages of the process, problem proposal and schematization, resolution and results and conclusions. Computer class attendance is compulsory (minimum assistance 80 %).

Computer classes will be taught in a telepresential way.

In the seminar classes, global problems about mechanical design and their subsequent development will be solved. Seminar class attendance is compulsory (minimum assistance 80 %).

Seminar classes will be taught in a telepresential way.

The resolution of issues and problems will be evaluated by the teacher for follow-up.

In order to complement their training in bibliographic search, autonomy and presentations, skills each group of students will in writing (and/or oral) a topic on mechanical design of equipment and installations that will consist of: index, introduction, theoretical foundation, analysis and realization of the design, results and conclusions, nomenclature and bibliography.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	40	10			10				
Horas de Actividad No Presencial del Alumno/a	60	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 methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 90%
- Exercises, cases or problem sets 5%
- Individual assignments 2%
- Teamwork assignments (problem solving, Project design) 3%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS ASSESSMENT SYSTEM
- Written exam , theory and problems 70-90%
- Practical work (exercises, case studies & problems set) 5-15%
- Individual work 5-15%

A minimum score of 5 in each task is required for counting the tasks.

The minimum score to pass will be 5.0 in theory and 5.0 in problems. To count the tasks, the minimum exam score must be 5.0. A minimum score of 5 in the exam is required for counting the tasks.

REQUESTING THE FINAL ASSESSMENT SYSTEM
Students that would like to be assessed by means of the final assessment system, regardless their participation in the continuous assessment, will have to present a written request addressed to the teacher in charge before week 9 by means of egela website.
Overdue requests or by other means ones will NOT be accepted.

ASSESSMENT CALL REJECTION
Both in the case of continuous and final assessment, since the weight of the final exam of the subject "Mechanical Design of Equipment" is greater than 40%, it will be enough with not presenting to the final exam, so that the final grade of the subject is <<not presented>> (Art. 12.2 Text approved in the Degree Committee of May 16, 2019 and applicable in 2019/20)

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

ASSESSMENT TESTS OR EXAM: 100%

The minimum score to pass will be 5.0, with a score higher than 4.0 in both theory and problems.

MANDATORY MATERIALS

- Basic bibliography (books and ASME code)
- Documentation of the topics provided in egela

BIBLIOGRAPHY

Basic bibliography

Chattopadhyay, S.; Pressure vessels: design and practice, CRC Press, Boca Ratón, Fla., 2004.
Rothbart, H.A.; Brown, T.H.; Mechanical Design Handbook, Second Edition, McGraw Hill, 2006.
Farr, J.R.; Jawad, M.H.; Guidebook for the Design of ASME, Section VIII: Pressure Vessels, Third Edition, ASME, 2005.
Megyesy, E.; Pressure Vessel Handbook, 14th Edition: ASME Code Section VIII, Division I Condensed; The Mechanical Engineering Reference Manual for the Design and Fabrication of ASME Boilers & Pressure Vessels, Pressure Vessel Publishing, 2008.
Moss, D.R.; Pressure Vessel Design Manual, Third Edition, Elsevier, 2004.
Singh, K.P.; Soler, A.I.; Mechanical Design of Heat Exchangers and Pressure Vessel Components, Arcturus Pub, 1992
Escoe, K.; Piping and Pipelines Assessment Guide, Volume 1, Gulf Professional Pub., 2006.
Kuppan, T.; Heat Exchanger Design Handbook, Marcell Dekker, 2000.
Escoe, A.K.; Mechanical Design of Process Systems: Piping and Pressure Vessels, CRC Press, Boca Ratón, 1994.
Escoe, A.K.; Mechanical Design of Process Systems: Shell-And-Tube Heat Exchangers, Rotating Equipment, Bins, Silos, Stacks, CRC Press, Boca Ratón, 1995.

Detailed bibliography

2007 ASME Boiler & Pressure Vessel Code VIII Division 1 Rules for Construction of Pressure Vessels, ASME, 2007.

Journals

www.asme.org/ American Web de la Society Of Mechanical Engineers - ASME.

Web sites of interest

- www.asme.org

OBSERVATIONS

During the evaluation tests:
- It is not allowed to use books, notes or notebooks, programmable calculator (non-programmable is allowed), as well as any kind of mobile phone, computer or electronic devices. All electronic devices must be turned off and put away, they never must be on the table.
- Once an evaluation test has been started, students are not allowed to leave the examination room during the first fifteen minutes. Subsequently, if a student leaves the classroom, he/she will not be able to enter again, under no circumstances (there will be no exit permission).
- If unethical or dishonest behaviour is detected, the protocol dealing with academic ethics and prevention of fraudulent and dishonest behaviour in evaluation test and academic assessments in the UPV/EHU will be applied. (https://www.ehu.eus/es/web/estudiosdegrado-gradukoikasketak/akademia-araudiak)

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GINQUI30 - Bachelor`s Degree in Chemical Engineering	**Year**	Fourth year

COURSE

26765 - Oil and Petrochemistry	**Credits, ECTS:**	4,5

COURSE DESCRIPTION

"Petroleum and Petrochemicals" is one of the optional subjects taught in the fourth term of the 4th year of the Degree in Chemical Engineering. it is part of the module called Intensification. In this subject the basis of oil refining is studied and an introduction is made to the different processes that make up the petrochemical sector.

Given its nature of intensification in the knowledge and application of raw materials in chemical engineering, it helps the training of chemical engineers through the development of processes to convert crude oil and oil fractions (including waste product recovery) into useful products for the consumer society. In this respect, scientific and technical knowledge about the chemical processes used in the petroleum and petrochemical industry will help chemical engineers to optimise production processes and introduce improvements into the different aspects of the process, with the aim of obtaining more efficient fuels and petrochemical products that are sustainable and more environmentally-friendly.

The work done in this subject will enable students to analyse the origin and stages of formation of petroleum and characterise the physical and chemical properties of its fractions. At the same time, the different processes of chemical transformation of petroleum and the raw materials used in the petrochemical industry (natural gas, olefins, etc.) will be studied from a scientific and technical point of view to obtain a range of useful products, from fuels and lubricating oils (in the case of a refinery) to polymers and many other derived products in the case of the petrochemicals sector.

To take "Petroleum and Petrochemicals" without too much difficulty, the student should have a basic mastery of material and energy balances. Basic knowledge of equipment design for fluid transport and heat exchange is also necessary, and also of reaction equipment and separation operations (covered in other subjects of the degree course).

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCES:

- Master and evaluate the technological and socioeconomic state of the chemical industry in general, and particularly in the local environment (G010).
-Apply the knowledge acquired to the development of innovative technologies and processes in strategic sectors of the chemicals sector (M04CM01).
- Use sources of data and databased related to the specific content studied in the Intensification module, plus office tools to support oral presentations (M04CM04).
- Efficiently communicate, in writing and orally, the knowledge, results and skills acquired, in a multidisciplinary and multilingual setting (M04CM05).

LEARNING OUTCOMES:

1. Look for technical and scientific information, including the literature in English, for the analysis and justification of refining and petrochemical processes.
2. Apply criteria of safety and environmental protection in the scientific analysis of petroleum-based products.
3. Incorporate, using block diagrams, the different parts of a refinery in a general layout
4. Handle tools to characterise petroleum fractions
5. Create flow diagrams of the different units in a refinery.
6. Analyse the processes for the production of petroleum-derived products and natural gas-based products, based on design and operation strategies.

Theoretical and Practical Contents

SECTION I.-PETROLEUM REFINING

1.- INTRODUCTION. Origin and Occurrence. Exploration, Recovery and Transportation. Types of crude oil. Chemical composition. Fractional composition. Petroleum analysis. General scheme and main objetives of a refinery.

2.- PETROLEUM FRACTIONATION. Crude oil reception. Storage. Dewatering and desalting. Pretreatment. Atmospheric distillation. Vacuum Distillation.

3.- REFORMING PROCESSES. Naphtha catalytic reforming. Alkylation. Isomerization. Technologies for the production of oxygenate compoungs.

4.- NON CATALYTIC CONVERSION PROCESSES. Thermal cracking. Coking processes. Visbreaking.
5.- CATALYTIC CONVERSION PROCESSES. Catalytic cracking. Catalysts. Fluid Catalytic Cracking (FCC). Hydrocracking.

6.- PETROLEUM FRACTION FINING: Desulphurization. Merox process. Sulphur compound extraction and sweetening. Sulphur recovery: Claus process. Lubricating oil production.

7.- INTEGRATION OF UNITS IN THE REFINERY. Types of refinery: "hydroskimming", médium conversión, high conversión, mixed.

8.- PRODUCTS. .Light and médium distillates. Liquified Petroleum Gases. Gasoline. Diesel. Lubricating oil. Asphalt. Fuel oil. Coke. Automotive fuel composition and formulation.

SECTION II.- PETROCHEMICAL INDUSTRY

10.- BASIC PRETROCHEMICAL PRODUCTION (I). Hydrocarbon decomposition. Synthesis Gas production. Steam Reforming. Partial Oxidation. Syngas aplications: hydrogen, ammonia and its derivatives. Methanol and its derivatives.

11.- BASIC PETROCHEMICAL PRODUCTION (II). Hydrocarbon transformation. Olefin production. Steam cracking. Olefin production technologies. Aromatic production. Hydrocarbon separation processes.

13.- SYNTHETIC PETROCHEMICAL PRODUCTION. Ethylene, Propylene, Butenes and diolefins. Benzene, Toluene, Xilenes (BTX). Polymerization technologies: monomers, polymers and copolymers. Main polymers and their applications.

FIELD WORK
Students will make a guided visit to the Petronor refinery in Muskiz, focusing on the laboratories for the analysis an characterisation of crude oil and its fractions. They will also have the opportunity to visit the different units of the refinery. This visit is subject to the rules of the refinery.

TEACHING METHODS

1. Lectures, combined with other cooperative learning techniques and active methodologies: Flipped Classroom, gamification, cooperative techniques, etc.
2. Reading and synthesis of text books.
3. Problem solving and practical activities (crude oil characterization).
4. Oral and written work presentations.
5. Questionnaires.
6. Exams.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	27	7	8						3
Horas de Actividad No Presencial del Alumno/a	30,5	15	19						3

Legend:

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 40%
- Exercises, cases or problem sets 10%
- Teamwork assignments (problem solving, Project design) 50%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS ASSESSMENT:
- Written exam: 40% (mínimum 5 of 10)
- Cases and problem solving: 10%
- Group Works (problem solving, projects): 50%

FINAL ASSESSMENT:

Withdrawing from the continuous assessment, the final evaluation (100%) will consist on some activities (including exams) that will allow the achievement of both competences and learning outcomes.

If you do not wish to participate in the continuous assessment system, you should present, by hand and in writing, your withdrawal from continuous assessment to the professor responsible for the subject. You will have 9 weeks to do this, starting from the beginning of the academic year, in accordance with the centre’s academic calendar (Article 8.3 of the Rules governing student assessment in official degree courses of the UPV/EHU).

In the case withdraw the continuous assessment, since the weight of the final exam is 40%, the student may withdraw from the call in the period up to one month before the completion of the classes in the corresponding subject. This withdrawal must be presented, by hand and in writing, your withdrawal from continuous assessment to the professor responsible for the subject. If it is a case of overall (final) assessment, non-presentation at the final exam set in the official calendar (in January) will mean the automatic withdrawal from the corresponding call (Article 12 of the Rules governing student assessment in official degree courses of the UPV/EHU).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Only the final assessment will be possible:
Written exam: 100%

MANDATORY MATERIALS

The information and material provided in eGela virtual platform.

BIBLIOGRAPHY

Basic bibliography

BASIC BIBLIOGRAPHY (Petroleum)

Speight J. G.; "The Chemistry and Technology of Petroleum". Fourth edition. CRC Press (2007)
Ramos Carpio, M. A.; "Refino de petróleo, gas natural y petroquímica"; Ed. Fundación Fomento Innovación Industrial, Madrid (1997)
Wauquier, J. P. "El refino del Petróleo: Petróleo crudo, Productos petrolíferos, Esquemas de Fabricación". Ed. Díaz de Santos, Madrid (2004).
Wauquier, J.P.; "Petroleum Refining: Separation Processes". Editions Technip, Paris (2000).
Leprince, P; "Petroleum Refining: Conversion Processes". Editions Technip, Paris (2001).

BASIC BIBLIOGRAPHY (Petrochemistry)

Chauvel, A., Lefebvre, G., "Petrochemical Processes. Technical and Economic Characteristics". 2 Tomos (Tomo 1: Synthesis-Gas Derivatives and major Hydrocarbons, Tomo 2 : Major Oxigenated, Chlorinated and Nitrated Derivatives); Ed. Technip, Paris, (1989).
Matar S. and Hatch L. F.; "Chemistry of Petrochemical Processes".2nd edition. Gulf Publishing Company, Houston, Texas (2000)
Weissermel K. and Arpe H-J.;"Industrial Organic Chemistry". Third edition VCH Publishers, Inc., New York (1997)

Detailed bibliography

Hsu, C., Robinson, P.; "Handbook of Petroleum Technology". Springer. New York (2017).
Meyers R. A.; "Handbook of Petroleum Refining Processes". Third edition. MacGraw Hill. New York (2004).
Tresse, S.A., Pujadó, P.R., Jones, D.S.; "Handbook of Petroleum Processing" 2º ed. Springer, New York (2015).
Parkash S.; "Refining Processes Handbook". Elsevier. (2003)
Trambouze, P.; "Petroleum Refining: Materials and Equipment". Editions Technip, Paris (2000)
Favennec, J.P.; "Refinery Operation and Management". Editions Technip, Paris (2001)
Gary, R.Y., Handwerk, G.E.; "Petroleum Refining - Technology and Economics" 4ª Ed., Marcel Dekker, New York (2001)

Journals

Hydrocarbon Processing

Fuel
Fuel Processing Technology
Energy & Fuels
Journal of Petroleum Science and Engineering
Petroleum Science
Chemistry and Technology of Fuels and Oils
International Journal of Oil, Gas and Coal Technology

Web sites of interest

REPSOL: http://www.repsol.com
BP OIL:http://www.bp.com
Honeywell UOP: http://www.uop.com
Instituto Francés del Petróleo: http://www.ifpenergiesnouvelles.fr/
Total: https://www.total.com/en/spain

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GINQUI30 - Bachelor`s Degree in Chemical Engineering	**Year**	Fourth year

COURSE

26766 - Chemical Process Economics	**Credits, ECTS:**	4,5

COURSE DESCRIPTION

This subject has two main objectives:
1. To provide students with principles, basic concepts, and methodology of engineering/industrial economics.
2. To help students to develop skills in the use of these methods and the rational decision making processes that they will encounter in their professional practice.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Specific competences to be developed in this matter:
A. Knowledge of economic aspects to be considered in the evaluation of industrial projects, especially those related to chemical engineering.
B. Learning of methods for evaluating investment alternatives in engineering.
C. Cost-estimation of process equipment in engineering, and replacement analysis.
D. Probabilistic risk analysis and decision-making.

Transversal or generic competences to be developed in the subject and in the Chemical Engineering degree:
CT1. Ethical commitment.
CT2. Learning capacity.
CT3. Teamwork.
CT4. Creative and entrepreneurial skills.
CT5. Communication skills.
CT6. Autonomy and responsibility.

Theoretical and Practical Contents

Chapter 1. INTRODUCTION TO ENGINEERING ECONOMY
Economy: Macroeconomics and microeconomics. The principles of Engineering economy. Engineering economy and the design process. Analysis and comparison of alternatives. Examples.
Chapter 2. ELEMENTS FOR THE ENGINEERING ECONOMIC ANALYSIS
Capital costs: investment and working capital. Cost concepts. Depreciation and its consideration as cost. Capital-estimation and cost-estimation techniques. Revenues and benefits. Income taxes.
Chapter 3. THE TIME VALUE OF MONEY
The concept of interest and equivalence. Types of interés; simple, compound, continuous. Cash-flow diagrams. Present and future equivalent values. Uniform series and arithmetic/geometric gradients of cash flow. Perpetuity investments.
Chapter 4. EVALUATING A SINGLE PROJECT
Conventional rate of return. The mínimum attractive rate of return (MARR). The present worth method. The future worth value. The anual woth method. The internal rate of return. The external rate of return. The payback (payout) period method.
Chapter 5. COMPARISON AND SELECTION AMONG ALTERNATIVES
Classification of investment alternatives. Independent alternative analysis. Analysis of mutually exclusive alternatives. The marginal criteria. Considering the lifetime of alternatives. Application of the anual worth method.
Chapter 6. REPLACEMENT ANALYSIS
Reasons for replacement analysis. Determining the economic life of a new asset (challenger). Determining the economic life of a defender. Comparison when useful lifes are different. After-tax replacement.
Chapter 7. FINANCIAL ANALYSIS
Sources of funds: loans and interest. The financial leverage. The leasing. A possible decisión: leasing or purchase?
Chapter 8. SENSITIVITY ANALYSIS.
What will happen if…? Sensitivity of a single project. Sensitivity of alternatives..
Chapter 9. BENEFIT-COST ANALYSIS.
Optimization target set variables. Optimal project capacity. Utilization coefficient: critical and closing productions. Calculation of capacity to be installed in a dynamic market. The dumping concept.
Chapter 10. RISK ANALYSIS AND DECISSION MAKING. Probabilistic concpts. Decision trees. Discounted decission trees: a combination of present worth value, probability and expected value. Sensitivity of decisions. Making decisions under uncertainty. Competitive decisions: game theory.

TEACHING METHODS

Theoretical concepts, magister lectures (M). (19 h). Assimilate concepts, take notes, plan the preparation of the topic. Raise doubts and complementary questions.

Practical activities and problems (GA). (11 h). Solve selected problems or proposed work. Presentation of results on blackboard or through written reports.
Seminars (S). (15 h). Raise doubts arising from non face-to-face assignments. Expose their results on the assigned work. Discussion of results.
Personal study. (45,5 h). Individual or group study activities planned by the students themselves, outside of regular classes.
Case-based study and internet questionaires. (22 h). Solve problems or work proposed in each topic or answer questionnaires posed on the Internet. Presentation of results through written reports.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	19	15	11						
Horas de Actividad No Presencial del Alumno/a	33	22	12,5						

Legend:

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

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

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Along the course exerxcises, case-based learning and problems will be proposed and resolved, which evaluation could provide up to 40% of the final mark.
Two specific written exams will be proposed, for each half of the matter. These assesments will complement the remaining 60% of the final mark.
When the minimum requirements have not been met or the global computation of previous sections has not reached a grade of 50%, the student should take the Final Exam with the total content of the course (no release of parts is considered).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Final written exam, for the final assesment and final mark.

MANDATORY MATERIALS

1. Resources in Moodle platform
2. Williams G. Sullivan, Elin M. Wicks y James T. Luxhoj, Engineering Economy, 17ª edición, Prentice Hall, Nueva Jersey, 2021.

BIBLIOGRAPHY

Basic bibliography

1. Williams G. Sullivan, Elin M. Wicks y James T. Luxhoj, Engineering Economy, 17ª edición, Prentice Hall, Nueva Jersey, 2021.
2. 16 american professors reveal their files, Engineering Economy: Exam Files, Engineering Press, San José, California, 1984.
3. José A. Sepúlveda, Williams E. Souder y Byron S. Gottfried, Engineering Economics, Schaum¿s Outline Series in Engineering, McGraw Hill, Nueva York, 1984.

Detailed bibliography

1. Max Kurtz, Handbook of Engineering Economics: Guide for Engineers, Technicians, Scientists, and Managers, McGraw Hill, Nueva York, 1984.
2. James L. Riggs y Thomas M. West, Engineering Economics, 3ª edición, McGraw Hill, Nueva York, 1986.

Journals

Web sites of interest

OBSERVATIONS

Universidad del País Vasco · Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GINQUI30 - Bachelor`s Degree in Chemical Engineering	**Year**	Fourth year

COURSE

26767 - Energy Engineering	**Credits, ECTS:**	4,5

COURSE DESCRIPTION

The subject develops competences with subsequent use in the field of Energy Engineering. Specifically, the subject will analyze and classify the different sources of energy and study the strategies to transform thermal energy into mechanical energy.
The teaching is face-to-face and is completed with various non-face-to-face tasks. Thus, the development of generic skills and competences such as autonomous learning, teamwork and problem solving will be promoted. In order to properly follow the subject, one must have acquired the skills and elementary concepts of Thermodynamics.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

A- Identify the different forms of energy (Primary and final energy).
B- Acquire scientific bases of the production and conversion of Energy.
C- Apply the basic principles of thermodynamics and thermotechnics and their application to solving energy engineering problems.
D- Understand the principles and objectives of the different energy transformation strategies with high efficiency (Engines, turbines, co-generation, renewable energies, energy policy ... etc).
E- Develop skills to solve practical problems.

The main learning outcomes, based on tasks or activities that the students should be able to develop after completing the course, are specified below:
• Identify the different forms of primary and final energy and understand the thermodynamic principles for the conversion of primary energy into final energy.
• Understand and interpret energy balances.
• Perform material and energy balances in combustion facilities. Calculate fuel consumption and the quantity and composition of combustion gases.
• Know the physico-chemical properties of solid, liquid and gaseous fuels as well as the calculation methodology of the upper and lower heat of combustion.
• Understand the thermodynamic cycles for the production of electric power in power plants with steam turbines and gas turbines.
• Design power plants with steam turbines and/or gas turbines: calculation of fuel requirements, selection of working fluid, inlet pressure to the turbine, condenser pressure, calculation of the thermal efficiency of the plant.
• Understand the strategies for increasing thermal efficiency: cogeneration and combined cycle.
• Know the thermodynamic cycles for the production of mechanical energy in internal combustion engines.
• Classify and understand the technology for the use of renewable energies.

Theoretical and Practical Contents

1. INTRODUCTION. Objectives of the Energy Engineering. Forms of energy: Primary and final energy. Scientific bases of the production and conversion of Energy.
2. FUELS AND COMBUSTION. Types and properties of fuels. Estimation of heat of combustion.
3. COMBUSTION FACILITIES. Material balance: Theoretical and real air calculation. Steam generators Energy balance.
4. THERMAL ENGINE. Concept of Thermal Engine. Classification of Thermal Engines. Efficiency criteria. Calculation of the thermodynamic properties of pure substances. Steam quality. Representation of thermal processes in P-V, T-V, T-S, H-S diagrams.
5. STEAM BASED POWER PLANTS. Rankine cycle. Strategies to increase efficiency: regeneration and overheating. Thermonuclear power stations.
6. GAS TURBINES. Brayton cycle. Strategies to increase efficiency: regeneration, overheating and stepped and refrigerated compression. Combined cycle.
7. INTERNAL COMBUSTION ENGINES. Otto and Diesel engines. Mixed cycle.
8. COGENERATION. Generation and Cogeneration. Cogeneration Technologies. Header Cycles and Tail Cycles. Efficiency criteria in cogeneration plants.
9. RENEWABLE ENERGIES. Classification and description of renewable energies: consolidated and developing technologies. Vector hydrogen and fuel cells.
10. ECONOMIC AND ENVIRONMENTAL ASPECTS OF ENERGY. Management of electricity supply and demand. Energy plans Energy reserves: Theory of the Hubbert peak. The global warming of the Planet. International agreements: Kyoto Protocol and its implications.

TEACHING METHODS

In order that the students can acquire the specific competences previously exposed, three different types of teaching modalities have been programmed: theory classes, practical classes and seminars. In the theory classes (T) the teacher presents the student with a summary of the topic in which it will include the fundamental objectives and concepts and information on material to prepare the topic. In the practical classes (GA) problem solving and/or questionnaires will be shown to apply the acquired knowledge. Those classes will be interactive, which allow discussing different resolution methodologies, identifying advantages and disadvantages of each of them. The seminars classes (S), will be held in smaller groups, to provide a working group environment and facilitate the discussion of doubts. Here, more personalized tasks will be programmed and analyzed according to the needs of the student. In addition to the domain of knowledge, competences on oral expression and synthesis and reasoning skills will also be evaluated. The seminars will also be used to review and share tasks assigned during the course to strengthen the concepts worked on. In general, in the planned activities, the student must be involved in processes of information search, analysis and critical reasoning.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	15	8	22						
Horas de Actividad No Presencial del Alumno/a	23	12	32,5						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Individual assignments 10%
- Teamwork assignments (problem solving, Project design) 10%
- Oral presentation of assigned tasks, Reading¿ 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

There are two evaluation methodologies: i) continuous evaluation, and ii) final evaluation. In the continuous evaluation, students must complete the tasks scheduled during the course, with the following percentages of qualification: resolution of individual tasks (10%), team project development (10%), group work with oral presentation (10 %) and individual written examns (70%). Two individual written exams will be carried out during the course, the first one in the middle of the semester and the second during the last teaching week. In order to be able to pass the subject in continuous evaluation, it is required to obtain a minimum grade of 4.0 in each of the individual written exams. Fulfilling this criterion, a minimum grade of 5.0 is required to PASS the subject in its continuous evaluation modality, taking into account the qualification percentages above detailed. In the case of not having obtained a minimum grade of 4.0 in any of the individual written exams, students will have to take a final written exam on the official date established for the ordinary examination session. The qualification of the subject will be made according to the percentages of qualification previously described. A minimum grade of 5.0 is required to PASS the subject.
Students can be evaluated through the final evaluation system, regardless of whether or not they have participated in the continuous evaluation system. For this, students must communicate to the teacher the renouncement to continuous evaluation, for which they will have a period of 9 weeks from the beginning of the subject, according to the academic calendar of the center.

Although being part of the continuous evaluation methodology, not taking the ordinary final exam of the subject will lead to a calification of NOT PRESENTED.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The final evaluation exam of the extraordinary evaluation session will consist of the necessary activities to be able to measure and evaluate the learning results. These results will include 100% of the final grade.

MANDATORY MATERIALS

The content of this section will be detailed in eGela on-line course.

BIBLIOGRAPHY

Basic bibliography

• Fundamentals of Engineering Thermodynamics. M.J. Moran, H.N. Saphiro, D.D. Boettner, M.B. Bailey, Wiley, London, 2014.
• Energy Science: principles, technologies, and impacts. J. Andrews and Nick Jelley, Oxford University Press, New York, 2017.
• Combustion Science and Engineering. K. Annamalai, I.K. Puri, Taylor & Francis, New York, 2007.
• Combustion Engineering. K.W. Ragland, K.M. Bryden, Taylor & Francis, New York, 2011.
• Handbook of Energy Engineering. P.E. Tyler G. Hicks, Mc Graw Hill, New York, 2012.

Detailed bibliography

Journals

Fuel
Combustion and Flame.
Combustion Science and Technology.

Web sites of interest

• https://www.iea.org/. International Energy Agency.
• http://www.eve.eus/. Basque Energy Agency.

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GINQUI30 - Bachelor`s Degree in Chemical Engineering	**Year**	Fourth year

COURSE

26769 - Project Organization and Management	**Credits, ECTS:**	7,5

COURSE DESCRIPTION

The objective of the topic consists of the acquisition by the student of the necessary knowledge about the terminology, content, structure and development of the project and its application in relation to the professional profiles and competences of the degree.
With the proposed program, the student should:
Know the professional field of the Chemical Engineer in relation to Project Management.
Acquire a global vision of Project Management, and master the fundamentals regarding their formulation, morphology and evaluation.
Know and understand the functions of Project Management.
Gain proficiency in Project Management techniques.
Be able to integrate into any work team for the design or management of engineering, business or development projects.

The descriptors are:
Methodology of projects. Organization, planning and programming. Project execution. Control and follow up. Project closure. Rules and legislation.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Competences
-Master the phases of writing, planning and management of industrial projects in general and the Chemical Industry in particular.
-Use information and communication technologies applied to advanced learning, and handle basic sources of information, including databases specific to the modules, as well as office tools to support oral presentations.
-Communicate and transmit, basically, in writing and orally, the knowledge, results, skills and abilities acquired in a multidisciplinary and multilingual environment.
-Organize and plan activities, adapting to group work, with recognition of diversity and multiculturalism, critical reasoning and constructive spirit.
-Participate and lead, where appropriate, work groups with critical reasoning and constructive spirit.
-Solve problems of the common matters of the industrial field, raised with criteria of quality, sensitivity for the environment, sustainability, ethical criteria and promotion of peace.

Expected learning outcomes
-Apply the theoretical concepts of Project Management to a practical case.
-Develope an economic feasibility study.
-Make an organization chart / temporal planning of the tasks of a project.

Theoretical and Practical Contents

LESSON 1. Introduction to Project Management. Concept and definition of project. Basic concepts of management and project management (Project Management). Project Management concept. Project Management functions. Fields of Project Management. Objectives and processes of Project Management.
LESSON 2. Project structure. Morphology of the project. Stage of approach, design and engineering. Stage of production and consumption. Project process. Matrix of project activities. Project cycle. Origin (types) of project.
LESSON 3. Contents and documents of the project. Memory. Plans. Specification of conditions. Budgets. Own-entity studies. Prevention of occupational risks (Health and Safety Study). Evaluation (Study) of Environmental Impact.
LESSON 4. Stages of the project. Feasibility study / preliminary study (Phase I). The preliminary draft (Phase II). Development project (Phase III). Implementation / start-up / operation of the project (Phase IV).
LESSON 5. Industrial legislation. Documentation for obtaining permits and licenses. Applicable municipal regulations. Permissions and licenses. Other project legislation for industrial facilities. Applicable general legislation.
LESSON 6. Purchase management. Hiring of the construction and assembly of the project. Purchase management. Hiring of civil works. Assembly contracting. 'Package LESSONs'. Construction and assembly of the project.
LESSON 7. Budgets and project evaluation. Economic analysis of projects. Economic items in projects. Estimation of economic items. Economic methods of evaluation and analysis of investments. Methods that do not take into account the value of money over time. Methods that take into account the value of money over time (chronological value of money).
LESSON 8. Planning and programming of projects. Gantt diagrams / network models. Programmatic methods: PERT, CPM. Optimization of time / cost. Leveling of personnel and equipment. Verification and adjustment of the programming.

TEACHING METHODS

The teaching of the subject is composed of different modalities.

In the lectures, the main contents of each topic will be discussed.
In the classroom classes, the students will perform different practical exercises that will complement the exposed theory.
In the seminars, the acquired skills will be complemented by some practical examples or cases to be discussed, usually in groups.
In the computer classes, activities related primarily to feasibility studies and project planning will be solved.
The students through the realization of a work must apply the acquired knowledge and skills to a project of an industrial installation.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	45	12,5	7,5		10				
Horas de Actividad No Presencial del Alumno/a	67,5	18,75	11,25		15				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 65%
- Oral presentation of assigned tasks, Reading¿ 35%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In ordinary call, the evaluation of the subject will be an average of a written test to be developed and an oral presentation (including the presentation on paper) made in-group. The contributions of the final mark will be 65% and 35%, respectively.
The written test will contain two parts, one of a theoretical-applied character and another of a practical nature. The respective contributions will be (60% and 40%). The practical part will focus on an economic feasibility study and a temporary project planning.
Written work
Oral Presentation (MS Power Point)
Compulsory attendance of all students to oral presentations
Discussion time

In the event that the sanitary conditions prevent the realization of a face-to-face evaluation, a non-face-to-face evaluation will be activated of which the students will be informed promptly.
Groups of two / three students
Free theme (to agree with the teachers)
The resignation of this evaluation system must be submitted in writing to the teacher before the end of the ninth week of the course.
Resignation of the ordinary call
The student who resigns from the call will have the mark of not presented.
In the case of continuous evaluation, students may waive the call in a period that, at least, will be up to one month before the end date of the teaching period of the corresponding subject. This waiver must be submitted in writing to the teacher.
When it is a final evaluation, the non-presentation to the test set on the official exam date will automatically waive the corresponding call.

For this subject, in both continuous and final evaluation cases, not attending the final test will involve that the final mark will be not presented.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The mark will be determined from a single written test that will include issues to develop and problems, taking into account the exposure of the work as a consultant.

To renounce this evaluation system, it is sufficient not to take the exam.

MANDATORY MATERIALS

Materials provided by the teacher and textbooks

BIBLIOGRAPHY

Basic bibliography

"Project management: a systems approach to planning, scheduling, and controlling" 9th ed. Kerzner, H., John Wiley & Sons, (2006)

Detailed bibliography

"Project Management Case Studies, 3rd Edition", Kerzner, H., John Wiley & Sons, (2009)
"Handbook for Process Plant Project Engineers", Peter Watermeyer, John Wiley & Sons, (2002)
"Engineering Economy", Sullivan, W.G., Wicks, E.M., Luxhoj, J.T., Prentice Hall, 2003.

Journals

Web sites of interest

OBSERVATIONS

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 310 - Faculty of Science and Technology

Cycle .

Degree GINQUI30 - Bachelor`s Degree in Chemical Engineering

Year Fourth year

COURSE

26770 - Chemical Engineering & Sustainability

Credits, ECTS: 4,5

COURSE DESCRIPTION

The subject "Chemical Engineering and Sustainability" of 4.5 ECTS, is optional and is taught in the first four-month period of the fourth year. This subject aims to bring the student to the current status and future approaches in the chemical industry, where the variable environment should also be considered in the design of processes along with the rest of the variables. A special attention is paid to the environmental aspects and impacts of chemical processes and a vision of European actions focused on sustainable development is given.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Principles of Sustainable Chemistry. Atomic economy. Applications of Catalysis in Sustainable Chemistry. Renewable Sources for the Obtaining of Energy. Life Cycle Assessment. Concepts of Best Available Technology and IPPC.
- CM01 - Apply the knowledge acquired to the development of innovative technologies and processes in strategic sectors of the Chemical Industry, focused on renewable energy, environment and border fields.
- CM04 - Handle skillfully the sources of information and databases related to the specific subjects studied in the intensification module, as well as office tools to support oral presentations.
- CM05 - Communicate and transmit, effectively, in writing and orally, the knowledge, results, skills and abilities acquired in a multidisciplinary and multilingual environment.
- CM06 - Organize, plan and lead activities in working groups, with recognition of diversity and multiculturalism.
- CM08 - Solve specific problems of the studied subjects, propose alternative problems, all of them raised with criteria of quality, sensitivity to the environment, sustainability, ethical criteria and promotion of peace.

Theoretical and Practical Contents

LESSON 1.- BASIC CONCEPTS OF SUSTAINABLE CHEMISTRY. Principles of "Green" Chemistry. Sustainability Parameters
LESSON 2.- ATOMIC ECONOMY. Performance of a Process. Types of Chemical Reactions. Examples of Processes
LESSON 3.- CATALYSIS IN SUSTAINABLE CHEMISTRY. Concept of Catalysis. Concept of Selectivity and types of Selectivity. Heterogeneous and Homogeneous Catalysis. Industrial Catalytic Applications.
LESSON 4.- RENEWABLE ENERGY SOURCES. General Bases. Renewable Raw Materials. Renewable Fuels Hydrogen. Biomass, Bioethanol and Biodiesel. Fuel cells.
LESSON 5.- LIFE CYCLE ANALYSIS. Principles and Fundamentals of the LCA. Methodologies: Functional Unit, Assignment Rules, Environmental Impact Assessment.
LESSON 6.- INDUSTRIAL PROCESSES IN THE CONTEXT OF THE IPPC. The IPPC Directive. Concept of Best Available Technology. BREF documents. Transparency Information: EPER Inventory. Applications.

TEACHING METHODS

Prior to the master classes, where the teacher will develop the contents of the different topics raised, the student will have, through the e-gela platform, the graphic material used, as well as documents of interest related to the subject. During the seminar classes, students in small groups will solve small questions raised by the teacher or inquire about some topic.

TYPES OF TEACHING

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

Legend:

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Multiple choice test 50%
- Exercises, cases or problem sets 20%
- Oral presentation of assigned tasks, Reading¿ 30%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the case of continuous evaluation, the evaluation would be according to:

FINAL EXAM: 50% OF THE FINAL MARK (minimum mark to be obtained: 4.0)
REALIZATION OF PRACTICAL CASES AND WRITTEN REPORTS (SEMINARS): 20% OF THE FINAL MARK
WORK (REPORT, ORAL EXPOSURE): 30% OF THE FINAL MARK
The student who wishes to renounce the continuous evaluation and choose the final evaluation must communicate it in writing to the teacher before week 9.

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

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation is through a FINAL EXAM (100%). It is considered that the student waives the call if they do not take the final exam.

MANDATORY MATERIALS

Materials provided by the teacher

BIBLIOGRAPHY

Basic bibliography

T. Anastas, J.C. Warner, Green Chemistry: Theory and Practice, Oxford University Press, 2000.
A.S. Matlack, Introduction to Green Chemistry, Marcel Dekker, 2001.
J.H. Clark, D. Macquarry, Handbook of Green Chemistry and Technology; Blackwell, 2002.
J.J. Bozell, M.K. Patel (eds.) Feedstocks for the Future: Renewables for the Production of Chemicals and Materials. American Chemical Society, 2006.
G. Rothenberg, Catalysis: Concepts and Green Applications, Wiley-VCH, 2008.
J.B. Guinee. Handbook on Life Cycle Assessment, Springer, 2002

Detailed bibliography

P.T. Anastas, L.G. Heine, T.C. Williamson (Eds.), Green Chemical Synthesis and Processes, ACS Symp. Series 767, ACS 2000.
R.A. Sheldon, I. Arends, U. Hanefeld. Green Chemistry and Catalysis, Wiley-VCH, 2007.
M.F. Hordeski. Alternative Fuels: The Future of Hydrogen, Second Edition, CRC Press, 2008.
A. Züttel (Editor), Hydrogen as a Future Energy Carrier, Wiley, 2008.
H. Baumann; A.M. Tillman. The Hitch Hiker¿s Guide to LCA. An orientation in life cycle assessment methodology and application, Studentlitteratur, 2004.
W.M. Nelson. Green Solvents for Chemistry, Oxford University Press, 2004.

Journals

Green Chemistry
The International Journal of Life Cycle Assessment
Catalysis Today

Web sites of interest

http://www.epa.gov/
http://www.pte-quimicasostenible.org/
http://www.usc.es/biogrup/redciclovida.htm
http://lct.jrc.ec.europa.eu/
http://feique.org
http://eippcb.jrc.es

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GMATEM31 - Bachelor's Degree in Mathematics	**Year**	Fourth year

COURSE

26212 - Algorithm Design	**Credits, ECTS:**	6

COURSE DESCRIPTION

Esta asignatura se imparte sólo en castellano.

The main objective of the course is to study the principles of the algorithm design. Students will learn the main goal and functionality of each proposed technique for problem solving. Its general scheme, common implementations, the involved computational resources as well as their applications will be studied.
The starting points are the basic computation knowledge and programming skills acquired so far during the grade course, particularly, but not only, in the first-year subjects "Introduction to Computing" and "Programming Foundations". In this framework, the foundations of algorithm design are introduced using an algorithmic language. Comparative analyzes are performed based on specifications, costs and constraints. In addition, effective implementations of the techniques presented are also studied. The computer analysis of resrouces really used will also be carried out.
The expertise and skills acquired in this course will support the student in the computer resolution of any algorithmic problem arising in the other subjects.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIES
M09CM07 - To select the most appropriate algorithm design techniques for solving each problem.
M09CM08 - To study the computational costs of algorithms.
M09CM09 - To propose valid alternatives based on the problem specifications and / or on the limitations on the algorithms.
M09CM10 - To propose effective implementations.
LEARNING OUTCOMES
The student must know the fundamental methods of algorithm design and be able to choose the appropriate algorithmic techniques for solving the proposed problems, as well as carry out comparative analysis based on specifications and objectives. He/she must also be capable of designing efficient implementations as well as estimating and analyzing their computational costs. The students must also be able to perform analyses of real costs on a computer. Finally, they must communicate ideas and results related to the subject both orally and in writing.

Theoretical and Practical Contents

1. INTRODUCTION: efficiency of algorithms, spatial and temporal complexities, analysis of recursive algorithms, review of basic techniques.
2. STATE-SPACE SEARCH ALGORITHMS: general schema, Depth First Search, Backtracking, Branch and Bound.
3. INFORMED SEARCH: heuristics and evaluation functions, optimal search, A* algorithm.
4. GREEDY ALGORITHMS: general schema, Prim algorithm, Kruskal algorithm, Dijkstra algorithm, applications to technological problems.
5. DYNAMIC PROGRAMMING: general recursive and iterative schemas, Principle of Optimality, Minimum Paths, Applications to technological problems.

COMPUTER PRACTICES
P0.- Selection and verification of the programming environment
P1.- Analysis of Iterative and recursive algorithms.
P2.- Depth first search (backtracking); branch and bound
P3.- Decision algorithms in zero-sum games.
P4.- Optimization problems: A* algorithm, greedy algorithms and dynamic programming.

TEACHING METHODS

The theoretical content will be exposed in master classes that follow basic references that appear in the Bibliography and in the material of obligatory use. These master classes will be complemented with problem classes (classroom practices) in which students will be asked to solve questions and exercises and thus the knowledge acquired in the theoretical classes will be applied. In the seminars, the students will make presentations of questions and examples related to the content of the course. In addition, there will be computer practices aimed at achieving the practical skills defined in the subject.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	5	10		15				
Horas de Actividad No Presencial del Alumno/a	45	7,5	15		22,5				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- . 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Continuous assessment:
- Presentations in Seminars: 15%
- Algorithmic resolution of proposed problems: individual exercises to be delivered along with a written exam (15%) and a final exam (45%).
- Individual Practice Work (Computer Practices): reports to be delivered and an additional verification on the computer 25%

A minimum score of 4/10 is required at each evaluation element.
Final Evaluation in the Ordinary Call:
- Algorithmic resolution of proposed problems (exam): 75%
- Individual Practice Work (Computer Practices): reports to be delivered and an additional verification on the computer 25%

A minimum score of 4/10 is required at each evaluation element.
If the sanitary conditions recommend to remove in-person exams then distance procedures will be activated. Students will be informed through the eGela platform.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Final Evaluation in the Extraordinary Call:
- Algorithmic resolution of proposed problems (exam): 75%
- Individual Practice Work (Computer Practices): reports to be delivered and an additional verification on the computer 25%

A minimum score of 4/10 is required at each evaluation element.
If the sanitary conditions recommend to remove in-person exams then distance procedures will be activated. Students will be informed through the eGela platform.

MANDATORY MATERIALS

Phyton programming language.
Course slides and some basic books.

BIBLIOGRAPHY

Basic bibliography

- Gilles Brassard, Paul Bratley. Fundamentos de algoritmia. Prentice-Hall, 2006.
- Ian Parberry. Problems on Algorithms (Second Edition). Prentice Hall, 2002.
- Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein. Introduction to Algorit ms (Third Edition). The MIT Press, 2009.
- Ellis Horowitz, Sartaj Sahni, and Sanguthevar Rajasekaran. Computer algorithms (second Edition). Universities Press, 2007.
- Francesc J. Ferri, Jesús v. Albert, Gregorio Martín, Introducció a l'anàlisi i disseny d'algorismes, Universitat de Valencia, 1998
- Robert Sedgewick an Kevin Wayne: Algorithms (Fourth Edition).
- Steven S. Skiena. The Algorithm Design Manual (Second Edition). Springer, 2008.

Detailed bibliography

- Jason Brownlee: Clever Algorithms: Nature-Inspired Programming Recipes. lulu.com, 2012
- Weixiong Zhang: State-Space Search. Algorithms, Complexity, Extensions and Applications. Springer 1999,

- Bo Xing and Wen-Jing Gao. Innovative Computational Intelligence: A Rough Guide to 134 Clever Algorithms. Springer 2014.

Journals

Web sites of interest

- Wikipedia (English version) [en.wikipedia.org]
- Clever Algorithms: http://www.cleveralgorithms.com/nature-inspired/index.html
- Algorithm language in Latex
- Algorithm2e: http://www.ctan.org/pkg/algorithm2e
- Use of Algorithm2e in Spanish: http://tex.stackexchange.com/questions/146050/how-to-write-pseudo-code-in-other-languages-spanish
- Python Programming Language
- Official Website: http://python.org/
- The Python Tutorial: https://docs.python.org/3/tutorial/
- Python 3 documentation: https://docs.python.org/3/
- Problem Solving with Algorithms and Data Structures Using Python
- Official Website: http://interactivepython.org/runestone/static/pythonds/index.html

OBSERVATIONS

Clarifications: students will have the right to be evaluated through the final evaluation system, regardless of whether or not they have participated in the continuous evaluation system. To do this, students must submit in writing the waiver of continuous assessment to the teaching staff responsible for the subject. To this end, students will have a period of 9 weeks for quarterly subjects and 18 weeks for annual subjects, starting from the beginning of the quarter.

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GMATEM31 - Bachelor's Degree in Mathematics	Year	First year

COURSE

26645 - Linear Algebra and Geometry I	Credits, ECTS:	12

COURSE DESCRIPTION

In this course, students will become familiar with basic concepts of Linear Algebra and some of their applications. Student will also be introduced to the management of mathematical language and the most common demonstration techniques.

In Degree in Mathematics, this subject shares a module with Linear Algebra and Geometry II, which is studied in the second year of the Degree. Both subjects have as common goal the understanding of the main concepts of Linear Algebra and Affine and Euclidean Geometries and their use to solve linear problems through matrices and geometric problems on planes and spaces. Likewise, both courses intend for the student to acquire basic and horizontal training in these subjects to allow them to understand and apply such knowledge and skills in multiple interrelated directions. Also, the contents studied in both will be used in both mandatory and optional higher-level courses.

In Degree in Physics, Degree in Electronic Engineering and Double Degree in Physics and Electronic Engineering, Linear Algebra and Geometry I, Differential and Integral Calculus I, Vector and Complex Analysis and Mathematical Methods comprise the Mathematics module. The central goal of this module is the acquisition of mathematical tools to allow students to focus on the physical aspects in other modules in the respective curricula. Likewise, students will learn to appreciate mathematical abstraction and conceptual rigour.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SPECIFIC COMPETENCIES
Know how to solve linear equation systems.
Understand the concept of vector space and the basic concepts related to vector spaces (subspaces and quotient spaces, basis and spanning set, linear transformations).
Know how to diagonalize matrices and compute the Jordan form of a matrix.
Know how to orthogonalize a vector system in an euclidean space.
Know how to diagonalize a quadratic form.
Work with points, vectors, distances and angles in affine and euclidean spaces.
Use references systems, subspaces and affine transformations.
Solve geometric problems of the plane and the spaces.
Classify isometries in the plane and the space, giving its type and characteristic elements.

LEARNING OUTCOMES
Solve linear equation systems.
Compute the Jordan form of a matrix.
Compute an orthogonalization of a vector system in an euclidean space.
Diagonalizing a quadratic form.
Work with points, vectors, distances and angles in affine and euclidean spaces.
Use references systems, subspaces and affine transformations.

Theoretical and Practical Contents

UNIT 1. VECTOR SPACES.
Vector space. Vector subspaces. Basis and dimension of a vector space. Change of basis.
UNIT 2. LINEAR TRANSFORMATIONS.
Linear transformations. Kernel and Range of a linear transformation. Isomophisms of Vector spaces. Matrix of a linear transformation.
UNIT 3. SYSTEMS OF LINEAR EQUATIONS AND DETERMINANTS.
Rank of a matrix. Elementary transformations and the computation of the rank of a matrix. System of linear equations. Rouché-Frobenius Theorem. The symmetric group. Determinant of a matrix. Cramer's Rule.
UNIT 4. DIAGONALIZATION OF ENDOMORPHISMS FROM V INTO V.
f-invariant subspaces. Eigenvalues and eigenvectors. Characteristic polynomial. Diagonalization. Introduction to Jordan canonical form.
UNIT 5. BILINEAR AND QUADRATIC FORMS.
Bilinear forms. Associated matrix of a bilinear form. Orthogonality. Non-degenerated forms. Orthogonal basis. Sylvester's law of inertia. Quadratic forms.
UNIT 6. EUCLIDEAN SPACES.
Inner product and norm. Orthonormality. Orthogonal subspaces. Some special endomorphisms. Isometries.
UNIT 7. AFFINE GEOMETRY
Affine structure of R^n. Affine subspaces. Intersection and parallelism. Affine reference system.
UNIT 8. EUCLIDEAN GEOMETRY

Universidad del País Vasco / Euskal Herriko Unibertsitatea

Euclidean affine structure of R^n. Perpendicularity. Distances and angles. Euclidean affine geometry of the plane and the space.
UNIT 9. GEOMETRIC TRANSFORMATIONS.
Affine transformations. Translations. Homotecies. Symmetries. Proyections. Rotations. Movements and similarities. Movements in the plane and the space.
UNIT 10. INTRODUCTION TO CONICS AND QUADRATICS.
Geometric elements of the conics. Reduction equations of the conics. Reduction equations of the quadratics.

TEACHING METHODS

Using the lecture methodology, the theoretical sessions will be presented in the master sessions, following the basic references contained in the Bibliography and the mandatory material. These lectures will be complemented with problem-solving classes in the practical classroom. These will be proposed to the students to solve questions in which the knowledge acquired in the theoretical classes is applied. Finally, in the seminar sessions, students will take a more active role and develop issues and representative examples of the content of the subject.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	72	12	36						
Horas de Actividad No Presencial del Alumno/a	108	18	54						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- See Guidelines and resignation 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

A final written examination will be taken on the subject taught in class on the date set in the official examination calendar of the Faculty corresponding to the regular May-June evaluation. This exam will be on the second of the dates assigned in the May-June calendar for the course. This examination will evaluate the level of acquisition of all the skills associated with the subject.

In addition, in order for students to be able to measure their progress in learning the subject, two partial exams are scheduled to take place in the official exam period in January and May-June, respectively. Both partial exams will be written. The first of the partial exams will cover the content explained in the first term of the course (weeks 1-15). The second partial exam will evaluate the acquisition of the competences associated to the content explained during the second term (weeks 16-30) and will take place on the first of the dates assigned to the course in the official May-June exam calendar. Students who pass one of the two partial exams or both partial exams will not have to take the exam on the content they have passed in the final exam of the ordinary evaluation.

CONTINUOUS EVALUATION:

PERCENTAGES OF THE MARKS
Written exam: 80%-100%
Oral exhibitions: 0%-5%
Submitted exercises and problems: 0%-15%

To apply the mentioned percentages the minimum mark in the written exam would be 4 over 10.

NON-CONTINUOUS EVALUATION: Final written exam 100%

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

A final written examination will be taken on the subject taught in class (weeks 1-30) on the date set in the official examination calendar of the Faculty corresponding to the extraordinary evaluation.

Final written exam: 100%

MANDATORY MATERIALS

Classroom notes. Exercise and problem sheets.

BIBLIOGRAPHY

Basic bibliography

M. CASTELLET e I. LLERENA, Álgebra Lineal y Geometría, Reverté, 2000.
M. EIE, S. CHANG, A first course in linear algebra, World Scientific, 2016.
E. HERNÁNDEZ, M.J. VÁZQUEZ y M.A. ZURRO, Álgebra Lineal y Geometría, Pearson, 2012.
P. PETERSEN, Linear algebra, Springer-Verlag, 2012.
A. SHELDON, Aljebra Lineala ondo egina, Euskal Herriko Unibertsitateko Argitalpen Zerbitzua, UPV/EHU, 2017.
A. SHELDON, Linear Algebra Done Right, Springer International Publishing, 2015.
G. STRANG, Introduction to Linear Algebra, 5th ed. Wellesley-Cambridge Press, 2016.
A. VERA y P. ALEGRIA, Problemas de Geometría Analítica y Formas Bilineales. Murcia,1993.
A. VERA y J.M. ARREGI, Aljebra Lineala eta Geometria I, Ed. AVL, Bilbao 1998.
A. VERA, J.L. HERNANDO y F.J. VERA, Problemas de Algebra I, Ed. Ellacuria, Bilbao 1986.
A. VERA y F.J. VERA, Introducción al Álgebra. Ed. Ellacuria, Bilbao 1984.

Detailed bibliography

R. BENAVENT, Cuestiones sobre Álgebra Lineal, Paraninfo, 2011.
J. DE BURGOS, Álgebra lineal y Geometría cartesiana, MacGraw-Hill, 2006.
J. DE BURGOS, Test y Problemas Álgebra, García-Maroto Editores, 2011.
W. H. GREUB, Linear Algebra, Springer-Verlag, 1981.
I.M. GUELFAND, Lecciones de Álgebra Lineal, Servicio Editorial de la Universidad del País Vasco, 1986.
E. HERNÁNDEZ, Álgebra y Geometría, Addison Wesley, 1999.
J. IKRAMOV, Problemas de Álgebra Lineal, Mir, 1990.
I.V. PROSKURIAKOV, Problemas de Álgebra Lineal, Mir, 1986.

Journals

Web sites of interest

https://ocw.ehu.eus/file.php/133/algebra/Course_listing.html
http://ocw.ehu.es/course/view.php?id=212
http://ocw.ehu.es/course/view.php?id=43
https://ocw.ehu.eus/course/view.php?id=343
http://ocw.ehu.es/ciencias-experimentales/introduccion-al-algebra-lineal/Course_listing
http://math.about.com/od/linearalgebra/Linear_Algebra_Help_and_Tutorials.htm

OBSERVATIONS

COURSE GUIDE 2024/25

Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GMATEM31 - Bachelor's Degree in Mathematics	**Year**	Second year

COURSE

26666 - Linear Algebra and Geometry II	**Credits, ECTS:**	6

COURSE DESCRIPTION

The objective of the subject is to deepen into some of the topics of linear algebra and geometry that were treated more superficially in the course Linear Algebra and Geometry I (canonical forms, affine, euclidean and proyective geometry, conics and quadrics). Both subjects belong to the same module and have as a common objective to learn main concepts of both linear algebra and affine and euclidean geometry. The aim is to use such knowledge to solve both linear problems using matrices and geometric problems of the plane and the space.

Another purpose of these courses is students to acquire a basic and horizontal training in these matters that allow them to understand and apply such knowledge and skills in multiple interrelated directions. Indeed, most of the contents in them will be used in higher courses.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SPECIFIC COMPETENCIES
M16CM03 - To understand the abstract concept of vector space and related basic concepts (subspaces and quotient spaces, basis and generating systems, linear aplications).
M16CM04 - To be able to diagonalize a matrix and to be able to compute the Jordan form of a matrix.
M16CM05 - To know how to orthogonalize a system of vectors in the euclidean space.
M16CM06 - To know how to diagonalize a quadratic form.
M16CM07 - Operate with points, vectors, distances and angles in the afine and euclidean space.
M16CM08 - To use, adequately, systems of references, subspaces and afine transformations.
M16CM09 - To solve, reasonably, geometric problems in the plane and space.
M16CM10 - To classify isometries in the plane and space determining their type and charactersitic elements.
M16CM11 - Understand the basics of the affine, euclidean and projective geometry.
M16CM12 - To recognise main types of homographies.
M16CM13 - To recognise conics and quadrics and to find their prominent elements.

LEARNING OUTCOMES

- To be able to diagonalize a matrix and to compute the Jordan form of a matrix.
- To know how to orthogonalize a system of vectors in the euclidean space.
- To know how to diagonalize a quadratic form.
- Operate with points, vectors, distances and angles in the afine and euclidean space.
- To use, adequately, systems of references, subspaces and afine transformations.
- To calssify isometries in the plane and space determining their type and charactersitic elements.
- To recognise main types of homographies.
- To recognise conics and quadrics and to find their prominent elements and classify them in the projective, afiine and metric spaces.
- To solve, reasonably, geometric problems in the plane and space.
- To use the suitable computing methods in each geometry.

Theoretical and Practical Contents

1. QUOTIENT VECTOR SPACES: Quotient vector space. Bases and dimension. Isomorphism theorem for vector spaces.
2. TRIANGULARIZATION AND JORDAN CANONICAL FORM: Endomorphisms and triangularizable matrices. Generalized fundamental subspaces. Jordan canonical form. Cayley-Hamilton Theorem. Minimal polynomial.
3. DUAL VECTOR SPACES: Dual space. Dual bases. Dual map. Orthogonality.
4. AFFINE EUCLIDEAN SPACES: Euclidean spaces: Orthogonality and duality. Affine spaces. Affine subspaces. Affine reference frames. Barycentric coordinates. Convexity. Affine maps. Affine euclidean spaces. Orthogonal affine subspaces. Clasification of isometries.
5. PROJECTIVE SPACES: Projective space. Homogeneous coordinates. Projective subspaces. Dual projective space. Homographies. Double points and hyperplanes. Main homography types.
6. CONICS AND QUADRICS: Classification of conics and quadrics from the affine, metric and projective viewpoint. Sheaves.

TEACHING METHODS

The theoretical sessions will be presented in the lectures, following the basic references contained in the Bibliography and the mandatory material. These lectures will be complemented with problem-solving classes in the practical classroom work sessions, in which the knowledge acquired in the theoretical classes will be applied. Finally, in the seminar sessions, students will take a more active role and will develop and discuss representative examples/exercises of the contents of the subject. In order the discussion to be more productive, those exercises will be given to the students in advance so that they can work on them before the seminar.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	6	18						
Horas de Actividad No Presencial del Alumno/a	54	9	27						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- See GUIDELINES 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Final written exam: %80-%100
Individual and/or group tasks: 0-%20

If any student renounces the continuous evaluation method, the final written exam of the usual call counts the 100% of the final mark.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Same percentages as in the ordinary call. The qualification of the students who have not previously passed the individual and/or group tasks part will depend solely on the written exam of the extraordinary call. Similarly, if any student renounces the continuous evaluation method, the final written exam of the extraordinary call counts the 100% of the final mark.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

M. CASTELLET e I. LLERENA, Álgebra Lineal y Geometría, Reverté, 2000.
I.M. GUELFAND, Lecciones de Álgebra Lineal, Servicio Editorial de la Universidad del País Vasco, 1986.
E. HERNÁNDEZ, Álgebra y Geometría, Addison Wesley, 1999.
J. IKRAMOV, Problemas de Álgebra Lineal, Mir, 1990.
I.V. PROSKURIAKOV, Problemas de Álgebra Lineal, Mir, 1986.

Detailed bibliography

W. H. GREUB, Linear Algebra, Springer-Verlag, 1981.
S. LANG, Linear Algebra 3rd. ed., Springer-Verlag, 1987.
R. H. WASSERMAN. Tensors & Manifolds, Oxford University Press, 1992.

Journals

Web sites of interest

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GMATEM31 - Bachelor's Degree in Mathematics	**Year**	Fourth year

COURSE

26671 - Number Theory	**Credits, ECTS:**	6

COURSE DESCRIPTION

The course focuses on a selection of topics from analytic and algebraic number theory. One of the big four items listed in the program below (THEORETICAL/ PRACTICAL CONTENT) will be selected each year, depending on the circumstances, and the course will deal with it. For the moment, the second topic, "Number Fields and Rings of Integers" has been selected.

More specifically, the aim of the course will be to understand how the "Fundamental Theorem of Arithmetic" (which states that every natural number greater than 1 can be written uniquely as a product of primes) can be extended to more general rings than the ring of ordinary integers, which are subrings of the field of complex numbers. These rings are the so-called rings of integers of number fields, that is, the finite extensions of the field of rational numbers.

We start from scratch, setting the existence and uniqueness of factorization in the ordinary integers. Next, we study the basic properties of principal and factorial domains. Then we pass to the study of the ring of integers of the a number field, Dedekind domains and the unique factorization theorem for ideals in these rings. Finally, a more detailed study of quadratic fields is made and the properties known so far for these rings are applied to the study of representations of integers by means of quadratic forms, to the resolution of Diophantine equations and to other related topics.

The classic example that serves as a model to what is studied in the course is Fermat's theorem on sums of two squares: an odd prime number is the sum of two squares of whole numbers if and only if it leaves remainder 1 when divided by 4. Of the several known proofs of this theorem, in our course it is highlighted the proof that can be deduced easily from the fact that the so-called ring of Gaussian integers is a factorial domain.

As a requirement to follow the course, a certain familiarity with the handling of congruences and with the basic concepts of the theory of commutative rings (homomorphisms, quotient rings, ideals, etc) is desirable. It is recommended, to get an idea about the topics, methods and ideas of the content of the course and the level at which they will be dealt in the class, to browse the first lessons of Stewart and Tall's book mentioned in the bibliography below.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIES

1. To apply the main methods for the study of arithmetic functions.
2. To relate different problems of number theory with arithmetic functions.
3. To know the problem of factorization in the rings of integers of number fields.
4. To know the basic facts about elliptic curves, the operation between its points and some of its properties and applications.
5. To know what are the main problems of additive number theory and its relations to other problems.

LEARNING OUTCOMES

1. To know how to deduce the laws of decomposition of primes in abelian extensions of the field of rational numbers.
2. To know how to apply the methods of algebraic number theory in the resolution of diophantine equations.
3. To be able to recognize problems of number theory whose solution depends on an elliptic curve.
4. To know how to calculate the rank and the torsion of the group of rational points of an elliptic curve in simple cases.
5. To know how to find estimates for different measures of algebraic numbers: means and measures of Mahler.

Theoretical and Practical Contents

1. ARITHMETIC FUNCTIONS: Dirichlet products and means. Distribution of prime numbers: Theorem of Chebyshev. The Prime number theorem. Its elementary proof. Its analytical proof. Characters and Theorem of Dirichlet.

2. NUMBER FIELDS AND RINGS OF INTEGERS: Integral extensions of rings. Dedekind rings. Unique factorization of ideals. Laws of decomposition of primes.

3. ELLIPTIC CURVES: The group law on a cubic. Rational points. Torsion points. Theorem of Mordell-Weil. Computation

of the rank.

4. ADDITIVE THEORY OF NUMBERS: Sums of squares. Partitions. Jacobi functions. The problem of Waring.

TEACHING METHODS

The theoretical content will be exposed in master classes following basic references that appear in the Bibliography. These master classes will be complemented by problem classes (classroom practices) in which students will apply the knowledge acquired in the theoretical lectures in order to solve problems. In the seminar sessions, exercises and representative examples will be considered. These will have been given to the students in advance, for them to have enough time to work out the solutions. Students must participate actively in the seminar sessions, and discussion of the solutions will be encouraged. Individual work on theory and problems might be proposed to the students, with the support of the lecturer, if needed, during the seminar sessions.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	6	18						
Horas de Actividad No Presencial del Alumno/a	54	9	27						

Legend:

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- See GUIDELINES 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

There will be a final writing exam. To pass the subject it will be enough to pass the writing exam and follow the activities in class. If the student decides to go to the final exam, the final mark will be the weighted average of the following activities, with the indicated weights:

20%, for other types of exercises, either individual or in groups, and written or with oral exposition, developed during the course.

80%, the final written exam (but, in any case, a minimum of four points out of 10 will be necessary to pass the subject)

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

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

There will be a writing exam. The final mark will be the weighted average of the following activities, with the indicated weights:

20%, for other types of exercises, either individual or in groups, and written or with oral exposition, developed during the course.

80%, the final written exam.

For the students not participating during the course in other types of exercise, the final mark will be that which is obtained in the written exam corresponding to this call.

In the event that the sanitary conditions prevent the realization of a face-to-face evaluation, a non-face-to-face evaluation will be activated, of which the students will be informed promptly

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

P. SAMUEL, Théorie algèbrique des nombres, Hermann, Paris, 1967.
I. STEWART, D. TALL, Algebraic Number Theory, Chapman&Hall, 1987.

Detailed bibliography

S. LANG, Algebraic Number Theory,1994.
R. LONG, Algebraic Number Theory, Marcel Dekker,1977.
D.A. MARCUS, Number Fields, Springer,1977.
T. ONO, An Introduction to Algebraic Number Theory, Plenum,1990.

Journals

Web sites of interest

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GMATEM31 - Bachelor's Degree in Mathematics	**Year**	Fourth year

COURSE

26672 - Differentiable Manifolds	**Credits, ECTS:**	6

COURSE DESCRIPTION

This subject is taught exclusively in Spanish.

Both the differential and the integral calculus in Euclidean spaces will be generalised to certain topological spaces known as differentiable manifolds. These spaces can be locally identified with Euclidean spaces by means of suitable local coordinate systems. Thus, the local geometry of manifolds is reduced to classical analysis, while the notions and relations which do not depend on the chosen local coordinates system are those proper to Differential Geometry.

The concept of the smooth manifold and smooth map will be introduced, and students will learn to work with coordinates. The tangent space, vector fields and differential forms on manifolds will be considered. The exterior differential of differential forms and the integral calculus with differential forms will be defined eventually proving a general version of Stokes' Theorem, and showing some classical applications and particular cases such as Green's and Stokes' Theorem as studied in classical Calculus.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIES:

M12CM01- Learn the notions, tools and methods of the geometry of smooth manifolds.
M12CM02- Know the differential, integral and tensor calculus on smooth manifolds.
M12CM03- Know certain important basic results of the geometry of smooth manifolds.
M12CM04- Use tensor and exterior calculus, both in intrinsic form and in coordinates. Apply the calculus methods of Differential Geometry.

LEARNING OUTCOMES:

1. Use tensor and exterior calculus, both in intrinsic form and in coordinates.
2. Apply the calculus methods of Differential Geometry.

Theoretical and Practical Contents

1. SMOOTH MANIFOLDS: Smooth manifolds. Basic notions and examples. Topology of a manifold. Smooth maps between manifolds. Diffeomorphisms. Tangent and cotangent space. Differential of a smooth map. Chain rule. Classification of smooth maps by the rank of its differential.

2. VECTOR FIELDS OVER A MANIFOLD: Tangent bundle. Vector Fields as derivations. Lie algebra of vector fields. Calculus in coordinates. Vector fields related by a smooth map. Integral curves of a vector field. Flow.

3. DIFFERENTIAL FORMS: Differential forms on manifolds. Exterior product. Exterior algebra of a manifold. Exterior differential of differential forms. Closed and exact forms. Notions about the de Rham cohomology groups. Betti numbers and invariance by diffeomorphisms. Lie derivative and interior product.

4. INTEGRATION IN MANIFOLDS. Volume forms and orientation. Integration in manifolds. Regular domains. Stokes' Theorem. Applications.

TEACHING METHODS

The more relevant facts will be exposed in the lectures following the basic references listed in the Bibliography.

Lectures will be supplied with classroom practices (problem sessions) and seminars.
The problem sessions will require students to solve problems by applying the concepts and results learned in the lectures.

In the seminar sessions, students will work on previously posed problems and relevant examples relative to the contents of the theorical lectures, to motivate reflection and academic discussion during the session.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	6	18						
Horas de Actividad No Presencial del Alumno/a	54	9	27						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- See GUIDELINES (Orientaciones) 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Written exam (mandatory to pass in order to apply the other parts with their percenteages): 60%
Seminars: 25%
Assignments (written problems): 15%

Article 8.3 of the Student Assessment Regulations for official degrees, "students shall be entitled to be assessed by the final assessment system, regardless of whether or not they took part in the continuous assessment system. To that end, students shall submit a written waiver of continuous assessment to the lecturer responsible for the subject within 9 weeks of the beginning of the semester [...] That final assessment will be a written final exam".

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Written exam: 100%.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

W. M. BOOTHBY, An introduction to differentiable manifolds and Riemannian Geometry, Academic Press, 1975.

F. BRICKELL y R. S. CLARK, Differentiable manifolds, an introduction, Van Nostrand, 1970.

P.M. GADEA y J. MUÑOZ, Analysis and algebra on differentiable manifolds: a workbook for students and teachers, Kluwer Academic Publishers, 2001.

J.M. GAMBOA y J.M. RUIZ, Iniciación al estudio de las variedades diferenciables, 2ª Edición, Sanz y Torres, 2006.

J. M. LEE, Introduction to smooth manifolds, Springer Verlag, 2002.

F. WARNER, Foundations of differentiable manifolds and Lie groups, Springer Verlag, 1983.

Detailed bibliography

Journals

Web sites of interest

https://www.ime.usp.br/~gorodski/teaching/mat5799-2015/hitchin-manifolds2012.pdf

OBSERVATIONS

Having successfully completed the following subjects is strongly recommended for a proper understanding and assimilation of this subject:

- Linear Algebra and Geometry I and II.
- Differential and Integral Calculus I and II.
- Curves and Surfaces.
- Differential Equations.
- Topology.

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GMATEM31 - Bachelor's Degree in Mathematics	**Year**	Fourth year

COURSE

26675 - Groups and Representations	**Credits, ECTS:**	6

COURSE DESCRIPTION

In this course we extend the contents about group theory covered in the course "Algebraic Structures" of the second year, and we give an introduction to group representation theory and to character theory. The final goal of the course is the proof of Burnside's p^aq^b theorem.

This course deepens the student's knowledge in the area of algebra, whose fundamentals are established in the module Algebraic Structures (2nd year) + Commutative Algebra (3rd year) + Algebraic Equations (3rd year). It is also closely related to the module Linear Algebra and Geometry. It has applications in coding theory that are considered in the course Codes and Cryptography.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCES

M11CM01 - To understand the concept of action of a group on a set and the equivalent concept of permutation representation.
M11CM02 - To know Sylow's theorems and to be able to apply them in order to prove the solubility of some groups and to classify groups of small order.
M11CM03 - To understand the equivalence between the concept of group representation and that of action on a vector space.
M11CM04 - To know how to define some basic group representations.
M11CM05 - To understand Maschke's theorem and its role in representation theory.
M11CM06 - To know the concept of a character and its main properties.
M11CM07 - To know how to calculate the character table of a group in some easy cases.
M11CM08 - To understand Burnside's theorem showing the solubility of groups of order p^aq^b.

LEARNING RESULTS

- To know the concepts and applications regarding actions of groups on sets.
- To know Sylow's theorems and its applications (classification of groups of small order and criteria for non-simplicity).
- To know how to define some basic group representations.
- To know how to calculate the character table of a group in some easy cases.

Theoretical and Practical Contents

1. FREE GROUPS AND GROUP PRESENTATIONS: Free groups. Universal property of free groups. Group presentations. Von Dyck's theorem. Examples.
2. GROUP ACTIONS ON SETS: Actions and permutation representations. Orbits and stabilizers. Conjugacy classes and centralizers. Actions of groups on groups and semidirect product.
3. SYLOW'S THEOREMS: Sylow subgroups. Sylow's theorems. Applications: criteria for non-simplicity and classification of some groups of small order.
4. SOLUBLE GROUPS: Commutators of elements and commutators of subgroups. The derived subgroup and the derived series. Soluble groups. Minimal normal subgroups in finite soluble groups.
5. GROUP REPRESENTATIONS: The concept of representation. Group representations. Irreducible representations and Schur's lemma. Maschke's theorem.
6. CHARACTERS: Character of a representation. Properties. Orthogonality relations. The space of class functions. Kernel and centre of a character.
7. BURNSIDE'S p^aq^b THEOREM: Algebraic integers. Divisibility of the degrees of the irreducible characters. Burnside's p^aq^b theorem.

TEACHING METHODS

The theoretical contents will be presented in master classes following basic references in the bibliography. These lectures will be complemented with problem classes (classroom practice), in which students will apply the knowledge acquired in the theoretical lectures in order to solve problems. In the seminar sessions, exercises and representative examples will be considered. These will have been given to the students in advance, for them to have enough time to work out the solutions. Students must participate actively in the seminar sessions, and discussion of the solutions will be encouraged. In some other classes the students will present work done in groups.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	6	18						
Horas de Actividad No Presencial del Alumno/a	54	9	27						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Exercises, cases or problem sets 15%
- Teamwork assignments (problem solving, Project design) 15%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

STUDENTS FOLLOWING CONTINUOUS EVALUATION

The final mark will be the weighted mean of the marks obtained in the following tasks:

T1. Individual problems or assignments along the course (with exposition in the classroom): 15%.
Some of these tasks will be presented in the problem sessions and some other in the seminar sessions. Attendance to seminar sessions is compulsory, except for good reason that will need to be documented.

T2. Problems or assignments done in groups along the course (with exposition in the classroom or in one of the teachers' office): 15%.

T3. Midterm exam (approximately in week 7 or 8 of the semester) of all the contents covered so far: 20%.

T4. Ordinary exam: 50%. There will be a written problem exam and a theory test that can be either oral or written. A minimum mark of 4,5 points out of 10 is needed in the ordinary exam in order to pass the course.

STUDENTS NOT FOLLOWING CONTINUOUS EVALUATION

In this case, 100% of the mark will correspond to the written ordinary exam. As a consequence, a minimum mark of 5 is needed in this exam in order to pass the course.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary call there will be a written exam and the final mark will be calculated as explained below.

STUDENTS FOLLOWING CONTINUOUS EVALUATION

The final mark will be the largest of the following two:

* Weighted mean of the tasks T1, T2, T3 and T4 indicated in the previous block, where T4 is replaced with the written extraordinary exam. In this case, a minimum mark of 4,5 points out of 10 is needed in this exam in order to pass the course.

* Mark of the written extraordinary exam. In this case, a minimum mark of 5 points out of 10 is needed in this exam in order to pass the course.

STUDENTS NOT FOLLOWING CONTINUOUS EVALUATION

In this case, 100% of the mark will correspond to the written extraordinary exam. As a consequence, a minimum mark of 5 is needed in this exam in order to pass the course.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

B. HUPPERT, Endliche gruppen I. Springer-Verlag, Berlín, 1967.
B. HUPPERT, Character Theory of Finite Groups. Walter de Gryter, Berlín, New York, 1998.
I.M. ISAACS, Character Theory of Finite Groups. Dover Publications, New York, 1994.
I.M. ISAACS, Finite Group Theory. American Mathematical Society, Providence (Rhode Island), 2008.
W. LEDERMANN, Introduction to Group Characters. Cambridge University Press, 2nd ed., Cambridge, 1987.
G. NAVARRO, Un curso de álgebra, Universidad de Valencia, 2002.
J. ROSE, A Course on Group Theory. Dover Publications, New York, 1994.

Detailed bibliography

J.L. ALPERIN, R.B. BELL, Groups and Representations. Springer, Berlin-New York, 1995.
L. DORNHOFF, Group Representation Theory, Part A. Marcel Dekker, New York, 1971.
L.C. GROVE, Groups and Characters. John Wiley & Sons, Inc., New York, 1997.
D.J.S. ROBINSON, A Course in the Theory of Groups, 2nd ed. Springer, New York, 1996.

Journals

Web sites of interest

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GMATEM31 - Bachelor's Degree in Mathematics	**Year**	Fourth year

COURSE

26677 - Advanced Numerical Methods	**Credits, ECTS:**	6

COURSE DESCRIPTION

A systematic presentation is made of some of the most important methods and techniques in Numerical Analysis related to system solving and computing of eigenvalues and eigenvectors. Practical work with computers in MATLAB is an essential requirement.

Conditioning and stability seen in the course Métodos Numéricos I (2nd year) are studied in depth, as well as their application to basic algorithms for the solution of problems of Linear Algebra.

This course and Resolución Numérica de Ecuaciones Diferenciales, both in the 4th year of the Degree in Mathematics, belong to the módulo Ampliación de Métodos Numéricos.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

M10CM01 - Learn the most important results and proofs of this course.
M10CM02 - Learn some advanced techniques of numerical computation and its translation into algorithms or constructive problem-solving methods.
M10CM03 - Understand the mathematical concepts needed for the numerical computation of eigenvalues.
M10CM04 - Apply knowledge to solving problems, both theoretical and practical.
M10CM05 - Use an IT tool that handles and applies some of the methods studied, and which serves as a support tool to programs.
M10CM06 - Communicate ideas on the subjects in this module, both in writing and orally.

LEARNING OUTCOMES
- Know some advanced techniques of numerical computation and its translation into algorithms or constructive problem-solving methods.
- Understand the mathematical concepts needed for the numerical computation of eigenvalues.
- Apply knowledge to solving problems, both theoretical and practical.
- Use an IT tool that handles and applies some of the methods studied, and which serves as a support tool to programs.
- Communicate ideas on the subjects in this module, both in writing and orally.
- Know rigorous proofs of some important results on the subjects in this module.
- Acquire new knowledge and techniques in an autonomous manner.

Theoretical and Practical Contents

1. VECTORS AND MATRICES: Vectors, matrices and submatrices. Elementary matrices. Kernell and image of a matrix: Rank and nullity. LU factorization: algorithm.
2. NORMS OF VECTORS AND MATRICES: Vector norms. Equivalence of norms. Matrix norms.
3. SINGULAR VALUES: Orthogonality and unitary matrices. Singular values. SVD Theorem. Pseudoinverse. Low rank appproximation.
4. CONDITIONING AND STABILITY: Floating point arithmetic. Relative error and significative digits. Conditioning. Condition numbers. Conditioning of linear systems. Stable algorithms.
5. QR FACTORIZATION AND THE LEAST SQUARES PROBLEMS: Orthogonal projectors. Gram-Schmidt algorithms. Householder reflectors. Givens rotations. Algorithms. Conditioning and stability.
6. EIGENVALUES OF MATRICES: Eigenvalues and eigenvectors. Schur factorization. Defective matrices. Conditioning.
7. ALGORITHMS FOR COMPUTING EIGENVALUES. NONSYMMETRIC EIGENVALUE PROBLEM: Power method. Inverse power method. Rayleigh quotient. QR algorithm. Convergence analysis. Hessenberg reduction. Implementation.
8. ALGORITHMS FOR COMPUTING EIGENVALUES. SYMMETRIC EIGENVALUE PROBLEM: QR algorithm for symmetric matrices. Divide and conquer algorithm. Other algorithms: bisection and Jacobi.
9. ITERATIVE METHODS: Krylov subspaces: Arnoldi and Laczos methods. Conjugate gradient method. Convergence analysis. Preconditioning.

PRACTICAL CONTENT
1. Solving with MATLAB computational problems related with the subject (linear system solving , norms, singular values, rank, QR factorization and eigenvalues).
2. Design of algorithms with MATLAB for solving least squares problems.
3. Design of algorithms for computing eigenvalues and singular values.

TEACHING METHODS

The theoretical content is presented in lectures, following basic references that appear in the bibliography and compulsory course material. The lectures are complemented by practical problem-solving classes in which the problems involving the knowledge acquired in class will be discussed. These problems will be notified to students in advance. In the seminars, work will be done on representative questions and examples of the subject, and the students will make presentations on themes related to its content. These presentations will be prepared in advance in small groups. Practical computer exercises will be done to acquire skills in the subject.

Much of the work done by the student is on an individual basis. The professors will provide guidance at all times, encouraging students to do the work enthusiastically and regularly. Students will also be encouraged to use one-to-one tutorials, where they can clarify any doubts or difficulties they may encounter.

TYPES OF TEACHING

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

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- See below 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The continuous assessment modality consists of the performance of practical work, individual and group projects, a partial exam, and the presentation of projects in the seminars. Moreover, the professors may propose students individual or in groups, previously programmed assessment sessions with them. This continuous assessment modality accounts for 35% of the final grade. The remaining 65% corresponds to a final written exam.

Students who opt to withdraw from the continuous assessment modality must give written notification addressed to their professors within 9 weeks of the start of the term. In this case, the grade for the final written exam accounts for 85% of the final grade while the mark for the computer sessions accounts for 15% of the final grade.

To be given a positive assessment, the grade for the compulsory computer sessions must be higher than 4, which accounts for 15% of the final grade, and the grade for the compulsory final written exam must be at least 4.

A student may withdraw from the call, following the rules in effect: "Artículo 12 del ACUERDO de 15 de diciembre de 2016, del Consejo de Gobierno de la Universidad del País Vasco / Euskal Herriko Unibertsitatea, por el que se aprueba la Normativa reguladora de la Evaluación del alumnado en las titulaciones oficiales de Grado".

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

To be given a positive assessment in the extraordinary call, the student must certify that he/she has obtained a mark higher than 4 in the compulsory practical work, and take a final written exam, in which his/her mark should be higher than 4. Practical computer work represents 15% of the final grade. Furthermore, students who obtain a mark above 5 in the tasks done throughout the year (either individually or in groups/pairs), their grade will be maintained if they wish. In such case, the weight of this grade will be 35%.

MANDATORY MATERIALS

Notes on the course (available at egela)
Guide to MATLAB (available at egela)

BIBLIOGRAPHY

Basic bibliography

Ll. N. TREFETHEN Y D. BAU: Numerical Linear Algebra, SIAM, 1997.
J. W. DEMMEL: Applied Numerical Linear Algebra, SIAM, 1997.
G. W. STEWART: Matrix Algorithms. Volume II: Eigensystems, SIAM, 2001.
D. S. WATKINS: The Matrix Eigenvalue Problem: GR and Krylov Subspace Methods, SIAM, 2008.
R. A. HORN, C. R. JOHNSON: Matrix Analysis, Cambridge University Press, 1989.
C. B. MOLER: Numerical Computing with MATLAB, SIAM, 2004.

Detailed bibliography

G. H. GOLUB Y Ch. F. VAN LOAN: Matrix Computations, SIAM, 1996.
G. W. STEWART, J. SUN: Matrix Perturbation Theory, Academic Press, 1990.
F. CHATELIN: Eigenvalues of Matrices, John Wiley and Sons, 1995. SIAM, 2013.

Journals

SIAM Journal on Matrix Analysis and Applications
Numerical Linear Algebra
Linear Algebra and its Applications

Web sites of interest

https://people.maths.ox.ac.uk/trefethen/
https://www.cs.berkeley.edu/~demmel/
https://www.mathworks.com/moler/
https://ocw.mit.edu/courses/18-335j-introduction-to-numerical-methods-spring-2019/

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GMATEM31 - Bachelor's Degree in Mathematics	Year	Fourth year

COURSE

26678 - Codes and Cryptography	Credits, ECTS:	6

COURSE DESCRIPTION

This course examines two major applications of mathematics in information technologies: error-correcting codes and cryptography. This course studies the tools that are arranged so that the information can be transmitted reliably and safely.

To do this, concepts of abstract algebra, which were studied in previous courses, are applied. For example, concepts and techniques studied in Linear Algebra and Geometry I, Algebraic Structures, Conmutative Algebra and Algebraic Equations are useful. Codes and Cryptography is part of a module together with Algorithm Design, which analyses their complexity.

Students acquire the basic techniques of this area to enable them to use them in other fields of mathematics and, if they wish, to undertake a deeper study of algebra through other optional subjects in their fourth year.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SPECIFIC COMPETENCES
M09CM01 An ability to understand the idea of coding and a code to detect and correct errors
M09CM02 Knowing how to use syndrome-based correction method.
M09CM03 Knowing how to obtain some linear codes (Hamming codes, BCH codes,...)
M09CM04 An ability to understand the idea of Public Key Cryptography.
M09CM05 An ability to understand RSA and Diffie-Hellman systems.
M09CM06 An ability to understand digital signatures and certificates.

LEARNING OUTCOMES
Knowing how to encode and decode messages using linear codes employing the appropriate method.
Knowing how to calculate the minimum distance of a linear code.
Knowing how to calculate generator and parity-check matrix
Knowing how to encrypt and decrypt messages, using the cryptographic private key and public key systems studied.

Theoretical and Practical Contents

1. LINEAR CODES. Introduction. Error-correcting codes: basic definitions. Hamming distance. Equivalent codes. Perfect codes. Linear codes: definition and main properties. Generator and parity-check matrix for linear codes. Encoding with a linear code. Decoding with a linear code. Example of linear codes: Hamming codes.

2. CYCLIC CODES. Definition and construction of cyclic codes. Generator polynomial and generator matrix of a cyclic code. Check polynomial and parity-check matrix of a cyclic code. Encoding and decoding with a cyclic code. Cyclic decodification. Example of cyclic codes: BCH codes.

3. PRIMALITY TESTS. Primality tests: definition and types. Deterministic primality tests. Fermat primality test. Pseudoprime numbers. Miller-Rabin primality test. Strong pseudoprime numbers

4. CRYPTOGRAPHY. Cryptography schemes. Private key cryptography: affine cyphers, Hill cryptosystem, substitution cyphers and DES. Public key cryptography: RSA cryptosistem, ElGamal cryptosystem. Hash functions. Diffie-Hellman key exchange method. Digital signatures.

COMPUTER PRACTICAL
Students will design and implement using Mathematica, computer programs related to the five units of the course.

TEACHING METHODS

Lectures: The master class methodology will be used to develop the theoretical part of the subject.

Classroom practical: Proposed problems related to the theoretical content of each topic will be solved.

Seminar: In these sessions students take on a more active role and must demonstrate the skills acquired to date in the relevant competences. Depending on the session, different activities will be performed, such as doing individual work, solving problems, etc. Attendance is mandatory.

Computer Practical: There will be two-hour biweekly sessions. Attendance is mandatory. In these hours, programs related to the subject matter presented in the lectures will be designed and implemented using the Mathematica symbolic calculation program.

TYPES OF TEACHING

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

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- See Guidelines and decline to sit 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The theoretical-practical competences of the subject will be evaluated through the following tests:

1. Final written exam, with theory, questions and problems on the theoretical contents of the course accounting for 80% of the final mark, to be taken on the date set in the official exam calendar.

2. Computer practical exam to be taken during week 15, for 10% of the final mark.

3. Partial written exam on the course to be taken during weeks 9-10, for 10% of the final mark.

To apply the above percentages it is necessary to have obtained 4 out of 10 on the final exam and to have performed all the computer practical assignments given in class.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

There will be a final written exam on the date set in the official exam calendar in which all the theoretical and practical competences of the course will be evaluated.

This test will consist of two parts, which must be passed independently to be able to pass the course:

1. Examination of theory, with questions and problems on the theoretical contents of the course accounting for 90% of the final mark.

2. Practical computer exam and to have performed all the computer practical exercises, accounting for 10% of the final mark.

Students who have passed the Computer Practical part of the ordinary call and are satisfied with their mark do not need to take the computer practical exam.

MANDATORY MATERIALS

Lecture notes and example, exercise and computer programming sheets

BIBLIOGRAPHY

Basic bibliography

AKRITAS, A.G. Elements of computer algebra with applications, John Wiley and Sons, New York, 1989.
BRESSOUD, D.M. Factorization and primality testing, Springer-Verlag, New York, Iberoamericana, Wilmington, 1989.
HILL, R. A first course in coding theory. Ed. Clarendon Press, 1986.
HOFFSTEIN, J, PIPHER, J, SILVERMAN, J.H. An introduction to mathematical cryptography, Springer Science+Business Media, LLC, 2008.
MUNUERA, J., TENA, J. Codificación de la Información. Universidad de Valladolid, Secretariado de Publicaciones e Intercambio Científico, 1997.
ROMAN, S. Coding and Information Theory, Springer-Verlag, New York, 1992.
STINSON, R. S. Cryptography Theory and Practice, 2nd. ed., Chapman and Hall, Boca Raton, 2002.

Detailed bibliography

KOBLITZ, N. A course in number theory and cryptography. Ed. Springer-Verlag.

MENEZES, A.J., VAN OORSCHOT, P.C., VANSTONE, S.A. Handbook of applied cryptography CRC Press.
SMART, N. Cryptography: an introduction. Ed. McGraw-Hill.
VAN LINT, J.H., VAN DER GEER, G. Introduction to coding theory and algebraic geometry. Ed. Birkhäuser.
VAN LINT, J.H. Introduction to coding theory. Ed. Springer-Verlag.

Journals

Web sites of interest

GARCIA, M.A., MARTINEZ, L., RAMÍREZ, T. Introducción a la Teoría de Códigos.
https://ocw.ehu.eus/course/view.php?id=446
QUIROS, A. La Teoría de Códigos: una introducción a las Matemáticas de la transmisión de información
http://www.grupoalquerque.es/ferias/2012/archivos/pdf/teoriacodigos.pdf

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GMATEM31 - Bachelor's Degree in Mathematics	**Year**	Third year

COURSE

26681 - Mathematical Modelling	**Credits, ECTS:**	6

COURSE DESCRIPTION

The overall aim of the course is to encourage reflection on mathematical modelling, on the current uses and applications of mathematics and to create mathematical models. In the subject, mathematical models of physics and biology will be studied, together with applications of mathematics in the present-day information and image society. The subject will also have a practical side. Various situations will be proposed that need to be translated into mathematical language, which will then be modelled and resolved to obtain a solution. It therefore combines questions of a general nature on mathematical modelling with the study of operational models, through the construction and analysis of models. Emphasis will be placed on the fact that models are justified by their adaptation to the experimental data of the phenomenon they are describing, or due to practical validity in terms of the need that they set out to satisfy.

Particular importance will also be paid to the historical aspects of the formulation of the different mathematical models.

In the subject, mathematical models applied to problems are presented, whose solutions or approximations can be found using specially studied techniques in the subjects Numerical Methods I and II, Differential Equations, Codes and Cryptography, Extension of Numerical Methods and Mathematical Programming.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

MC07CM01 - Acquire a vision on the capacity and power of mathematics to solve practical problems, and of its applications in a wide variety of areas.
M07CM02 - Develop the ability to find solutions, take decisions and propose operational methods to other sciences or engineering disciplines.
M07CM03 - Foster the ability to use mathematics. Mathematics are also a tool that students need to learn how to use.
- Learn about interactions between different parts of mathematics towards achieving a common objective.
- Know real situations, practical problems and their mathematical modeling.
- Learn about modeling models, including their origin and their own history.
- Gain experience in decision-making when approaching a practical situation and accepting the model.

Theoretical and Practical Contents

1. INTRODUCTION TO MATHEMATICAL MODELLING.
2. MATHEMATICS IN THE PRESENT-DAY SOCIETY OF INFORMATION AND IMAGES.
Corrective codes. Applications of Perron Theorem. Linear programming. Cellular Automaton.
3. MODELS IN BIOLOGY.
Growth models in a population. Interaction models between species. Health-based models.
4. MODELS IN PHYSICS.
Control theory. Graphs and molecules.
5. PRACTICAL WORK.

Practical work is done with computers, implementing and applying the algorithms studied and described in the theoretical part of the subject.

TEACHING METHODS

The theoretical content will be explained in lectures, following basic references that appear in the Bibliography and material of compulsory use. Lectures are complemented with problem-solving classes (practical sessions) in which students will be asked to solve questions where the knowledge acquired in the theoretical classes will be applied. Representative questions and examples of the subject content will be worked on seminars. These will usually be notified in advance so that the students can work on them with a view to later reflection and discussion in a dedicated session. Practical work with computers aimed at acquiring skills in the subject will also be done.

Students will do individual work on theory and problems in periodic seminars with the support of the professor.

An important part of the student's work is of an individual nature. The professors will provide guidance for this work and will encourage students to do it with regularity and enthusiasm. Students are also encouraged to make use of one-to-one tutorials to clarify any doubt of difficulty they may encounters in the subjects.

TYPES OF TEACHING

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

Legend:

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- See orientations. 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CRITERIA FOR CONTINUOUS ASSESSMENT

Written exam: 60%

Computational exercises: 20%. They can be evaluated by an exam or by performance in computer practice sessions.

Active methodologies: 20%. It will consist of one or more of the following activities: e-gela quizzes, out-of-class work, oral presentations and discussions with the teacher. These activities may be individual or in groups.

Specific details will be provided on the first day of class.

In order to pass the course at least a 4.5 out of 10 is required in both the written exam and the computational exercises.

CRITERIA FOR FINAL ASSESSMENT
A student who does not wish to participate in continuous assessment may officially withdraw from it in writing to the professor responsible for his/her subject, within 9 weeks of the start of the term. The evaluation will consist of a written exam and a computational exercise's exam. In order to pass the course, a 4.5 out of 10 must be obtained in both exams. Likewise, the student may be required to submit a work or give an oral presentation during the exam period to evaluate the competencies worked on through active methodologies.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation criteria will be the same as the final evaluation ones in the ordinary call.

MANDATORY MATERIALS

- The teachers will upload useful material in the eGela virtual classroom.
- Information obtained from Internet.
- Scientific software as Microsoft Excel, Wolfram Mathematica, MatLab and Pyhton.

BIBLIOGRAPHY

Basic bibliography

F. BRAUER Y C. CASTILLO-CHÁVEZ: Mathematical Models in Population, Biology and Epidemiology, Text in Applied Mathematics, Springer, 2001
M. BRAUN: Differential Equations and Their Applications: An Introduction to Applied Mathematics, 4th ed, Springer, 1992.
J. M. CORON, Control and Nonlinearity, American Mathematical Society, 2007 (available in https://www.ljll.fr/~coron/Documents/Coron-book.pdf)
L. EDELSTEIN-KESHET: Mathematical Models in Biology, SIAM, 2005.
R. HABERMAN: Mathematical Models: Mechanical Vibrations, Population Dynamics, and Traffic Flow, SIAM, 1998.
K. P. HADELER, Topics in Mathematical Biology, Springer, 2017
M. MARTCHEVA, An Introduction to Mathematical Epidemiology, Springer, 2015
J.D. MURRAY: Mathematical Biology,Springer-Verlag, 1989
O. PAPINI Y J WOLFMAN: Algèbre discréte et codes correcteurs, Springer-Verlag, 1995.
C. ROBINSON. Dynamical systems: stability, symbolic dynamics, and chaos. CRC press, 1998.
E. TRÉLAT, Contrôle optimal: théorie & applications, Vuibert, Collection "Mathématiques Concrètes", 2005 (available in https://www.ljll.math.upmc.fr/trelat/fichiers/livreopt2.pdf)
S. WAGNER, H. WANG: Introduction to Chemical Graph Theory, CRC Press, 2019

Detailed bibliography

Journals

Web sites of interest

Programa "dfield" para representacion de soluciones de EDO:
http://www.cs.unm.edu/%7Ejoel/dfield/dfield.jar

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25

Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GMATEM31 - Bachelor's Degree in Mathematics	**Year**	Third year

COURSE

26682 - Numerical Methods II	**Credits, ECTS:**	6

COURSE DESCRIPTION

The main objective of the course is the overview of the most relevant techniques of numerical analysis for finding numerical approximations of solutions of ordinary differential equations. To get a passing score on the assessments, the students have to programme and implement the numerical methods discussed during the course providing appropiate conclussions according to the results obtained.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

M05CM01 - Knowledge about the basic techniques of numerical calculation and its translation into algorithms or constructive methods of problem solving.
M05CM02 - Programming on computer in a structured language the numerical methods studied in the course and apply them effectively.
M05CM03 - Use libreries and packages as a support tool for own programs with the aim applying the numerical methods studied.
M05CM04 - Analyze the convenience of one or another numerical method to a specific problem based on the analysis of errors, the computational cost and other characteristics.
M05CM05 - Evaluate the results obtained after a computation process and chose the data to visualize them in an appropriate way to communicate verbally and in writing the conclusions.

Theoretical and Practical Contents

1. NUMERICAL INTERPOLATION: Introduction to polynomial interpolation. Lagrange’s and Newton’s formulas. Hermite interpolation. Rational interpolation.
2. NUMERICAL INTEGRATION METHODS: Newton-Cotes quadrature. Richardson extrapolation. Romberg integration. Gauss quadrature.
3. INTRODUCTION TO NUMERICAL INTEGRATION OF ORDINARY DIFFERENTIAL EQUATIONS: Problem formulation and reduction of order. Convergence, zero-stability and absolute stability. Explicit Euler’s method.
4. ONE STEP RUNGE-KUTTA METHODS: Introduction to Runge-Kutta methods. Consistency order and stability of Runge-Kutta methods.
5. LINEAR MULTISTEP METHODS: Introduction to linear multistep methods. Consistency order and stability of linear multistep methods. Predictor-corrector methods. Stability of predictor-corrector methods
6. BACKWARD DIFFERENCE METHODS: Backward differences. Adams methods.
7. STIFF SYSTEMS: Concepts and interpretation. Stability definition of stiff systems. Pade approximations for the exponential function. Numerical methods for stiff systems.

TEACHING METHODS

The theoretical content will be exposed in master lessons following basic references that appear in the bibliography and in the compulsory materials. These master lessons will be complemented with problem lessons (classroom practices), in which the students will be proposed to solve questions where the knowledge acquired in the theoretical lessons will be applied. In the seminars, topics and examples representative of the content of the subject will be developed; they will be generally provided in advance to the students to work on them, and will motivate the subsequent reflection and discussion in the session devoted to it. In addition, computer assignments will be carried out with the aim of achieving the competences of the subject.

TYPES OF TEACHING

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

Legend:

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Exercises, cases or problem sets 20%
- Individual assignments 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

- Written exam (%60 of the overall grade). Minimum score = 4,00 to be graded.
- Programming numerical methods (%20 of the overall grade)
- Resolution and presentation of individual work (problems and seminars) (%20 of the overall grade)

A minimum grade of 4 points in the written exam and in the computer assignments will be required in order to apply the above percentages.

Computer practices will be done in groups of two students. Each group will develop their practices autonomously, that is, without sharing their content with other groups. In case of detecting substantial parts of code with an analogous structure in different groups, these practices will automatically be invalidated. The delivery of the practices is obligatory to gain acces to an individual exam consisting on questions about computing. This trial will ensure the acquisition of the corresponding competences and that will be used to determine the grade.

Students who request it throughout the first 9 weeks from the beginning of classes in the second semester of the course, may substitute the continuous assessment by a "single assessment" that will ensure the acquisition of the competences of the subject. This evaluation may consist of one or more tests such as a written exam, an oral presentation of materials related to the content and skills of the subject, or a practical programming exam. Students must apply for the "single assessment" modality to the subject coordinator by a writing and signed document.

Students who do not appear on the official date of the examination of each call, will automatically be considered as absent and thus will be registered by the teachers.

During the assessment trials, as long as it has not been explicitly authorized in writing by the teaching staff of the subject, the use of books or notes, as well as telephone, electronic, computer devices or of another type of devices is forbidden. In individual tests, all kinds of collaboration and exchange of academic material between people is forbidden. In the case of detecting any irregularity or cases of dishonest or fraudulent practices, the provisions of the protocol on academic ethics and the prevention of dishonest or fraudulent practices will be applied in assessment tests and in academic work at the UPV / EHU. These regulations can be consulted at the link:

https://www.ehu.eus/es/web/estudiosdegrado-gradukoikasketak/akademia-araudiak

The aforementioned protocol refers to the sanctioning regime, "Decree of September 8, 1954, which approves the Regulations for academic discipline of the official Centers of Higher Education and Technical Education under the Ministry of National Education, which includes the actions considered infractions, and the possible sanctions to be imposed after their commission, "where in article 5.4, practices such as" The impersonation of persons in acts of teaching life and the falsification of documents are declared as "serious misconduct".

The evaluation tests will be carried out in person, as long as the circumstances allow it and there are no orders from the competent authorities to prevent it. In case that causes that prevent the performance of in-person assessment tests take place, then, computer resources will be used to carry out online tests of the same type, weight and conditions.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

- Written exam (%60 of the overall grade). Minimum score = 4,00 to be graded.
- Teamwork programming numerical methods (%20 of the overall grade)
- Resolution and presentation of individual work (problems and seminars) (%20 of the overall grade)

A minimum grade of 4 in the written exam will be required in order to apply the above percentages.

Computer practices will be done in groups of two students. Each group will develop their practices autonomously, that is, without sharing their content with other groups. In case of detecting substantial parts of code with an analogous structure in different groups, these practices will automatically be invalidated. The delivery of the practices is obligatory to gain acces to an individual exam consisting on questions about computing. This trial will ensure the acquisition of the corresponding competences and that will be used to determine the grade.

Students who request it throughout the first 9 weeks from the beginning of classes in the second semester of the course, may substitute the continuous assessment by a "single assessment" that will ensure the acquisition of the competences of the subject. This evaluation may consist of one or more tests such as a written exam, an oral presentation of materials related to the content and skills of the subject, or a practical programming exam. Students must apply for the "single assessment" modality to the subject coordinator by a writing and signed document.

Students who do not appear on the official date of the examination of each call, will automatically be considered as absent and thus will be registered by the teachers.

During the assessment trials, as long as it has not been explicitly authorized in writing by the teaching staff of the subject, the use of books or notes, as well as telephone, electronic, computer devices or of another type of devices is forbidden. In individual tests, all kinds of collaboration and exchange of academic material between people is forbidden. In the case of detecting any irregularity or cases of dishonest or fraudulent practices, the provisions of the protocol on academic ethics and the prevention of dishonest or fraudulent practices will be applied in assessment tests and in academic work at the UPV / EHU. These regulations can be consulted at the link:

https://www.ehu.eus/es/web/estudiosdegrado-gradukoikasketak/akademia-araudiak

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The evaluation tests will be carried out in person, as long as the circumstances allow it and there are no orders from the competent authorities to prevent it. In case that causes that prevent the performance of in-person assessment tests take place, then, computer resources will be used to carry out online tests of the same type, weight and conditions.

MANDATORY MATERIALS

Notes published in the host Moodle/e-gela

BIBLIOGRAPHY

Basic bibliography

J. Stoer, R. Bulirsch: Introduction to Numerical Analysis. Springer, 1983.

D. Kincaid, W. Cheney: Análisis Numérico. Las matemáticas del cálculo científico. Addison-Wesley, 1994.

E. Hairer, S.P. Nørsett, G. Wanner: Solving Ordinary Differential Equations I. Non Stiff Problems. Springer, 1987

S.D. Lambert: Computational Methods in Ordinary Differential Equations. John Wiley & Sons, 1973

S.D. Lambert: Numerical Methods for Ordinary Differential Systems. John Wiley & Sons, 1991.

Detailed bibliography

J.C. Butcher: The Numerical Analysis of Ordinary Differential Equations. John Wiley & Sons, 1987

E. Hairer, S.P. Nørsett, G. Wanner: Solving Ordinary Differential Equations II. Stiff and Differential-Algebraic Problems. Springer, 1996

Journals

Web sites of interest

Octave: https://www.gnu.org/software/octave/index

Python: https://www.scipy.org/

C & C++ (GNU): https://www.gnu.org/software/gsl/

netlib: http://www.netlib.org/

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GMATEM31 - Bachelor's Degree in Mathematics	Year	Second year

COURSE

26687 - Topology	Credits, ECTS:	6

COURSE DESCRIPTION

The objective of the course is to familiarize students with the basic techniques and notions of General Topology. First of all it is intended that the students know the different ways of defining a topological space using techniques such as bases and subbases of open sets, neighborhood and neighborhood base systems. In the first lesson particular attention is also paid to the study of metric spaces. Next, basic topics of General Topology are studied, such as continuity of functions, construction of derived topological spaces (products and quotients), compactness and connectedness.

The subject aims for students to start their knowledge in topology, studying the basic structures needed in many other subjects belonging to the area of Geometry and Topology and also Mathematical Annalysis.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SPECIFIC COMPETENCIES

M02CM11 - Understand the basic concepts, methods, results and proofs related to Topological spaces and Metric spaces.
M02CM12 - Assimilate the concepts of Continuity, Compacness and Connectedness.
M02CM13 - Recognize topological structures in concrete examples.
M02CM14 - Construct examples of topological spaces using the notions of subspace, product space and quotient space
M02CM15 - Use convergence of sequences to study continuity and compacness.

LEARNING OUTCOMES

- Recognize topological structures in concrete examples.
- Construct examples of topological spaces using the notions of subspace, product space and quotient space.
- Use convergence of sequences to study continuity and compacness.

Theoretical and Practical Contents

1. TOPOLOGICAL SPACES: Topology. Open and closed sets. Base and subbase of a topology. Neighbourhoods. Neighbourhood bases. Distance. Metric spaces. Open and closed balls.

2. SUBSETS IN TOPOLOGICAL SPACES: The interior of a set. The closure of a set. Accumulation points and isolated points. The derived set. The boundary of a set.

3. CONTINUITY: Continuous functions. Homeomorphisms. Topological properties. Sequences in metric spaces: convergence and sequential continuity.

4. CONSTRUCTION OF TOPOLOGICAL SPACES: Subspaces. Combined functions. Embeddings. Product topology. Projections. Quotient topology. Identifications.

5. COMPACTNESS: Compact spaces and compact subsets. Products of compact spaces. Sequential compactness. Compactness in Hausdorff spaces.

6. CONNECTEDNESS AND PATH CONNECTEDNESS: Connected spaces and connected subsets. Connected components. Paths in topological spaces. Path connectedness. Path-components.

TEACHING METHODS

The theoretical sessions will be presented in the lectures, following the basic references contained in the Bibliography and the mandatory material. These lectures will be complemented with problem-solving classes in the practical classroom work sessions, in which the knowledge acquired in the theoretical classes will be applied. Finally, in the seminar sessions, students will take a more active role and will develop and discuss representative examples/exercises of the contents of the subject.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	6	18						
Horas de Actividad No Presencial del Alumno/a	54	9	27						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- See GUIDELINES 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS EVALUATION

Written exam (weight: %70-%85)
Evaluation criteria:
- Accuracy on definitions and reasoning.
- Appropriate use of mathematical language.
- Correct methods of reasoning, with clear and well organized explanations of the arguments and the intermediate steps.

Seminars (weight: %5-%10)
Evaluation criteria:
- Correct answers and appropriate use of mathematical language.
- Clear reasoning.
- In oral presentations, accuracy and order.

Resolution of written exercises (weight: %10-%20)
Evaluation criteria:
- Correct answers and appropriate use of mathematical language.
- Clear reasoning.
- Accuracy and order in the exercises delivered.

FINAL EVALUATION (in case of renouncing the continuous evaluation)

Written exam: 100%

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Written exam: 100%

MANDATORY MATERIALS

Classroom notes. Proposed exercise list.

BIBLIOGRAPHY

Basic bibliography

Theory

R. AYALA, E. DOMINGUEZ y A. QUINTERO; Elementos de Topología General, Addison-Wesley Iberoamericana, 1997.
J. R. MUNKRES, Topología, Prentice Hall, 2002.
S. WILLARD, General Topology, Dover Publications Inc, 2004.

Problems and exercises

G. FLEITAS MORALES Y MARGALEF ROIG, Problemas de Topología General, Alhambra, 1980.
G. FLORY; Ejercicios de Topología y Análisis, Reverté, 1978.
E.G. MILEWSKI, Problem solvers. Topology, Research & Education Association, 1994.

Detailed bibliography

I. ADAMSON; A General Topology Workbook, Birkhäuser, 1995.
E. BURRONI, J. PENON, La géometrie du caoutchouc. Topologie, Ellipses, 2000.
L. A. STEEN y J. A. SEEBACH, Counterexamples in Topology, Dover, 1995.
O. YA. VIRO, O. A. IVANOV, N. YU. NETSVETAEV y V. M. KHARLAMOV, Elementary Topology. Problem Textbook, AMS, 2008.

Journals

Americal Mathematical Monthly

Web sites of interest

Topology without tears
http://www.topologywithouttears.net/

Topology Atlas
http://at.yorku.ca/topology/

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GGEOLO30 - Bachelor`s Degree in Geology	**Year**	Third year

COURSE

26777 - Ore Deposits and Industrial Rocks	**Credits, ECTS:**	9

COURSE DESCRIPTION

In this subject an introduction to geology and the methods of studying mineral concentrations of economic interest are made. Likewise, a description of the formation environments, morphology, mineralogy, geochemistry and deposit models of the main ore deposits is made. The characteristics, applications and specifications of use of the main groups of minerals and industrial rocks are also studied; and a description of the industrial processes used for the elaboration of the most important products derived from industrial rocks is also included.
Given the wide variety of geological environments in which ore deposits can be developed, and taking into account that the student must be familiar with an important number of minerals and rocks, it is highly recommended that students have a broad notion of mineralogy and petrology before taking the course. This is essential for the development of a primary professional activity in the field of geology, such as the exploration and exploitation of mineral deposits, which employs a good number of professionals in this branch of science.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SPECIFIC COMPETENCES

M06GM6.4 Knowing the typology of mineral concentrations of economic interest.
M06GM6.5 Knowing the main industrial rocks and their uses.
M06GM6.6 Understanding the processes of formation and accumulation of geological energetic resources.
M06GM6.7 Knowing the main methods of exploration and evaluation of natural resources.

TRANSVERSAL COMPETENCES

G001 Capavility for analysis and synthesis.
G002 Problem solving ability.
G003 Ability to search and manage information.
G004 Ability to apply knowledge to practice.
G005 Autonomous and creative learning and work.
G006 Ability to carry out teamwork.
G007 Capavility for organization, planning and time management.
G008 Determination, perseverance and responsibility in the tasks assigned.
G009 Oral and written communication in the native language.
G010 Motivation for quality and a job well done.

Theoretical and Practical Contents

Introduction to the geology of ore deposits. Notion of ore deposit. Metallogeny. Ore and gangue concept. Factors that condition exploitability. Methods of study of Ore Deposits. General principles in geology of ore deposits. Morphology of ore deposits. Classification. Chronological and spatial relationships. Genetic models: their interest as a basis for exploration. Fundamental genetic model. Textures and structures: classification and interpretation. Regional distribution of deposits. Discontinuities, heterogeneities and anisotropy in the distribution of ore deposits. Belts, provinces and metallogenic epochs. Metalotects. Paragenesis and most frequent associations. Geothermometry, geobarometry and isotopic studies applied to the investigation of mineral deposits. Origin of metals and mineralizing fluids. Classification of mineral deposits. Classification criteria. Main types of ore deposits and tectonic position.
Ore deposits related to igneous activity:
Magmatic deposits of Cr-Ni-Cu-PGE associated with ultrabasic and basic rocks. Fe-Ti deposits in anorthosites. Diamond deposits. Carbonatites. Pegmatitic deposits, Albitites and Greisens. Hydrothermal deposits. Cu, Mo and Sn porphyries. Deposits in Skarns. Epithermal deposits of precious metals. Massive sulfide deposits.
Ore deposits related to sedimentation: Sedimentary-exhalative base metal deposits (Sedex) hosted in sediments. Oolitic iron deposits and iron formations (BIF). Copper deposits in a sedimentary environment (Copperbelt). Manganese deposits. Phosphate deposits. Manganese nodules. Stratabound deposits of base metals in carbonates (MVT type). Placer-type mechanical concentration deposits. U-V deposits embedded in detrital rocks (Red beds).

Industrial rocks. General characteristics. Classification and uses. Standardization. Aggregates and binders: Types and basic properties. Use of aggregates. Characterization tests and specifications. Binders: Types. Cements, raw materials and manufacturing process. Cement and concrete tests.
Ornamental rocks: General concepts: lithotects and natural block. Marble, slate and granite. Extraction and elaboration of ornamental rocks.
Siliceous sands: Uses of sands and characteristics. Raw materials for the manufacture of glass.
Clay materials: Ceramic clays. Technological properties of clays and manufacturing process of ceramic materials. Special

clays: kaolin, bentonites, sepiolite and paligorskite.
Industrial minerals: Raw materials for agricultural use. Raw materials in the manufacture of paints and paper. Materials used in the rubber industry, adhesives, sealants and plastics. Pharmaceutical materials.

TEACHING METHODS

Students acquire broad theoretical notions related to mineral deposits during the 54 master classes that are taught. Teaching these classes is generally supported by the use of projected images, which are previously available to students on the eGela platform. This allows them to follow the explained matter more optimally. The practices (microscope, "visu" and five-day field trip, during which mines and quarries in Spain are visited) greatly contribute to expanding the theoretical knowledge acquired. During these practices, the students have to prepare a notebook in which the descriptions of the samples/mines studied are collected, and other relevant information offered by the teachers or geologists of the mines visited during the field trip. The student's attitude must be receptive and participatory both during the lectures and during the practices.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	54	4		7					25
Horas de Actividad No Presencial del Alumno/a	81	6		10,5					37,5

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 80%
- Teamwork assignments (problem solving, Project design) 10%
- Oral presentation of assigned tasks, Reading¿ 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EVALUATION METHODOLOGY:
Ordinary call
- Final exam: 100%

During the development of the evaluation tests, the use of books or notes, as well as telephone, electronic devices, computer or other devices, by the students will be prohibited. [Only calculator is allowed*]. In any case of dishonest or fraudulent practice, the provisions of the protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and in academic work at the UPV/EHU will be applied.

In relation to the protocol to waive continuous assessment, consult articles 8.3 and 12.2 of the assessment regulations.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The criteria are similar to those of the ordinary call.

MANDATORY MATERIALS

EQUIPMENT FOR THE FIELD-TRIP
In addition to the work material (geologist's compass and hammer, maps, aerial photos,...) students must bring their "Individual Protection Equipment" (private property, use and maintenance). At least:
- Appropriate footwear and clothing
- Reflective vest
- Protective glasses: in sampling and to break rocks
- Safety helmet: In quarries, caves, cliffs, mines, construction sites,….

In case of NOT bringing this material, they will NOT take part in the field-trip, with the academic consequences that may arise from it.

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Journals

Mineralium Deposita
Economic Geology
Industrial Minerals.
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Roc Maquina
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Minerals

Web sites of interest

http://www.igme.es/actividadesIGME/lineas/RMeIA.htm
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OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GGEOLO30 - Bachelor`s Degree in Geology	**Year**	Fourth year

COURSE

26778 - Environmental Geology and Geological Risks	**Credits, ECTS:**	6

COURSE DESCRIPTION

Environmental geology and risk topics are increasing relevance in the society. Geologic processes triggered by the climate change have direct influence in the human society, creating anthropogenic changes. This subject focus on the interaction between geologic processes and the living world, we will learn how to asses them and the different type of management options to mitigate them. Learning land planning and the Environmental Impact Assessment we will work on natural resource extraction impact and restoration of a degraded environment.

One of the aims of this subject is to identify environmental problems, in order to improve the land-use management and risk mitigation.

Analysing the physical environment and geological heritage, we will take a close look at how to manage the environment.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

ESPECIFIC COMPETENCIES

GO14: Learn and comprehend current environmental processes and related potential risks, as well as the necessity to extract and preserve the earth resources.
GM6.8. Learn and evaluate geologic risk related to natural and anthropic processes.

TRANSVERSE COMPETENCIES
GT2: Capability to sole problems.
GT5: Speaking and writing skills.

Theoretical and Practical Contents

0. Introduction to Environmental Geology. Basic concepts. Land planning, sustainable development goals, environmental legislation.
Module 1: Earth system, subsystems, dynamics and cycles, active processes, indicators and system monitoring. Climate change in the Earth system.
Module 2: Natural resources and the environment, ecosystem services, soil, restoration of degraded environments. Geological heritage and geodiversity. Introduction to geological hazards and general concepts.
Module 3: Risks associated with the river environment. Risks associated with the coast. Risks associated with hillside movements. Seismic hazards. Risks associated with vulcanism. Risks associated with subsidy.
Module 4: Environmental impact assessment. Typology, impact identification and assessment methodologies, corrective measures, monitoring plan. Examples.

Field practices: mapping of active processes and environmental dynamics. Waste and contaminated soil management. Geological heritage management, conservation and prevention of geological risks. Departure times may vary slightly depending on the circumstances of the day.

TEACHING METHODS

In order to reach these capabilities, the subject is divided in theory lessons, classroom exercise, QGIS computer program, team and individual work, and field work.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	3	6						15
Horas de Actividad No Presencial del Alumno/a	54	4,5	9						22,5

Legend:

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 40%
- Exercises, cases or problem sets 20%
- Individual assignments 20%
- Teamwork assignments (problem solving, Project design) 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The student may refuse evaluation 10 days before the first job/practice to be presented, in writing addressed to the teachers of the subject.

In order to be evaluated, the student must participate in all the different parts of the subject matter and obtain a minimum in each of them.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The same as in the other.

MANDATORY MATERIALS

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Journals

Environmental Geology (Springer)
Environmental Impact Assessment Review (Elsevier)
Geoheritage (Springer)
Environmental Earth Sciences (Springer)

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http://www.igme.es/internet/default.asp
http://www.eia.es/web/00_comun/home.asp
http://www.aegweb.org/i4a/pages/index.cfm?pageid=1
http://www.usgs.gov/hazards/
http://www.ipcc.ch/

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GGEOLO30 - Bachelor`s Degree in Geology	Year	Second year

COURSE

26783 - Mineralogy	Credits, ECTS:	9

COURSE DESCRIPTION

DESCRIPTION AND CONTEXTUALISATION OF THE COURSE
Minerals, the object of study of this subject course, are the basic ingredients of rocks and soils, making knowledge of them essential for any professional geologist. In fact, students need a good training in this field before taking on other core courses such as "Sedimentary Petrology", "Igneous Petrology", "Metamorphic Petrology", "Mineral Deposits and Industrial Rocks" or "Geochemistry", and optional ones like "Analytical Mineralogy".

The petrographic microscope is a basic tool to study minerals, so students are specifically recommended to have completed the course in Crystallography (second year, first term), as this is where the basics of using this device are taught.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SKILLS / LEARNING OUTCOMES OF THE SUBJECT COURSE
The competencies to be worked on during this course are the following:
MO2.GM2.2 Being familiar with the physical, chemical and structural properties of minerals
MO2.GM2.3 Identifying the main minerals and their context from a hand sample and using a microscope.
GO03 Ability to find and manage information
G017 Obtain, process, analyse and interpret field and laboratory data and observations using appropriate techniques and instruments, and document the results appropriately in written reports or field notebooks.

This course introduces the basic concepts of Mineralogy based on the study of the physical, chemical and structural properties of minerals. On the one hand, students are expected to learn to identify minerals, both from hand samples and using an optical microscope. One the other, the aim is to develop their ability to incorporate and interpret the information they provide on their geological context, relating it to the different settings for formation of minerals.

Theoretical and Practical Contents

THEORETICAL-PRACTICAL CONTENTS (SPANISH)
- INTRODUCTION: Basic concepts in Mineralogy.
- THE CLASSIFICATION OF MINERALS: Criteria and models for the classification of minerals. Silicates: structural classification and general characteristics.
- TECTOSILICATES. The Silica Group. Feldspars, feldspathoids and zeolites.
- PHILOSILICATES. Basic structure and classification. Polytypism.
- INOSILICATES. Pyroxenes and pyroxenoids. Amphiboles
- CYCLOSILICATES, SOROSILICATES and NESOSILICATES. Beryl, cordierite, tourmaline. Epidote Group. Olivine, garnets, aluminum silicates. Other silicates.
- NO SILICATES Carbonates, halides, sulfates, native elements, sulfides, oxides, hydroxides. Others.
- MORPHOLOGICAL PROPERTIES. Habit. Crystal aggregates and special textures. Pseudomorphism. Typomorphic minerals.
- PHYSICAL PROPERTIES OF MINERALS. Density. Specific gravity. Mechanical properties: toughness, deformation, hardness, cleavage, partition, fracture. Thermal, radioactive, magnetic, electrical and surface properties. Color.
- THE CHEMICAL COMPOSITION OF MINERALS. Interpretation of chemical analysis of minerals. Structural formulas, graphical representation
- MAGMATIC ENVIRONMENT OF MINERAL FORMATION. Interpretation of phase diagrams.
- SEDIMENTARY ENVIRONMENT OF MINERAL FORMATION. Eh-pH diagrams.
- METAMORPHIC ENVIRONMENT OF MINERAL FORMATION. Geothermobarometry.
- HYDROTHERMAL SYSTEM. Fluid inclusions.
- IDENTIFICATION OF MINERALS IN A HAND SAMPLE
- IDENTIFICATION OF MINERALS IN THIN SECTIONS

TEACHING METHODS

METHODOLOGY
Lectures will be given in a room assigned to the group. During these lectures visual resources will be used (computer presentations, transparencies) and there will be analysis of representative examples of different settings for formation of minerals. Discussion will be encouraged in the class of matters related to the field, so students are recommended to attend classes regularly.
The practicals, in which a variety of rock samples will be studied, will take place in the Visu (0.3) and Optical (0.7) laboratories. During these classes students will have to work autonomously under the supervision of the lecturer,

developing their ability to recognise the different types of mineral.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	54			36					
Horas de Actividad No Presencial del Alumno/a	81			54					

Legend:

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 40%
- Exercises, cases or problem sets 55%
- Individual assignments 5%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

ORDINARY SESSION: GUIDANCE AND WITHDRAWAL
Written examination to be sat: 40%
- Answering questions about the programme followed

Practical examinations: 55%
- Identifying minerals in ten hand samples of rock (25%)
- Identifying minerals in two thin sections (30%)

Individual papers: 5%
- Keeping a notebook on the practicals

To pass the course students must pass both the written examination and the practical tasks set.
Books, memos and notes are banned from use by students during the assessment tests, as are telephones, electronic, IT or any other kind of device. Only calculators with basic functions may be used.

During the examination the "Protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and in academic work at the UPV / EHU" will be applied.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY SESSION: GUIDANCE
Final assessment.
The same assessment criteria as in the ordinary session will be used.

MANDATORY MATERIALS

OBLIGATORY MATERIALS
Practicals notebook for Visu and optical labs.
Instruments for Visu practicals: hand magnifier, magnet, etc.

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Journals

Macla
Boletín de la Sociedad Española de Mineralogía
European Journal of Mineralogy
The Canadian Mineralogist
Economic Geology
American Mineralogist

Web sites of interest

http://webmineral.com/
http://www.webmineral.com/Alphabetical_Listing.shtml
https://www.mindat.org/
https://virtual-museum.soils.wisc.edu/displays/
http://www.quartzpage.de/intro.html

http://www.ehu.eus/mineralogiaoptica/
http://edafologia.ugr.es/optmine/index.htm
http://geolab.unc.edu/Petunia/mainmenu.bak
http://www.tulane.edu/~sanelson/eens211/index.html

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GGEOLO30 - Bachelor`s Degree in Geology	Year	Second year

COURSE

26786 - Sedimentology	Credits, ECTS:	6

COURSE DESCRIPTION

CONTEXT AND DESCRIPTION
Sedimentology is the scientific study of sediment formation and its subsequent transformation into sedimentary rock. In addition, the environmental conditions under which these processes take place are studied.
In order to access the course, applicants are expected to have foundation level knowledge of Geology, Physics, Chemistry and Biology (studied the 1st year of the degree course in Geology at the University of the Basque Country). In terms of contents, Sedimentology is a cornerstone in the study of other geological specializations studied in our degree course. These include Stratigraphy (2nd year), Sedimentary petrology and Multidisciplinary camp (3rd year), and Energy resources, Sedimentary environments, and Basin analysis & historic geology (4th year). In addition, Final Projects invariably require sedimentological knowledge.
Regarding career opportunities, the exploration and exploitation of natural resources, groundworks (environmental, construction, etc.), and R&D all require professionals with a sound knowledge of Sedimentology.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

LEARNING OUTCOMES AND COMPETENCES
Successful students will acquire a sound knowledge of physical, chemical and biological sedimentary processes, from their identification through to interpretation (sedimentary facies). Additionally, students will acquire an understanding of the abovementioned sedimentary processes and products in the context of terrestrial, transitional and marine environments (i.e., facies associations and sequences).
CORE COMPETENCES:
MO4.GM4.1. To have an understanding of the main sedimentary processes and environments, and to be able to identify their sedimentary products.
MO4.GM4.6. To have an understanding of sedimentary rocks, their characteristics and their geodynamic context.
MO4.GM4.8. To be able to identify the most common fossils and exogenous rocks in the field, and record the data adequately in a geologist’s notebook.
GENERAL AND TRANSVERSAL COMPETENCES:
GO01. Skills of analysis and synthesis.
GO03. Skills of information gathering and managing.
GO04. Ability to put knowledge into practice.
G017.- To take, perform and analyze field and laboratory data with the suitable methods and devices, and then to show the results correctly by means of different kinds of reports.

Theoretical and Practical Contents

COURSE DESCRIPTION
1. Basic concepts and learning objectives.
2. Erosion and the transport and accumulation of sediment.
3. Current driven bedforms and sedimentary structures: unidirectional water currents, multidirectional water currents (waves and tides), wind currents and second-order currents.
4. Erosion driven sedimentary structures and their relationship with corrasion, obstacles and objects.
5. Soft sediment deformation structures.
6. Sediment gravity flows and their deposits.
7. Bioconstructions, bioerosion and bioturbation.
8. Sedimentary systems: concepts and basic principles.
9. Continental systems.
10. Coastal and shallow marine systems.
11. Deep marine systems.

TEACHING METHODS

METHODOLOGY
As students are starting from scratch in sedimentology, its fundamentals will be explained in class. In addition to this foundation, students will be expected to carry out individual study in order to deepen their knowledge and solve specific exercises set during the course. As a complement to theoretical study, both laboratory and field work will be carried out in order to put theory into practice.
Laboratory work will be carried out in five two-hour sessions, distributed in the timetable published by the Faculty. Fieldwork will be carried out in three five-hour working sessions (three Fridays). As transfer time and breaks are not computed, fieldtrips will be full-day sessions. The timetable published by the Faculty specifies starting and finishing times, but the definitive schedule may change depending on variable circumstances (sea conditions, weather, traffic, etc.). The actual schedule of each fieldtrip will be specified on the call published on eGela.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	35			10					15
Horas de Actividad No Presencial del Alumno/a	52,5			15					22,5

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 30%
- Multiple choice test 30%
- Exercises, cases or problem sets 20%
- Individual assignments 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS ASSESSMENT
- Classroom exercises and laboratory assignments: 20%
- Field exercises and assignments: 20% (only the field sessions in which the student has participated will be taken into account; his/her mark for not attended sessions will be 0).
- Final examination: 60%

NOTICE:
An overall minimum score of 5 points out of 10 is required to pass. For the two first items (exercises and field work) to be considered in the continuous assessment program, a minimum of 4 points out of 10 has to be obtained in the third item (exam).
The exam will consist of two parts: theory and practice, each representing 50% of the final result of the exam. However, it is necessary that a minimum of 2 points (out of 5) is obtained in the theory part. The theory exam will include multiple choice tests, in which the negative value of the sum of all incorrect answers and the positive value of the only correct answer of each question will correspond to the same absolute number. The practical exam will include exercises similar to those done in the classroom and the laboratory (diagram blocks, sample analysis and measurement, interpretation of photograghs) and the topics covered in field sessions.
If a student cannot participate in the activities to be carried out during the continuous assessment program (exercises, laboratory, field), he/she will have the option to be evaluated only with a final exam which will include all the parts of the subject (theory content, exercises, laboratory work and field work). In order to take advantage of this option, it has to be communicated in writing to the appropriate lecturer in the first two weeks of the academic year.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

End of course exam resit (extraordinary call): Final examination.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Boggs, S.Jr. (2012). Principles of sedimentology and stratigraphy. Prentice-Hall, New Jersey.
Collinson, J.D. & Thompson, D.B. (1982). Sedimentary structures. Allen & Unwin.
Dabrio, C., y Santiago (2003). Estratigrafía. Colección Geociencias Universidad Complutense Madrid.
Nichols, G. (2009). Sedimentology & Stratigraphy. Wiley-Blackwell, Oxford.
Ponce, J.J., Carmona, N., Montagna, A.O. (2018). Atlas de estructuras sedimentarias inorgánicas y biogénicas. Fundación YPF, Buenos Aires.
Stow, A.V. (2005). Sedimentary rocks in the field: a color guide. Elsevier.

Detailed bibliography

Allen, J.R.L. (1982). Sedimentary structures: their character and physical basis. Elsevier.
Leeder, M. (2010). Sedimentology and sedimentary basins: from turbulence to tectonics. Wiley-Blackwell, Oxford.
Reading, H.G. (1996). Sedimentary environments and facies. Blackwell science.

Journals

Sedimentology
Sedimentary Geology
Journal of Sedimentary Research

Facies
The Depositional Record
The Sedimentary Record
Basin Research

Web sites of interest

http://www.gpc.edu/~pgore/geology/historical_lab/contents.php
http://www.virtual-geology.info/sedimentology/index.html
http://strata.geol.sc.edu/
http://walrus.wr.usgs.gov/seds/index.html
http://www.virtual-geology.info/sedshots/sedshots-index.html

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GGEOLO30 - Bachelor`s Degree in Geology	**Year**	Second year

COURSE

26790 - Stratigraphy	**Credits, ECTS:**	6

COURSE DESCRIPTION

The contents of this subject are designed to develop the basic stratigraphic methodology to describe and organize in space and time the rock units that compond the earth’s crust. It also considers the basic tools to establish the time succession and interpretation of the geological processes occurred throughout the history of the Earth.
It is highly recommended to have read the subject Sedimentology before enrolling this subject.
The subject Stratigraphy it is very related to the subjects Sedimentology, Energetic Resources, Basin Analysis, Historical Geology and Sedimentary environments.
This subject is linked to the profesional practice in research centres, oil and mining companies, environmental companies and teaching centres.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The contents of this subject are designed to develop the basic stratigraphic methodology to describe and organize in space and time the rock units that compond the earth’s crust. It also considers the basic tools to establish the time succession and interpretation of the geological processes occurred throughout the history of the Earth.
The subject aims to achieve the following specific competencies:
- M04GM4.2.- Development of the basic stratigraphic methodology in order to arrange the rock units in time and space.
- M04GM4.1.- Knowledge of the main sedimentary processes and environments and identification of their products.
- M04GM4.4.- Understanding of the fossil record and its biostratigraphic and palaecological implications.
- M04GM4.6.- Knowledge of the sedimentary rocks, their characteristics and their geodynamic context.

And it also aims to achieve the following cross-disciplinary competencies :
- G001.- Analysis and synthesis skills.
- G004.- Ability to put knowledge to practical use.
- G005.- Autonomous and creative learning and work.
- G010.- Motivation for quality and well done work.

And between the general competencies:
- G017.- To take, perform and analyze field and laboratory data with the suitable methods and devices, and then to show the results correctly by means of different kinds of reports.

Theoretical and Practical Contents

Theoretical content
Lesson 1. Concepts and basic principles in Stratigraphy: Definition and objectives. Basic principles in Stratigraphy. Stratigraphic disciplines. Stratigraphic procedure.
Lesson 2. Data collection methodology in Stratigraphy: Surficial, subsurface, aerial and laboratory/office methods.
Lesson 3. Age of rocks: relative dating and the standard chronostratigraphic chart. Absolute dating.
Lesson 4. Stratigraphic continuity and unconformities: concepts. Stratigraphic unconformity types.
Lesson 5. Stratigraphic classification: concepts and procedure. Stratigraphic unit types.
Lesson 6. Lithostratigraphic, biostratigraphic, chronostratigraphic, magnetostratigraphic and allostratigraphic units.
Lesson 7. Stratigraphic correlation : Concepts and correlation types. Correlation methods.
Lesson 8. Chemostratigraphy: Bases for its use. Non- isotopic (carbonate) and isotopic (oxygen, carbon and strontium isotope) chemostratigraphy.
Lesson 9. Marine transgressions and regressions: Concepts and types.
Lesson 10. Sequence stratigraphy: Cyclicity in the filling of sedimentary basins. Concept of sequence. Sequence genesis and orders. Eustatic cycles. Depositional sequence models.
Lesson 11. Basin analysis: Basin analysis concepts. Controls in the filling of sedimentary basins. Graphical methods in basin analysis. Subsidence analysis.
Lesson 12. Sedimentary basin classification : Types of sedimentary basins in relation to Plate Tectonics. Formation and main features.

Practical content
- Relative and radiometric dating.
- Realisation and interpretation of stratigraphic logs.
- Petrophysical (wireline) log interpretation.
- Interpretation of seismic profiles.
- Correlations. Realization and interpretation of stratigraphic and chronostratigraphic cross-sections.

Field training
1. Realisation of stratigraphic logs. Establishment and interpretation of lithostratigrapic units. Identification and interpretation of stratigraphic unconformities. Relative dating of units.
2. Multidisciplinary stratigraphy. Litho-, bio-, chrono- and magnetostratigraphic units, and depositional sequences. Identification and interpretation of stratigraphic cycles (2nd, 3rd, 4th and 5th orders). Cyclostratigraphy. Stratotypes. Event stratigraphy.
Note: Each field practice is developed in a session of five working hours (commuting and breaks/interruptions are not counted) and, therefore, have a full day duration (morning and afternoon).

TEACHING METHODS

The methodology of the subject is based on theory lectures, where basic theorethical contents are explained. This lectures are complemented by practical sessions and field training, where theoretical contents are applied on real case studies.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	35		15						10
Horas de Actividad No Presencial del Alumno/a	52,5		22,5						15

Legend:

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Exercises, cases or problem sets 25%
- Positive attitude and participation (questions, answers, etc.) 5%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

ASSESSMENT METHODOLOGY

Continuous assessment:
- Final exam: 70%
- Practical work (exercises, case studies and problem set): 12,5%
- Practical field-work (field reports and/or field exercises): 12,5%
- Positive attitude and participation (questions, answers, etc.): 5%

It is a condition to obtain at least 5 points out of 10 in the final exam in order to pass the subject.

Final assessment:
- Final exam: 70%
- Practical work (exercises, case studies and problem set): 15%
- Practical field-work (field reports and/or field exercises): 15%

Waives
The student has the right to decline the continuous assessment: the student has to present a written form to the lecturer during the first 9 weeks after beggining of the term, following the application of current regulations of the UPV/EHU (BOPV, 13th march 2017, nº 50, article 8.3).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary exam call, grading of the final exam, practical work and field training will weigh the same as in the final assessment:
- Final exam: 70%
- Practical work (exercises, case studies and problem set): 15%
- Practical field-work (field reports and/or field exercises): 15%

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Coe, A.L. (ed.) (2022). Deciphering Earth's History: the Practice of Stratigraphy. Geological Society, London, 349 pp.
Boggs, S. (2006). Principles of Sedimentology and Stratigraphy. Harlow, Essex: Pearson Education, 4. edición. 662 pp.
(Spanish group) Dabrio, C.J. & Hernando, S. (2003). Estratigrafía. Facultad de Ciencias Geológicas, Universidad Complutense de Madrid, 382 pp.
Doyle, P., Bennett, M.R. y Baxter, A.N. (2001). The Key to Earth History: An Introduction to Stratigraphy. John Wiley & Sons, New York, 224 pp.
Nichols, G. (1999). Sedimentology and Stratigraphy. Blackwell, Oxford, 355 pp.
Vera, J.A. (1994). Estratigrafía: Principios y métodos. Ed. Rueda, Madrid. 806 pp.

Detailed bibliography

Brookfield M.E. (2004). Principles of Stratigraphy. Blackwell Publishing, Oxford, 340 pp.
Doyle, P. y Bennett, M.R. (eds.)(1998). Unlocking the Stratigraphical Record: Advances in Modern Stratigraphy. John Wiley & Sons, Chichester, 532 pp.
Fritz, J.F. y Moore, J.N. (1988). Basics of Physical Stratigraphy and Sedimentology. John Wiley & Sons, New York, 371 pp.
Lemon, R.R. (1990). Principles of Stratigraphy. Merring Publishing Company, Columbus, 559 pp.
Miall, A. D. (2000). Principles of Sedimentary Basin Analysis, 3rd ed.Springer-Verlag, Berlin, 616 pp.
Prothero, D.R. y Schwab, F. (2004). Sedimentary Geology. An Introduction to Sedimentary Rocks and Stratigraphy. W. H. Freeman and Company, New York, 575 pp.
Salvador, A. (1994). International Stratigraphic Guide: A guide to stratigraphic classification, terminology, and procedure, 2. ed. The International Union of Geological Sciences and The Geological Society of America, 214 pp.
Schoch, R.M. (1989). Stratigraphy. Principles and Methods. Van Nostrand Reinhold, New York, 375 pp.

Journals

Sedimentology
Sedimentary Geology
Journal of Sedimentary Research
Stratigraphy
Lethaia

Web sites of interest

http://www.stratigraphy.org/
http://strata.geol.sc.edu/exerices/ExercisePrintOuts.html
http://facstaff.gpc.edu/~pgore/geology/historical_lab/contents.php
http://www.bib.ub.edu/recursos-informacio/guies-tematiques/geologia/#c4820
http://strata.geol.sc.edu/
http://www.glossary.oilfield.slb.com/

OBSERVATIONS

It is highly recommended to have read the subject Sedimentology before enrolling this subject. Otherwise, the student may have struggles to follow the subject.

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GGEOLO30 - Bachelor`s Degree in Geology	**Year**	Fourth year

COURSE		
26797 - Micropaleontology	**Credits, ECTS:**	6

COURSE DESCRIPTION

A microfossil is a fossil evidence that, due to its small size (mm or microns), can only be studied with a binocular microscope or through an optical or scanning electron microscope. Microfossils may correspond to whole organisms or fragments of the hard parts of larger organisms. The microfossils of animals or their parts are known as microfauna (for example, ostracods and teeth of micromammals) although this term is also used for some microfossils of protists (for example, foraminifera). Plant microfossils, usually from fossilization of phytoplankton, are called microflora (for example, diatoms and dinoflagellates).

The science that is responsible for the study of microfossils is called Micropalaeontology. The techniques to study microfossils are diverse, depending on the group being studied and the sediment or rock types in which it is found, but the most common is the wet screening when we are dealing with organisms preserved in soft sediments.

Some microfossil groups are of great importance as palaeoenvironmental proxies and others as biostratigraphic markers, both in marine and continental sedimentary series of different ages.

This subject is taught only in Spanish and is included in the English Friendly Course (EFC) programme.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Objetives:
-To know the conceptual bases of Micropalaeontology.
-To know the morphological and palaeoenvironmental characteristics as well as the evolutionary history of the main microfossil groups and to use them in the resolution of geological problems.

Specific competences:
M04GM4.1- To know the main sedimentary processes and environments and identify their products.
M04GM4.2- To develop the stratigraphic methodology necessary for the temporal and spatial arrangement of the rock units.
M04GM4.4- To understand the fossil record and its biostratigraphic and palaeoecological implications.
M04GM4.5- To identify the main fossil groups and their context in a hand sample and under a microscope.
M04GM4.8- To observe the most common fossils and exogenous rocks in the field and complete the field notebook.

Transversal competences:
G001- Capacity for analysis and synthesis.
G003- Search capacity and information management.
G004- Ability to apply knowledge to practice.
G007- Ability to organize, plan and manage time.
G009- Oral and written communication in the native language.
G010- Motivation for quality and a well-done job.

Theoretical and Practical Contents

1.Introduction to Micropalaeontology: Concept and current status. Historical development and importance. Fundamentals and Applications. Methodology of the samples in Micropalaeontology. Preparation techniques and study methods. Taphonomy in Micropalaeontology. Main groups of microfossils: criteria used and classification.

2. Kingdom Protista. Dinoflagellates: Introduction. Morphology of dinoflagellates. Classification of dinoflagellates. Biology of dinoflagellates. Palaeoenvironmental applications. Biostratigraphic applications. Evolutionary history.

3.Diatoms: Introduction. Morphology and Systematics. Biology of diatoms. Palaeoenvironmental applications. Biostratigraphic applications. Evolutionary history.

4. Calcareous nannoplankton: Introduction. Morphology and Systematics. Biology of calcareous nannoplankton. Palaeoenvironmental applications. Biostratigraphic applications. Evolutionary history.

5.Radiolaria: Introduction. Morphology and Systematics. Biology. Taphonomy of radiolarians. Palaeoenvironmental applications. Biostratigraphic applications. Evolutionary history.

6. Foraminifera: Introduction. Morphology and Systematics. Biology and Ecology Palaeoenvironmental applications. Biostratigraphic applications. Evolutionary history.

7. Kingdom Plantae. Spores and Pollen: Introduction. Morphology and Systematics. Distribution and Ecology. Applications in continental settings. Applications in marine environments.

8. Kingdom Animalia. Ostracoda: Introduction. Biology. Ecology and Palaeoecology. Classification. Applications in palaeoenvironmental interpretation. Origin and evolutionary tendencies.

9. Microvertebrates: Conodonts. Introduction. Characteristics of the conodontal elements. General history of the conodonts: palaeoecology and biostratigraphy. Other vertebrate microfossils: micromammals. Introduction. Morphology and Systematics. Biology and Ecology. Palaeoenvironmental and biostratigraphic applications. Origin and evolutionary history.

TEACHING METHODS

PRACTICAL CONTENTS:
-Field trip: collection of samples in an area of geological interest.
-Laboratory work: preparation of samples collected in the field and microfossil analysis in order to perform a palaeoenvironmental and biostratigraphic interpretation of the sedimentary record.
-Bibliographic or practical guided work: development of theoretical or practical works on a subject of micropalaeontological interest that will be presented orally later in class.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	35			20					5
Horas de Actividad No Presencial del Alumno/a	52,5			30					7,5

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Exercises, cases or problem sets 20%
- Individual assignments 5%
- Oral presentation of assigned tasks, Reading¿ 5%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

A. Evaluation during the academic course:
-Laboratory practices and field trip: evaluation of the notebook of practices carried out along the academic course and of the exercises for the resolution of associated geological problems, as well as of the annotations made in the field notebook (5%).
-Oral presentation: evaluation of the scientific level, structure and presentation of a bibliographic work carried out in relation to some aspects of the contents (5%).

B. Final examination of theoretical contents (70%) and laboratory practices (20%).

These evaluation criteria will be applicable for both the ordinary and the extraordinary calls.

During the examination the "Protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and in academic work at the UPV/EHU" will be applied.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

A. Evaluation during the academic course:
-Laboratory practices and field trip: evaluation of the notebook of practices carried out along the academic course and of the exercises for the resolution of associated geological problems, as well as of the annotations made in the field notebook (5%).

-Oral presentation: evaluation of the scientific level, structure and presentation of a bibliographic work carried out in relation to some aspects of the contents (5%).

B. Final examination of theoretical contents (70%) and laboratory practices (20%).

These evaluation criteria will be applicable for both the ordinary and the extraordinary calls.

During the examination the "Protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and in academic work at the UPV / EHU" will be applied.

MANDATORY MATERIALS

-Laboratory for treatment of samples collected during the field trip.
-Laboratory (chemical products: methylene blue, rose bengal, trichlorethylene, hydrogen peroxide, multiple slides, needles, brushes, picking trays, etc.) and field (sampling bags, labels, permanent markers, etc.) consumables.
-Optics laboratory (binocular microscopes).

BIBLIOGRAPHY

Basic bibliography

-ARMSTRONG, H.A. and BRASIER, M.D. (2005). Microfossils. 2nd edition, Blackwell Publishing, 296 p., Oxford.
-GEORGESCU, M.D. (2018). Microfossils through time: an introduction. Schweizerbart Science Publishers, 400 p., Stuttgart.
-HAQ, B.U. and BOERSMA, A. (1998). Introduction to Marine Micropaleontology. Elsevier, 376 p., Singapore.
-JONES, R.W. (2011). Applications of Palaeontology. Techniques and case studies. Cambridge University Press, 406 p., Cambridge.
-LIPPS J.H. (Ed.) (1993). Fossil prokaryotes and protists. Blackwell Scientific Publications. 342 p., Boston.
-MOLINA, E (Ed.) (2017). Micropaleontología. 3rd edition, Prensas de la Universidad de Zaragoza. 686 p., Zaragoza.
-SARASWATI, P.K and SRINIVADSAN, M.S. (2016). Micropaleontology: Principles and Applications. Springer, 224 p., Berlin.

Detailed bibliography

-ALFÉREZ, F. (1990). Mamíferos. In: Meléndez, B. (Ed.) Paleontología 3: Mamíferos (1º parte). Editorial Paraninfo, 1-24, Madrid.
-ATHERSUCH, J.; HORNE, D.J. and WHITTAKER, J.E. (1989). Marine and Brackish Water Ostracods. Linnean Society of London and The Estuarine and Brackish-WaterSciences Association, 343 p., Leiden.
-BOLLI, H.M., SAUNDERS, J.B. and PERCH-NIELSEN K. (Eds.) 1985. Plankton Stratigraphy. Cambridge University Press. Volumes 1 and 2.
-BOUDAGHER-FADEL, M.K., BANNER, F.T. and WHITTAKER, J.E. (1997). The early evolutionary history of planktonic foraminifera. Chapman & Hall. London.
-BOWN, P.R. (ed.) (1998). Calcareous nannofossil biostratigraphy. Kluwer Academia Publishing.
-DUPRÉ, M. (1992). Palinología. Cuadernos Técnicos de la Sociedad Española de Geomorfología, 5, 30 p. Geoforma Ediciones, Logroño.
-HAYNES, J.R. (1981). Foraminifera. MacMillan Publishers LTD, London.
-HASLETT, S.K. (2002). Quaternary Environmental Micropalaeontology. Arnold, 340 p., London.,
-MARTIN, R.E. (2000). Environmental Micropaleontology. The application of Microfossils to Environmental Geology. Kluwer Academic, 481 p., New York.
-ZALASIEWICZ, J. and WILLIAMS, M. (2018). Skeletons, The Frame of Life. Oxford University Press, 320 p., Oxford.

Journals

Journal of Foraminiferal Research
Journal of Micropalaeontology
Marine Micropalaeontology
Micropaleontology
Palaeogeography Palaeoclimatology Palaeoecology
Paleoceanography
Palynology
Review of Palaeobotany and Palynology
Revista Española de Micropaleontología

Web sites of interest

-Cushman Foundation: //www.cushmanfoundation.org/
-eForams website: //www.eforams.org/

-Foraminifera Gallery://www.foraminifera.eu/
-Grzybowski Foundation: //www.es.ucl.ac.uk/Grzybowski/
-Micropaleontology Press: //micropress.org/
-Micropalaeontological Society: //www.tmsoc.org/
-MIRACLE (microfosil image recovery and circulation for learning and education): http://www.ucl.ac.uk/GeolSci/micropal/welcome.html
-North American Micropaleontology Section,SEPM://www.sepm.org/nams/micro.htm
-Revista Española de Micropaleontología: //www.igme.es/
-The Curator of Micropalaeontology Blog: //www.nhm.ac.uk/natureplus/blogs/micropalaeo/
-WoRMS: //www.marinespecies.org/foraminifera

OBSERVATIONS

-This subject has a linked moodle course, also called Micropalaeontology (https://egela.ehu.eus), for communication and exchange of materials between lecturer and students.

-This subject of the Bachelor Degree in Geology is included in the TMS Student Award scheme of the Micropalaeontological Society. The student who best develops her/his academic tasks during each academic year will receive a free subscription to the Micropalaeontological Society for a year, will be able to participate in its activities, and will receive the journals and internal bulletins of this scientific society.

-The field trip schedule may be affected by traffic conditions.

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GGEOLO30 - Bachelor`s Degree in Geology	Year	First year

COURSE

27806 - Physics	Credits, ECTS:	9

COURSE DESCRIPTION

Any Science focused on the understanding and description of Nature needs a solid foundation on Physics. Physics studies Nature at its most fundamental level.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

In general:

-Explain and analyze the essential phenomena, concepts, principles and theories related to Biology, Geology and Biochemistry.
-Know, describe, analyze and evaluate the physical environment.
-Know and apply the physical and chemical principles of Biology, Geology and Biochemistry.

Transversal competences:
G001 - Ability to analyze and synthesize and reason critically in the application of the scientific method.
G002 - Ability to solve problems.
G005 - Learning and continuous autonomous work, promoting initiative and adaptation to new situations.
M01C18 - Process and interpret data from observations and measurements according to explanatory models.

Specific competences:
Degree in Biology:
M04C03 - Know and apply the physical and chemical principles of Biology.
M04C05 - Demonstrate a basic knowledge of mathematics and statistics applied to Biology.
Degree in Geology:
M01GM1.3 - Development of spatial vision and the capacity of abstraction.
Degree in Biochemistry and Molecular Biology:
MO1.1 - Understand and apply the basic knowledge of Physics, Mathematics and Chemistry to biological systems
MO1.7 - Master the basic terminology of the different physical quantities, and correctly use the systems of international units and their equivalences
Degre in Biotechnology:
M01CM1.1 - Understand and apply the basic knowledge of Physics, Mathematics and Chemistry to the biological and engineering systems.

Theoretical and Practical Contents

1. GENERAL CONCEPTS
Unit systems. Dimensional analysis. Laws of scale.

2. INTRODUCTION TO MECHANICS
Uniform movement. Movement uniformly accelerated. Linear momentum. Force. Static Biomechanics. Newton's laws. Work, Energy and Power. Elastic properties of materials.

3. FLUIDS
A) Hydrostatics. Density. Pressure. Atmospheric pressure. Floatation.
B) Hydrodynamics. Flow in ideal fluids. Bernoulli equation. Venturi effect.
C) Flow in viscous fluids. Law of Poiseuille. Reynolds number. Law
of Stokes. Blood circulation.
D) Surface tension. Law of Laplace. Capillarity.

4. THERMODYNAMICS
Temperature scales. Heat. Heat capacity. Calorimetry. First Law of thermodynamics. Entropy. Second principle of thermodynamics. Phase transitions and phase diagrams. Heat transmission: Conduction, convection, radiation.

5. DISSEMINATION PROCESSES
Collisions and average free travel. Law of Fick. Stationary diffusion. Thermal diffusion: Fourier's Law. The diffusion with drag. Diffusion in solutions. Law of Nerst. Osmosis.

6. ELECTRICITY AND MAGNETISM
Electric charge Coulomb law. Electric field and potential. Gauss's theorem. Electric capacity and capacitors. Electric dipoles. Electric current. Ohm's law. Resistance. Sources of electric power. Power in electrical circuits. Circuits Nervous driving Magnetic field. Force on a moving load.
Mass spectrometer.

7. WAVES AND OPTICS
Wave motion. Types of waves. Wave pulses and periodic waves. Interference of waves and standing waves. Doppler effect. Sound and ultrasound. Electromagnetic waves. Electromagnetic spectrum. Refractive index. Reflection and refraction of light. Diffraction. Polarization. Mirrors and lenses. The optical microscope. The human eye

8. RADIACTIVITY

The atomic nucleus Mass number and atomic number. Isotopes. Law of disintegration. Radioactive activity Radioactive dating Interaction of radiation with matter. Biological effects

TEACHING METHODS

Master lessons and practical problem-solving classes.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	54	5	31						
Horas de Actividad No Presencial del Alumno/a	81	7,5	46,5						

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Both in the partial (that will take place at the end of the first quarter) and in the final exams, there will be theoretical questions as well as problems to be solved. Students that pass the partial exam can choose not to answer the questions corresponding to the material of the first quarter in the final exam. In that case, the mark of the partial exam will count 1/3 over the final mark, whereas the other 2/3 will be taken from the mark of the final exam. Students that do not pass the partial exam will have to perform the complete final exam. The mark for the students that perform the complete final exam will be given by the mark obtained in this exam. Failing to take the final call exam (ordinary call) is equivalent to waiving the call.

During the evaluation tests it is not allowed to use books, notes or notebooks, as well as any kind of mobile phone, computer or electronic devices. Only didactic material, devices or computer authorized by the teaching team may be used. If unethical or dishonest behaviour is detected the protocol dealing with academic ethics and prevention of fraudulent and dishonest behaviour in evaluation test and academic assessments in the UPV/EHU will be applied.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

All students that take the resit exam will have to perform the complete exam, even if they had passed the partial exam. The extraordinary call exam counts 100% of the grade. Failure to take the exam (extraordinary call) is equivalent to waiving the call.

During the evaluation tests it is not allowed to use books, notes or notebooks, as well as any kind of mobile phone, computer or electronic devices. Only didactic material, devices or computer authorized by the teaching team may be used. If unethical or dishonest behaviour is detected the protocol dealing with academic ethics and prevention of fraudulent and dishonest behaviour in evaluation test and academic assessments in the UPV/EHU will be applied.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Physics for Scientists and Engineers. P. M. Fishbane, S. Gasiorowicz, and S. T. Thornton. (Prentice Hall, 1996)
Física para ciencias de la vida. Jou i Mirabent, David. McGraw-Hill (2009).
Física. W. Kane y M.M. Sternheim. Reverté (2ª edición 1996)
Física para las Ciencias de la Vida. A. Cromer. Reverté (2ª edición 1996)

Detailed bibliography

Physics. 8th Edition, Cutnell & Johnson. (John Wiley & Sons, INC, 2009)
Física para Ciencias e Ingeniería. (2 volúmenes) R. A. Serway y J. W. Jewett. Thomson-Paraninfo (2005)
Física biológica: energía, información, vida. P. Nelson. Reverté (2005).
Física. (2 volúmenes) P. A. Tipler Reverté (4ª edición 2000).
Física de los procesos biológicos. F. Cussó, C. López y R. Villar. Ariel. (1ª edición 2004).
Introducción a la Física y a la Biofísica. J. González Ibeas. Alhambra (1974).
Física. D. Tilley y W. Thumm. Fondo Educativo Interamericano (1976).

Journals

Web sites of interest

http://www.sc.ehu.es/sbweb/fisica/
http://www.colos.org/
http://webphysics.davidson.edu/Applets/TaiwanUniv/index.html

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GGEOLO30 - Bachelor`s Degree in Geology	**Year**	Fourth year

COURSE

26803 - Basin Analysis and Historical Geology	**Credits, ECTS:**	6

COURSE DESCRIPTION

The aim of Basin analysis and Historical Geology is to provide a broad comprehensive view on the origin, architecture and evolution of sedimentary basins, taking into account that sediments are the main archive of the physico-chemical transformations and biological evolutionary patterns occurring during Earth's history.

The knowledge of sedimentary basins is based on a dynamic multidisciplinary approach that involves a wide range of geological disciplines (Stratigraphy, Subsurface Geology, Structural Geology, Paleontology, Mineralogy, Geochemistry). However, the sedimentary nature of most basin fills makes Sedimentary Geology the key discipline for the study of the changing sedimentary processes through time, the succession of diagenetic phases and products, and the complex relationships that can be established at different temporal and spatial scales between tectonism and sedimentation, as a function of controlling factors such as sea level changes, sediment supply, climate and subsidence.

The understanding of the filling history and dynamic evolution of sedimentary basins is of prime interest for the exploration and management of most energy, mineral and rock natural resources. It also has direct application on environmental and climatic change issues, providing solutions to emerging problems such as the safe subsurface storage of CO2 and of different radiactive and liquid wastes derived from human activity. It is important to note that the history of Earth and the main events in the evolution of life cannot be fully understood without the critical understanding provided by sedimentary basin analysis.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Geology degree, Module M05 (Global Geology):

-M05GM5.6. To know the analysis methodology on sedimentary basins.

Geology degree, Module M06 (Economic Geology):

-M06GM6.6. To understand the processes that led to the origin of geological energy resources.

General skills related to the above described ones:

-G012. To use properly the geological terms, conventions, codes and units.
-G013. To gain the spatial and temporal vision about geological processes and their products (minerals, rocks, fossils, structures, and so on) on the Earth.
-G016. To make subsurface models based on geophysical and surficial data.
-G017. To take, perform and analyze field and laboratory data with the suitable methods and devices, and then to show the results correctly by means of different kinds of reports.
-G011. To know and use geological concepts, principles, paradigms and theories.
-G022. To show geological field-experience on several subjects such as rocks, structures, geomorphologies and other natural components.

Transversal skills related to the above described ones:

-G004. Capacity for bringing knowledge into practice.
-G006. Group-working ability.
-G001. Power of synthesis and analysis.

Theoretical and Practical Contents

GENERAL CONTENTS

-Methodology for the analysis of sedimentary basins.
-Formation mechanisms.
-Description and classification.
-Sedimentary filling.
-Historical geology.

DETAILED CONTENTS

Basin analysis methodology: conceptual and empirical data on stratigraphy, sedimentary processes, cycles, events, main geotectonic contexts and depositional facies models.
Basic concepts on Earth zonation and dynamics.
Basin formation mechanisms: extension, flexure and shear of the lithosphere; mantle dynamics.
Basins at stable plate areas: cratonic basins; oceanic basins.
Basins at divergent plate areas: rifts, aulacogens, passive margins.
Basins at convergent plate areas: subduction-related trenches, forearc, back-arc, intra-arc, retro-arc, foreland.
Basins at shear areas.
The sedimentary cycle: denudation, sediment transport and input, sedimentation, organic matter.
Subsidence, diagenesis and thermal history. Diagenetic processes and products; organic matter thermal degradation.
Basin fill architecture and prediction models for fossil fuels.
Historical evolution and controlling factors of depositional sequences; origin of rocks with prospective interest.

Historical Geology, introduction; Earth origin; Archean Eon. Proterozoic Eon.
Phanerozoic Eon: Palaeozoic Era; Mesozoic Era; Cenozoic Era.

TEACHING METHODS

Conceptual and deductive methods. Discussion and use of examples.
The student should be interested and aimed to discuss and criticize the proposed subjects, being skill in processing and implementing the information.
-Magistral classes: theoretical concepts.
-Classroom exercises.
-Use of software of interest.
-Field-trips: studied concepts application, case-study analysis, fiel-data obtention and analysis.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	35		6		4				15
Horas de Actividad No Presencial del Alumno/a	52,5		9		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 methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 35%
- Multiple choice test 30%
- Exercises, cases or problem sets 15%
- Oral presentation of assigned tasks, Reading¿ 10%
- Field-trips report and exercises 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Legal provisions.
Evaluation methods. BOPV 2017-III-3 norm.

8th article.
8.2. Continuous evaluation (during and after the teaching period).
Evaluation methods (exam, exercises, field-trip reports,...).

Continuous evaluation:
-exercise evaluation after handing.
-report evaluation after the last field-trip. A field-exercise per field-trip is carried out by each student.
-evaluation of an oral presentation of a key subject on historical geology.

Exam evaluation:
-Written exam on practical and theoretical subjects.

The final result is obtained with the sum of the above explained evaluation items, following the corresponding percentages. To do this, the written exam should be passed with a mark equal to or above 5 points, that is, the 50 % of the subject.

8.3. If the student decides to withdraw from the examination, the withdrawal must be requested in the first nine weeks from the beginning of the teaching period. In order to formalize this, the student should present a writing form to the head-teacher of the subject.

12.2. article. In the continuous evaluation, in case the written exam value is over 40% of the total value, and the student does not take part in the exam, the final calification is "not presented". By the contrary, if the written exam value is under 40% of the total value, the student may present the withdrawal from the examination up to one month before the classes finish, by means of a writing form to the head-teacher of the subject.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Extraordinary examination. BOPV 2017-III-3 norm.

9th article
9.1. If the student cannot pass the exam in the continuous evaluation, an extraordinary written exam can be done in order to test the skills and knowledge.

9.3. Results obtained in the continuous evaluation are kept (%35) and added up to those obtained in the written exam (%65).

MANDATORY MATERIALS

Field-trip tools (sledgehammer, compass, metric scale, bags, magnifying glass, notebook...).
Security material (adequate shoes and garments, reflective vest, safety googles).

BIBLIOGRAPHY

Basic bibliography

Allen, P.A., Allen, J.R. (2005). Basin analysis: principles and applications. 2nd edition. Blackwell, Oxford, 549 pp.
Allen, P.A., Allen, J.R. (2013). Basin analysis: principles and applications to petroleum assessment. 3rd edition. Blackwell, Oxford, 619 pp.
Anguita, F. (2011, edición revisada). Biografía de la Tierra. Historia de un planeta singular. https://eprints.ucm.es/13263/1/Biograf%C3%ADa_de_la_Tierra_revisada_por_Francisco_Anguita_-_2011.pdf
Apraiz, A. (2005). Plaka Tektonika: Lurraren funtzionamendua ulertzeko teoria. UEU, Bilbao, 425 pp.
Benedetto, J.L. (2010, tercera edición), El continente de Gondwana a través del tiempo: una introducción a la Geología Histórica. http://www.librogondwana.com.ar
Busby, C., Ingersoll, R.V. (1995). Tectonics of sedimentary basins. Blackwell, Oxford, 579 pp.
Busby, C., Azor, A. (2011). Tectonics of Sedimentary Basins: Recent Advances. Wiley. 664 p.
Coe, A. (2003). The sedimentary record of sea-level change. Cambridge University Press, Cambridge, 288 pp.
Einsele, G. (2000). Sedimentary Basins: evolution, facies and sediment budget. 2nd edition. Springer, Heidelberg, 792 pp.
Keary, P., Klepeis, K.A., Vine, F.J. (2009). Global Tectonics. 3rd edition. Wiley-Blackwell, 496 pp.
Macdougall, J.D. (1996). A short history of planet Earth. John Wiley and sons, New York, 266 pp.
Miall, A.D. (2000). Principles of sedimentary basin analysis. 3rd edition. Springer, Heidelberg, 490 pp.
Miall, A.D. (2016). STRATIGRAPHY A modern Synthesis. Springer, Heidelberg, 454 pp. https://link.springer.com/book/10.1007%2F978-3-319-24304-7
Schettino, A. (2015). Quantitative Plate Tectonics. Physics of the Earth – Plate Kinematics –Geodynamics. https://link.springer.com/content/pdf/10.1007/978-3-319-09135-8.pdf

Detailed bibliography

Gluyas, J. y Swarbrick, R. (2003). Petroleum Geoscience. Blackwell, Oxford, 359 pp.
Lunine, J. I. (1998). Earth: Evolution of a habitable world. Cambridge, 344 pp.
Watts, A. B. (2001). Isostasy and Flexure of the Lithosphere. Cambridge, 480 pp.

Journals

Sedimentology
The Depositional Record
AAPG Bulletin
Basin Research.
Sedimentary Geology
Marine and Petroleum Geology
Palaeogeography, Palaeoclimatology, Palaeoecology

Web sites of interest

http://www.sedimentologists.org
http://www.aapg.org
http://www.sepm.org

http://www.sciencedirect.com
https://www.springer.com/gp

OBSERVATIONS

During the examination the "Protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and in academic work at the UPV / EHU" will be applied.

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOQU30 - Bachelor`s Degree in Biochemistry and Molecular Biology	**Year**	Second year

COURSE

25267 - Instrumental Techniques	**Credits, ECTS:**	6

COURSE DESCRIPTION

In this subject, the theoretical foundation of two typical tools used by biochemists is studied: chromatography and electrophoresis, as well as their practical applications. As a representative example of the preparative and analytical utility of these techniques, emphasis is placed on the purification and characterization of proteins and enzymes. The course also covers how to conduct laboratory assays to determine enzyme activity and contextualize it within enzymatic purification. A practical and quantitative approach is achieved through laboratory practices, problem-solving, and computer simulation.

This subject requires students to have knowledge not only in Biochemistry but also in Chemistry, Mathematics, and Physics. It is fundamental in the education of scientific professionals, as it explains preparative and analytical techniques essential for their career. The subject builds upon knowledge acquired in other previously taken courses (Biochemistry I, Biochemistry II, Basic Biochemical Methodology), complements concurrent subjects (Molecular Biology and Genetic Engineering, Recombinant DNA Technology), and lays the groundwork for subsequent subjects (Biocatalysis, Biotechnological Processes and Products, among others).

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Cross-cutting skills:

-The student distinguishes and describes the principles of chromatographic and electrophoretic separation of proteins and explains their biochemical applications.
-The student correctly executes laboratory protocols related to the field of Biochemistry and Molecular Biology, applying them particularly to protein purification, considering criteria of purity and yield.
-The student handles, interprets, and explains the information extracted from scientific literature regarding protein separation, purification, and characterization techniques.

Specific skills:
-The student applies the results of an inquiry or research process in academic work, considering Sustainable Development Goals.
-The student synthesizes and communicates ideas orally and in writing, using academic language and integrating the terms covered in the subject.

Theoretical and Practical Contents

Syllabus:

1. Protein purification and enzymatic assays.
2. Chromatographic techniques.
3. Electrophoretic techniques.

1.Protein purification and enzymatic assays
Strategies and steps for protein purification. Purification controls. Purity criteria. Purification tables. Techniques for isolation and purification of recombinant proteins.
Enzymatic activity with enzymatic extracts and with purified enzymes. Interfering and auxiliary enzymes. Coupled assays. Continuous and discontinuous methods. Reaction progress curves. Kinetic characterization of an enzyme.

2.Chromatographic techniques
Introduction. Definitions. History of chromatography. Theory of Chromatography. Classification of chromatographic techniques. Partition and adsorption chromatography. Chromatographic band and peak. Chromatographic equilibrium. Properties of the Gaussian curve. Chromatographic parameters: retention time and volume, retention factors, delay, and separation. Components of a chromatographic system. Adsorption chromatography. Hydroxyapatite chromatography. Hydrophobic interaction chromatography. Ion exchange chromatography. Affinity chromatography. Partition chromatography. Size exclusion chromatography. Paper and thin-layer chromatography. HPLC, UPLC, and FPLC. Gas chromatography. Supercritical fluid chromatography.

3.Electrophoretic techniques
Introduction. Theory of electrophoresis. Classification. Gel Electrophoresis. Two-dimensional electrophoresis. Electrophoresis in other media. Immunoelectrophoresis. Activity assay in gels. Capillary electrophoresis.

TEACHING METHODS

To follow the theoretical lectures, students have access to all slides, supplementary readings, and other teaching materials on the virtual classroom platform (e-Gela). In addition to theoretical lectures, students will engage in laboratory practices and computer simulations of protein purification. Students will receive information on gathering scientific articles related to protein purification for the Seminar assignment. Finally, students will make an oral presentation to summarize the scientific papers they have previously worked on.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	35	5		15	5				
Horas de Actividad No Presencial del Alumno/a	52,5	7,5		22,5	7,5				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Final Exam (Written Exam): 60-65%

Assignments (practical sessions, seminars...): 35-40%
The total sum of the percentages will be
100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Evaluation system

The lecture-based teaching will be evaluated through a final exam comprising questions related to lectures, practical sessions, and seminars, representing 60-65% of the final grade. The remaining percentage (35-40%) will be allocated to other assignments (seminars, laboratory practices, problem-solving, and computer simulation) to complete the 100%.

Passing the final exam with a score equal to or higher than 5 out of 10 is required to calculate the average with the other sections of the course.

A joint activity will be conducted with the subject Recombinant DNA Technology / Molecular Biology and Genetic Engineering to integrate the knowledge acquired in protein overexpression and purification. Additionally, the cross-cutting competency of Social Commitment, Communication, and Multilingualism will be addressed.

Students have the right to be evaluated through a end-of-course evaluation system. To do so, the student must submit in writing to the responsible faculty member of the course a waiver for continuous evaluation system. Students have a period of 9 weeks from the beginning of the semester to do so.

In case of waiving continuous evaluation system, the student will be evaluated through a final exam held on the same date as the continuous evaluation final exam. This exam will consist of the same exam as in the continuous evaluation system plus other exams and/or activities equivalent to the assignments evaluated in continuous evaluation system.

Attendance to laboratory practices is mandatory. The course cannot be passed if laboratory practices are not completed, regardless of the chosen evaluation system (continuous or end-of-course).

In any type of evaluation, not taking the final exam is enough to receive a grade of "not presented" for the course.

Academic Ethics and Dishonest Practices
This subject adheres to the "Protocol on Academic Ethics and Prevention of Dishonest or Fraudulent Practices in Assessment Tests and Academic Work at UPV/EHU," with the consequences outlined in section 5 of this protocol.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The grade obtained in the passed sections of continuous evaluation system (practical sessions and seminars) will be retained in the extraordinary assessment session of the same academic year.

MANDATORY MATERIALS

There is no single book that can be classified as a reference textbook for this subject. An online platform (e-Gela) is available at the beginning of the course, which includes multimedia teaching materials, supplementary readings, and other didactic tools to follow the course. Commercially available software programs will be used for computer simulation.

BIBLIOGRAPHY

Basic bibliography

PRINCIPLES AND TECHNIQUES OF BIOCHEMISTRY AND MOLECULAR BIOLOGY. Keith Wilson and John Walker. 7th Ed. Cambridge Univ. Press, 2010

BIOCHEMICAL TECHNIQUES: THEORY AND PRACTICE, Robyt, J.F. and White, B.J. Waveland Press, Prospect Heights, 1990

BIOCHEMISTRY LABORATORY: MODERN THEORY AND TECHNIQUES. Rodney F. Boyer. Benjamin Cummings, 2006
FUNDAMENTAL LABORATORY APPROACHES FOR BIOCHEMISTRY AND BIOTECHNOLOGY, A. J. Ninfa and D. P.Ballou, Wiley, 1998

PRINCIPLES AND TECHNIQUES OF PRACTICAL BIOCHEMISTRY, B.L. Williams and K. Wilson, Cambridge,Cambridge University Press, 2005

THE TOOLS OF BIOCHEMISTRY, Cooper, T. Wiley and Sons, New York, 1977

ENZYME ASSAYS. A PRACTICAL APPROACH. Eisenthal, R. and Danson, M.J. (eds) IRL Press, Oxford, 1992

Detailed bibliography

BIOTECHNOLOGY. A LABORATORY COURSE, Becker, J.M., Caldwell, G.A. & Zacho, E.A. Academic Press, San Diego,1996

PROTEIN METHODS, Bollag, D.M. and Edelstein, S.J. Wiley-Liss, Inc., New York, 1991

GUIDE TO PROTEIN PURIFICATION, Deutscher, M.P. (Ed.) Methods Enzymology, vol 182, Academic Press, London,1990

PROTEIN PURIFICATION METHODS. A PRACTICAL APPROACH, Harris, E.L.V.& Angal, S. (Eds) IRL Press, Oxford,1989

PROTEIN PURIFICATION APPLICATIONS. A PRACTICAL APPROACH, Harris, E.L.V. IRL Press, Oxford, 1990

PROTEIN PURIFICATION PROTOCOLS, Doonan, S. (Ed.). Humana Press Inc., Totowa, NJ, 1996

ENZYME PURIFICATION AND RELATED TECHNIQUES, Jakoby, W.B. Academic Press, London, 1989

PROTEIN PURIFICATION: PRINCIPLES, HIGH RESOLUTION METHODS AND APPLICATIONS, Janson, J.C. and Rydén, L. (Eds) Wiley VCH Publishers, Inc., New York, 1998

PROTEIN PURIFICATION: PRINCIPLES AND PRACTICE, Scopes, R. Springer-Verlag, New York, 1998

A PRACTICAL GUIDE TO MEMBRANE PROTEIN PURIFICATION, von Jagow, G. and Schägger, H. (Eds.) Academic Press, New York, 1994

Journals

Biochimica et Biophysica Acta, Journal of Biological Chemistry, Protein Expression and purification, Electrophoresis, Analytical Biochemistry, etc.

Web sites of interest

Simulation software for protein purification (Prácticas de ordenador)
http://agbooth.com/pp_java/

Cytiva Chromatography Handbooks
https://www.cytivalifesciences.com/en/us/support/handbooks

Nomenclature for chromatography
http://publications.iupac.org/pac/1993/pdf/6504x0819.pdf

Chromatography simulator – Chromulator
https://people.ohio.edu/gu/CHROM/index_chrom.html

HPLC simulator
https://hplcsimulator.org/

OBSERVATIONS

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOQU30 - Bachelor`s Degree in Biochemistry and Molecular Biology	**Year**	First year

COURSE

26710 - Biochemistry I	**Credits, ECTS:**	6

COURSE DESCRIPTION

In Biochemistry I, students will acquire basic knowledge of the molecular structures and functions making up living organisms. They will also develop essential laboratory skills to conduct simple biochemical experiments, and learn how to accurately describe, analyze, and critically interpret their findings.

Biochemistry I is a critical subject that, along with Biochemistry II, lays the groundwork for many of the subsequent courses in this field. It provides students with a strong foundation in the basic principles of biochemistry, which are essential to understand complex topics in the future.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIES / LEARNING OUTCOMES

Cross-cutting skills:

· Develop the ability for analysis, synthesis and critical reasoning in the application of the scientific method.

· Develop autonomous learning and adaptation to new situations.

· Develop ethical commitment and the ability to participate in social debate.

Specific skills:

· Acquire structural and functional knowledge of the molecules making up living beings, including their basic components and polymeric structures.

· Recognize the structures of different types of biomolecules.

· Understand the fundamentals of enzymatic reactions, including the concepts of catalysis, kinetics, and enzymatic inhibition.

· Apply acquired knowledge to solve qualitative and quantitative problems.

· Develop basic laboratory skills required to conduct simple biochemical experiments.

Theoretical and Practical Contents

Theoretical and practical contents

Syllabus:

Topic 1. Concept of biochemistry. Its historical evolution. Place of Biochemistry among the experimental sciences. Objectives of Biochemistry.

Topic 2. Bioelements and biomolecules. Functional groups and bonds. Three-dimensional structure of biomolecules: isomerism and stereospecificity. Configuration and conformation.

Topic 3. Water as a solvent. Colligative properties. pH and buffers. Buffers of biological interest.

Topic 4. Proteins. Amino acids. The peptide bond. Peptides: structure and properties. Structural levels in proteins. Protein sequencing. Native structure and denaturation. Protein functions. Basic concepts for protein purification. Purity criteria.

Topic 5. Enzymes. Nomenclature and classification. Catalysis: thermodynamic and kinetic aspects. Enzyme kinetics. Michaelis-Menten equation. Graphical determination of Vmax and Km. Units of enzyme activity. Enzyme inhibition and regulation. Concept and types of inhibition. Covalent modifications of enzymes. Allosteric enzymes.

Topic 6. Carbohydrates. Functions and classification. Simple monosaccharides and derivatives. Oligosaccharides. Polysaccharides.

Topic 7. Nucleic acids. Concept and biological interest. Pyrimidine and pyrimidine bases. Nucleosides and nucleotides.

Polynucleotides: primary, secondary and tertiary structure. Nucleic acid sequencing. Free nucleotides with specific functions. Intermediates of cellular chemical energy, cofactors of enzymatic reactions, cellular communication.

Topic 8. RNA. Composition and structure. Types of RNA: heterogeneous nuclear, small nuclear, transfer, ribosomal, messenger, viral. Catalytic RNA.

Topic 9. DNA. Structure and properties. Levels of structuring: A, B and Z helices. DNA as genetic material. Chromatin structure. Optical properties of DNA: fusion and renaturation. DNA hybridization. DNA-RNA hybrids.

Topic 10. Lipids. Functions and classification. Saponifiable and non-saponifiable lipids.

Topic 11. Biological membranes. Lipid bilayers. Composition, structure and properties. Membrane proteins. Dynamics of components. Liposomes.

The theoretical content described above will be applied to solve exercises and problems in class, as well as in laboratory sessions. During these laboratory sessions, students will have the opportunity to apply the knowledge they have acquired and develop their practical skills in a supervised setting.

1st session. Learning the use of automatic pipettes, pH measurement and preparation of buffer solutions.

2nd session. Quantification of sugars and use of a sucrose standard curve.

3rd session. Quantification of sucrose in breakfast cereals.

4th session. Separation of macromolecules by Gel Filtration Chromatography.

TEACHING METHODS

Topics 1 to 11 outlined in the syllabus will be explained in detail during lectures (M).

In classroom practices (GA), students will solve qualitative and quantitative exercises and problems related to the concepts covered in the lectures. In seminars (S), students will work on solving a simple biochemical question using the techniques they have learned.

In the laboratory sessions, students will carry out the four practical activities described above. Attendance to the practical sessions is mandatory.

In computer practical session, students will use the Jmol program to visualize biomolecules, including their isomerism and their structural and functional variability.

The theoretical content described above will be applied to solve exercises and problems in class, as well as in laboratory sessions. During these laboratory sessions, students will have the opportunity to apply the knowledge they have acquired and develop their practical skills in a supervised setting.

1st session. Learning the use of automatic pipettes, pH measurement and preparation of buffer solutions.

2nd session. Quantification of sugars and use of a sucrose standard curve.

3rd session. Quantification of sucrose in breakfast cereals.

4th session. Separation of macromolecules by Gel Filtration Chromatography.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	37	2	6	12	3				
Horas de Actividad No Presencial del Alumno/a	55,5	3	9	18	4,5				

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Exercises, cases or problem sets 35%
- Teamwork assignments (problem solving, Project design) 5%
- praktiken azterketa (garatu beharreko galderak eta ariketak) 60%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EVALUATION SYSTEM

Final evaluation system

QUALIFICATION TOOLS AND PERCENTAGES

· Practical sessions (exercises, problems…) 35%

· Teamwork (problem solving, Project design) 5%

· Written exam (multiple choice questions + short questions) 60%

ORDINARY ASSESSMENT SESSION: GUIDELINES AND OPTING OUTANCE

The assessment of the Biochemistry I course is divided into three sections:

a) 60% Written exam (multiple-choice questions and short questions).

b) 35% Laboratory, classroom and computer practical sessions (20% GL+10% GA+5% GO).

c) 5% Teamwork (problem solving, project design, etc).

The criteria for assessing the sections are as follows:

· Appropriateness of the answers, integration of information, approach to and development of the problem exercise, correct use of units of measurement, and clarity and precision of language.

· Adequate execution of the experimental protocol, analysis and interpretation of

results, and effective presentation of findings.

· Correct approach and execution of exercises, as well as thorough completion and presentation of assigned tasks.

The final grade for the course will be calculated by adding the partial grades of each assessed section. To pass the course and to have your overall grade calculated, you must obtain a minimum percentage of the maximum grade in each of the following sections:

a) Written test: 50%.

b) Laboratory practice test: 40%.

c) Classroom practice test: 30%.

Attendance to laboratory session is mandatory.

Waiving: Failing to take the final exam is sufficient to waive the final grade.

Not taking the final exam is enough to receive a grade of "not presented" for the course.

The use of books, notes, phones, electronic devices, computers, or other equipment is not allowed during assessment tests (except for a calculator*). If any academic dishonesty or fraudulent practices are detected, the protocol on academic ethics and prevention of such practices at UPV/EHU will be enforced.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY ASSESSMENT SESSION: GUIDELINES AND OPTING OUT

The final grade will be calculated by adding the grades obtained in the following sections:

a) Written exam (multiple-choice test and short questions) (70%)

b) Laboratory sessions (20%)

c) Classroom practical sessions (10%)

The grades of the sections passed will be kept for the extraordinary assessment session of that school year (until July) if the subject is failed in the ordinary call. Neither the computer practices nor the seminars will be assessed in the extraordinary session; however, if these sections are passed in the ordinary session, those grades will be maintained for the extraordinary session and the corresponding percentage will be deducted from the written test.

The final grade of the course will be obtained by adding the grades of each assessed section. In order to pass the subject, and averaged with the other sections of the subject, the minimum percentage over the maximum grade must be obtained in the following sections:

a) Written test: 50%.

b) Laboratory practice test: 40%.

c) Classroom practice test: 30%.

Attendance of laboratory sessions is mandatory. Students that do not attend those laboratory sessions during the ordinary session, will not have another chance to do so during the extraordinary session.

Not taking the written test will be qualified as "not presented" in the final grade for the course.

The use of books, notes, phones, electronic devices, computers, or other equipment is not allowed during assessement tests (except for a calculator*). If any academic dishonesty or fraudulent practices are detected, the protocol on academic ethics and prevention of such practices at UPV/EHU will be enforced.

MANDATORY MATERIALS

MATERIALS REQUIRED

The eGela webpage (http://egela.ehu.eus) will be used to publish the course guide and information about the activities performed in the laboratory, computer room and classroom.

Before entering the laboratory, students must carefully read the protocol for the corresponding session. This protocol will be uploaded to eGela.

BIBLIOGRAPHY

Basic bibliography

RECOMMENDED READINGS

Basic bibliography

Lehninger Principles of Biochemistry, (2012) 6th Edition, Nelson D.L. & Cox. M. M., Freeman and Company, New York.

Bioquímica (2013) (6ª ed) Stryer L., Berg J. M. & Tymoczko J. L., Editorial Reverte, Barcelona.

Bioquímica curso básico (2014) Tymoczko J. L. , Berg J. M., Stryer L., Editorial Reverte, Barcelona

BIOQUÍMICA Las bases moleculares de la vida (2009) 4 Ed., McKee T. & McKee. J.R., McGraw Hill Interamericana Editores, México.

Detailed bibliography

In-depth bibliography

Molecular Biology of the Cell (2008) (5th ed) Alberts A., Johnson A., Lewis J., Raff M., Roberts K. & Walter P., Garland Science, New York.

Fundamentals of Biochemistry (2006) 2nd ed., Voet D., Voet J.G. & Pratt CW., John Wiley & Sons, New York.

Bioquímica (2002) 3ª edición, Mathews, C.K. & van Holde, K.E., McGraw Hill Interamericana, Madrid.

Journals

Journals

· Nature

· Science

· Investigación y Ciencia

Web sites of interest

http://www.biology.arizona.edu/default.html
http://wwwbioq.unizar.es/
http://www.zientzia.net
http://www.ehu.es/biomoleculas
http://www1.euskadi.net/euskalterm/indice

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GBIOQU30 - Bachelor`s Degree in Biochemistry and Molecular Biology	Year	Second year

COURSE

26714 - Genetics	Credits, ECTS: 6

COURSE DESCRIPTION

The subject of Genetics is the first one related to the study of the transmission of biological characteristics in the Degrees of Biology, Biochemistry and Molecular Biology, and Biotechnology. For this reason, in this subject the basic contents of genetic inheritance are presented: the types of hereditary transmission, as well as the analysis of methodologies that are applied in the different types of organisms.

The course focuses mainly on the genetic analysis of eukaryotic organisms, where the fundamentals of Mendelian inheritance and other more complex situations that alter the genotype/phenotype relationship are analyzed. The effects caused by changes in the gene sequence and in the structure and number of chromosomes, the bases of genetic improvement in animals and plants, and general aspects of Population Genetics are also considered. Less exhaustively, the mechanisms of transfer of genetic information in bacteria and viruses, and their evolutionary and health effects, are evaluated. Procedures for the resolution of practical cases are also worked on, using examples of heritable characters, real or fictitious, in different species of eukaryotes, including the human species. The subject uses various training resources worked in teams, which facilitate autonomous learning, stimulate interest in the subject, promote individual responsibility in cooperative work, develop verbal and written communication skills, and encourage critical thinking and reasoning.

Previous knowledge in Genetics is not required, but it is advisable to have studied Biology in High School and have a basic knowledge of some subjects of the 1st year of the degrees in Biosciences (subjects such as Cellular Biology and Biochemistry), and the calculation of probabilities worked in Biostatistics, as well as in High School Mathematics. Given its basic nature, the contents of this subject are essential to advance in the compulsory and/or optional subjects in the Genetics area and in subjects from other related areas that participate in the Biosciences Degrees, such as Molecular Biology, Cellular Biology, Anthropology or Microbiology.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

When students finish this subject:

1. They understand the basic principles of inheritance and apply them for the correct resolution of simple cases of transmission of characters.
2. They know the influence that the existence of physically linked genes has on heredity, the effect of multiple genes involved in the same character and the environment on phenotypic expression, and are able to recognize and reasonably interpret biological characters that show forms of complex transmission.
3. They understand the molecular mechanisms involved in genetic and epigenetic changes and recognize their effects on phenotypic expression.
4. They identify factors that influence the inheritance of quantitative traits and the evolution of populations, and are able to predict in a basic way what will happen to traits subjected to selective forces or other evolutionary factors.
5. They cooperatively solve simple cases of genetic counseling using specialized databases.
6. They plan, design, and carry out simple research projects as a team, which they later present in the form of a scientific article.
7. They develop skills for safe work in the laboratory and for the correct handling of chemical compounds and biological agents, and of the chemical and biological residues that are generated.
8. They critically develop valid conclusions (reasoned and justified) through efficient and comprehensive management of the information acquired.

Theoretical and Practical Contents

THEORIA

INTRODUCTION

1.- History of Genetics. Definition of Genetics. Parts of Genetics. Basic concepts.

CELL DIVISION, MENDELISM AND THE CHROMOSOME THEORY OF INHERITANCE

2.- Topography of chromosomes and Cell Division. Mitosis and cell cycle. Meiosis and sexual reproduction.

3.- Basic principles of the inheritance of a single gene. Mendelian inheritance. Mendel's experimental method. Monohybrid cross: principle of equivalent allelic segregation. Dominance and recessiveness. The test cross and its importance. Probability and genetic events. Pedigree analysis.

4.- Basic principles of the inheritance of several independent genes. Principle of independent segregation. Dihybrid and polyhybrid cross. The test cross with several genes. Evaluation of genetic data: Chi-square analysis. Chromosomal theory of heredity.

MODIFICATIONS TO MENDELISM: EFFECT OF THE LOCATION OF THE GENE IN THE CHROMOSOME

5.- Genes located in sexual chromosomes: Linkage to sex. Pedigree analysis. Gene determination and sexual

differentiation. Other situations: genes located in mitochondria and chloroplasts.
6.- The inheritance of linked genes. Complete or partial linkage of genes located on the same chromosome. Meiotic recombination and genetic mapping. Three point mapping. Interference and coincidence coefficient.
MODIFICATIONS TO MENDELISM: INTERACTION AND VARIATION IN PHENOTYPIC EXPRESSION 7.- Allelic and gene interaction. Allelic interaction: complete dominance, partial dominance and codominance. Multiple alleles and lethal alleles. Pleiotropy. Gene interaction: epistasis, new phenotypes, other modifications. Complementation analysis.
8.- Variation of the phenotypic expression. Penetrance and expressiveness. Influence of the genetic background and influence of the environment. Epigenetics: Imprinting, X chromosome inactivation. Influenced and sex-limited inheritance.
9.- Quantitative Genetics. Polygenic inheritance. Statistical methods for the analysis of quantitative characteristics. Heritability and estimation methods.
CHROMOSOMAL ALTERATIONS IN EUKARYOTES
10.- Changes in the structure of chromosomes. Mechanisms and types. (a) Deletions (b) Duplications (c) Pericentric and paracentric inversions (d) Translocations
11.- Changes in the number of chromosomes. (a) Euploidy: monoploid, diploid, polyploid. Autopolyploidy and allopolyploidy. (b) Aneuploidy: nullisomies, monosomies and trisomies. (c) Somatic aneuploidies: mosaicism vs. chimerism.
POPULATION GENETICS
12.- Population Genetics. Allelic and genotypic frequencies. Hardy - Weinberg equilibrium. Balance test. Non-random crosses: consanguinity. Processes that change gene frequencies. Mutation. Migration. Genetic drift: founder effect and bottlenecks. Natural selection, fitness and alteration of allelic frequencies.
GENETIC ANALYSIS IN BACTERIA
13.-Recombination in Bacteria. Gene transfer mechanisms: (a) Conjugation: F+ and Hfr strains. F' factors and sexduction. (b) Transformation: phases. (c) Generalized and specialized transduction. Genetic maps in bacteria. Recombination in bacteriophages and genetic maps in viruses.
PROGRAMMING OF LABORATORY PRACTICES (P) AND SEMINARS (S)
P1- Observation and analysis of the human karyotype
S1- A practical case of genetic counseling
P2- Identification of mutants in Drosophila
S2- Experimental design in Drosophila to determine the inheritance of two phenotypic characters
P3- Directed crosses in Drosophila and phenotypic analysis of the offspring

TEACHING METHODS

The subject uses four face-to-face teaching modalities (master classes, classroom practices, laboratory practices and seminars) in which various activities are performed.
- In the master classes, fundamental theoretical concepts of Genetics are worked on and their application to the resolution of practical cases of transmission of characters with qualitative and quantitative variation, and their application to problem solving.
- In seminar classes, laboratory practices and classroom practices, the student is introduced to the bases of genetic counseling and the principles of experimentation (hypothesis development, experimental design, execution of the experiment, analysis of results, discussion and conclusions and preparation of scientific articles). These activities are carried out in groups of four people whose composition is maintained for the entire course.
The teaching team is fully coordinated in terms of the types of activities that are performed and the schedules of the different activities, both between groups of the same subject and between subjects of the same course.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	35	5	5	15					
Horas de Actividad No Presencial del Alumno/a	55	15	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 methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 20%
- Multiple choice test 20%
- Exercises, cases or problem sets 20%
- Teamwork assignments (problem solving, Project design) 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The continuous evaluation system includes the evaluation of training activities carried out in teams and a final individual test in the form of an exam.
1) The written tests worked in teams include the resolution of theoretical and practical problems and the preparation of reports related to the laboratory and seminar sessions (40% of the overall grade). The evaluation of each member of the team will be individualized based on the level of commitment and personal involvement. To pass the subject, a minimum participation in team activities of 80% and a minimum mark of 5 are required.
2) The final written test, whose evaluation constitutes 60% of the overall mark for the subject, consists of test questions, short questions and two problems. To pass the subject, a minimum of 4 (out of 10) is required in each of the sections.
Students under continuous evaluation can refuse exam call at any time until a month before the ending of the classes. However, it is recommended to declare the intention to renounce continuous evaluation before the end of the third week of teaching period.
During the development of the final test, the use of books, notes, as well as telephone, electronic, computer or other devices, by students will be prohibited. Only calculator is allowed. In case of dishonest or fraudulent practice, the protocol of UPV/EHU with regard to academic ethics and prevention of dishonest or fraudulent practices will be applied.
For all students (regardless of whether they take a continuous or final assessment), it will be enough not to attend the final test to be <<Not Presented>>.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary call, the evaluation system will be similar to that followed in the ordinary call. The positive results of the continuous assessment obtained by the students during the course are saved. In case of negative results in the continuous evaluation, the final evaluation test will constitute 100% of the mark for the subject. During the development of the final test, the use of books, notes, as well as telephone, electronic, computer or other devices by students will be prohibited. Only calculator is allowed. Only calculator is allowed. In case of dishonest or fraudulent practice, the protocol of UPV/EHU with regard to academic ethics and prevention of dishonest or fraudulent practices will be applied.
For all students (regardless of whether they take a continuous or final assessment), it will be enough not to attend the final test to be <<Not Presented>>.

MANDATORY MATERIALS

Teachers will provide students with the following material:
THEORY SCHEMES AND FIGURES COLLECTION to facilitate the monitoring of classes on theoretical content.
COLLECTION OF PROBLEMS: this collection will be the basic material for learning how to solve cases. It will be used during master classes and must be used by the student as material for personal work.
LABORATORY PRACTICE PROTOCOL: including the objectives of each activity, its technical development and some questions that each student must answer during or after completion of the corresponding practice. It is mandatory to read the protocol before carrying out the corresponding practice.
PROTOCOL FOR THE SEMINARS: the objectives of each activity and the necessary documentation are included.
All this documentation will be available to the students in the virtual classroom of the subject, sufficiently in advance.

BIBLIOGRAPHY

Basic bibliography

.- BROOKER RJ (2017) Genetics. Analysis & Principles. 6/e. McGraw Hill (978-1259921650)
.- GRIFFITHS AJF, WESSLER SR, CARROLL SB, DOEBLEY J (2015) An introduction to genetic analysis. 11/e. FREEMAN AND CO (978-1429229432)
.- HARTL DL, JONES EW (2017) Genetics. Analysis of Genes and Genomes. Jones and Bartlett Publishers 9/e. (978-1449635962)
.- HARTWELL L, GOLDBERG L, FISCHER JA, HOOD L, AQUADRO CF (2017) Genetics. From Genes to Genomes. 6nd edition. McGraw-Hill (978-0073525310)
.- KLUG WS, CUMMNINGS MR, SPENCER CA, PALLADINO MA. KILLIAN D (2019) Concepts of Genetics (978-1292265322)
.- PIERCE BA (2020) Genetics: A Conceptual Approach. Freeman & Company. 7/e
.- PIERCE BA (2021) Genetics Essentials. Concept and Connections. 5/e. MacMillan 9781319383367

Detailed bibliography

.- CONKITE, D. (2008) A problem-based guide to Basic Genetics. Ed. Thomson.

Journals

Nature Review Genetics
Nature
Science

Web sites of interest

https://ocw.ehu.eus/course/view.php?id=397
https://www.ucm.es/genetica1/apuntes-de-genetica
www.segenetica.es/docencia.php
www.ncbi.nlm.nih.gov/sites/entrez?db=omim
www.biologia.arizona.edu/mendel/mendel.html
www.genome.gov/sglossary.cfm
teknopolis.elhuyar.org/
www.zientzia.eus/

OBSERVATIONS

https://ocw.ehu.eus/course/view.php?id=397
https://www.ucm.es/genetica1/apuntes-de-genetica
www.segenetica.es/docencia.php
www.ncbi.nlm.nih.gov/sites/entrez?db=omim
www.biologia.arizona.edu/mendel/mendel.html
www.genome.gov/sglossary.cfm
teknopolis.elhuyar.org/
www.zientzia.eus/

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOQU30 - Bachelor`s Degree in Biochemistry and Molecular Biology	**Year**	First year

COURSE

26721 - Basic Biochemical Methodology	**Credits, ECTS:**	9

COURSE DESCRIPTION

The subject "Basic Biochemical Methodology" is mainly a practical subject. In Basic Biochemical Methodology, students will acquire basic knowledge about the techniques commonly used in biochemistry laboratories. The knowledge acquired in this subject is of vital importance for the subsequent academic and professional development.
The use of scientific literature, experimental design, laboratory safety, and ethics will be covered during the first semester. During the second semester, the teaching activities are focused on acquiring sufficient knowledge and skills for the proper performance of the laboratory practices that will take place throughout the degree program. The various teaching activities in this semester of "Basic Biochemical Methodology" are closely aligned with the subject "Instrumental Techniques" offered in the second year. In "Instrumental Techniques," students will delve deeper into the concepts previously learned in "Basic Biochemical Methodology," specifically regarding chromatography, electrophoresis, and protein purification.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The general objective of this subject is to provide training that will enable students to work in the future in research centres, biotechnological industries, or educational institutions. To this end, the specific (M) and transversal (G) competencies and their learning outcomes (LO) detailed below will be addressed:

Specific Competencies

M04.1 - Understand the principles, instrumentation, and applications of the main techniques of Biochemistry and Molecular Biology and their usefulness in Biotechnology.

RA1 - The student will be able to explain the knowledge related to the separation and analysis of biomolecules.
RA2 - The student will be able to design and interpret experimental protocols to solve specific biochemical problems.

M04.2 – Execute properly laboratory protocols in Biotechnology and in Biochemistry and Molecular Biology.

RA3 - The student will be able to use skillfully basic instrumentation and the most commonly used experimental methods in biochemistry.
RA4 - The student will be able to explain and implement good laboratory practices.
RA5 - The student will be able to solve theoretical-practical exercises to obtain precise quantitative data.

M04.7 – Extract and analyse information from bibliographic sources, biological databases, and other bioinformatics tools.

RA6 - The student will be able to manage the scientific-technical literature in their field and apply it to the acquired knowledge.

Transversal Competencies

G001 - Acquire adequate capacity for analysis, synthesis, and critical reasoning in the application of the scientific method.

RA7 - The student will be able to describe, quantify, analyze, and critically evaluate the experimental results obtained and draw conclusions from them.

G002 - Develop continuous autonomous learning, fostering initiative and adaptation to new situations.

RA8 - The student will be able to manage the decisions they make, the knowledge they apply, the difficulties they encounter in learning, and how to overcome them.

G003 - Acquire the ability to convey ideas and communicate them to both professional and non-professional audiences, promoting the use of foreign languages, especially English.

RA9 - The student will be able to use structures and norms in specialized written communication for the preparation of academic and/or scientific documents.

RA10 - The student will be able to communicate orally their ideas and arguments in a comprehensible manner and in accordance with established formal criteria.

Theoretical and Practical Contents

Syllabus:

BLOCK 1: Introduction to Experimentation and Information and Communication Technologies

Topic 1: Scientific Articles and Journals. Bibliographic Searches. Data Repositories for Scientific Articles. PubMed. Science Citation Index.

Topic 2: The Scientific Method in Biochemical Research and Ethical Considerations. The Scientific Method in Biochemical Research. Formulating a Hypothesis. Experimental Design. Data Treatment and Evaluation. Drawing Conclusions. Ethical Considerations.

Classroom Practices: How many types of scientific articles can we find? Reading opinion articles about the editorial system and predatory journals. Reviewing basic laboratory calculations (concentrations, dilutions, etc.). Analysing the results of a Bradford experiment (using Excel: inserting a chart, linear regression, etc.). Guidelines and recommendations on writing a scientific paper (bias in writing lab reports, etc.).

Computer Practices: Bibliographic search and bibliometrics.

BLOCK 2: Experimentation in Biochemistry. Cellular Systems and Subcellular Fragmentation

Topic 3: Good Practices in a Biochemistry Laboratory: Identification of Hazards (physical, chemical, biological, and radiological). General and Personal Safety Measures. Safety Regulations. Behaviour in Emergency Situations.

Topic 4: Levels of Experimentation in Biochemistry: Studies with Intact Animals, Isolated Organs, Tissues, or Cells. Molecular Studies (Structural or Functional). Cellular Systems. Techniques for Separating Different Cell Types. Cell Cultures. Cell Quantification and Viability. The Hemocytometer.

Topic 5: Subcellular Fractionation: Methods for Homogenization and Obtaining raw Extract. Preparative Centrifugation (Differential and Density Gradient). Marker Enzymes to Identify Various Cellular Organelles. Organelle Viability. Analytical Centrifugation.

Classroom Practices: Solving exercises and problems related to centrifugation. Designing workflows for conducting experimental sessions.

Laboratory Practices:

Cell Fragmentation and Protein Quantification.
Isolation of Chloroplasts by Sucrose Gradient Centrifugation.
Mitochondria Purification. Determination of Mitochondrial Viability.

BLOCK 3: Basic Techniques Used in the Biochemistry Laboratory

Topic 6: Preparation and Separation Techniques. Chromatography. Electrophoresis Techniques. Agarose Gels, Native Gels, SDS-PAGE. Isoelectric Focusing. Two-Dimensional Electrophoresis. Capillary Electrophoresis. Chromatography. Types of Chromatography. Electrophoretic Techniques: Electrophoresis in Agarose Gels, Gradient Gels, SDS-PAGE, Isoelectric Focusing, Two-Dimensional Electrophoresis, Capillary Electrophoresis.

Topic 7: Analytical Techniques. Spectrophotometry Techniques. Equipment: Visible and Ultraviolet Spectroscopy. Design of Enzymatic Assays. DNA Denaturation and Renaturation. Polymerase Chain Reaction (PCR). RT-PCR. DNA Chips.

Topic 8: General Techniques for Macromolecule Labelling and Their Applications. Radiochemical Techniques. Immunochemical Techniques. Immunoprecipitation. Immunoassays (ELISA, RIA). Identification Techniques. Western Blot, Dot Blot.

Classroom Practices: Simple practical problems on chromatography. Electrophoresis Experiment Simulator: SDS-PAGE. Enzyme Reaction Calculation Problems. Simple practical problems on PCR and qPCR. Simple practical problems on Immunotechniques. Radioactivity Calculation Exercises and Problems. Complex Theoretical-Practical Experimental Exercises. How to Give a Good Oral Presentation Using ICT Resources.

Laboratory Practices:

Gel Filtration Chromatography. Determination of the Molecular Mass of a Protein.
Purification of Lysozyme from Egg White by Ion Exchange Chromatography.

Protein Electrophoresis in Polyacrylamide-SDS Gel.
Nucleic Acid Electrophoresis in Agarose Gel. Characterization of Plasmid DNA.
Seminars:

Seminars. Communication (written and oral) of a Current Scientific Topic Related to the SDGs (Sustainable Development Goals)

TEACHING METHODS

The teaching methodology includes lectures, classroom practices, seminars, computer practices, and laboratory practices:

Lectures: The instructor will present the course content using a digital presentation and links to audiovisual content (available on Egela). Students will be encouraged to ask questions, and the instructor will also pose questions to prompt student reflection and communication. This approach allows for necessary feedback during each lecture.

Classroom Practices: Students will solve scheduled problems and questions. These practices are typically used as supplementary material to the theoretical lectures or laboratory practices.

Computer Practices: Students will apply their knowledge related to bibliographic searches and bibliometric analyses (quality indicators). Additionally, they will attend a seminar on databases and complete practical exercises using information from the lectures.

Laboratory Practices: This methodology is designed for students to acquire the appropriate skills for working in a laboratory. Students will develop manual skills to observe and obtain results, analyze and reflect on them, and communicate their findings through practice reports. Laboratory practices are closely related to the theoretical content of the course, allowing students to apply the knowledge gained in lectures to real experimental work situations.

Seminar Sessions: Students will develop a topic related to Biotechnology or Biochemistry and the Sustainable Development Goals (SDGs) outlined in the EHUagenda. They will communicate their findings both in writing and orally in the format of scientific dissemination.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	40	5	10	30	5				
Horas de Actividad No Presencial del Alumno/a	60	7,5	15	45	7,5				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Oral presentation of assigned tasks, Reading¿ 10%
- In this section, the sum of the percentages corresponding to theory (45%), laboratory practices (30%), computer exercises (5%), and problem-solving exercises (10%) is included. 90%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The assessment of the "Basic Biochemical Methodology" course is divided into five sections:

-Written Exam 45%: Correct answers, expression, argumentation, and use of scientific terminology will be taken into consideration. A minimum of 50% correct answers is required.
-Laboratory Practical Session 30%: Attendance, attitude, and cleanliness; accuracy and clarity of the report/exam will be taken into account, with a requirement to pass at least 50% of the questions.
-Computer Practical Session 5%: Attendance, attitude, and completion of exercises.
-Seminar 10%: Attendance, attitude, organization of information, analytical and synthesis skills, clarity of presentation, and participation in the debate.
-Problem-solving 10%: Attendance, correct resolution of problems posed during classroom exercises; exam, requiring a minimum of 50% correct answers.
In the case of taking partial exams, it will be necessary to obtain a minimum of 50% correct answers to pass the subject.
Attendance to the different teaching modalities throughout the course will be mandatory to be eligible to take the exams in

the regular session. A minimum of 50% correct answers will be required to pass the exam.
Waiving: Failing to take the final exam is sufficient to waive the final grade.
Not taking the final exam is enough to receive a grade of "not presented" for the course.
The use of books, notes, phones, electronic devices, computers, or other equipment is not allowed during assessment tests (except for a calculator*). If any academic dishonesty or fraudulent practices are detected, the protocol on academic ethics and prevention of such practices at UPV/EHU will be enforced.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The final grade will be calculated by adding the grades obtained in the following sections:
-Written Exam 45%
-Laboratory Practical Session 30%.
-Computer Practical Session 5%.
-Seminar 10%.
-Problem-solving 10%.
Participation in the different teaching modalities throughout the course will be mandatory to be eligible to take the exams in the extraordinary session. A minimum of 50% correct answers will be required to pass the exam.
The grades of the sections passed will be kept for the extraordinary assessment session of that school year if the subject is failed in the ordinary call.
Not taking the written test will be qualified as "not presented" in the final grade for the course.

MANDATORY MATERIALS

The eGela webpage (http://egela.ehu.eus) will be used to publish the course guide and information about the activities performed in the laboratory, computer room and classroom.
Before entering the laboratory, students must carefully read the protocol for the corresponding session. This protocol will be uploaded to eGela.

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Basic bibliography

- Wilson, K. and Walker, J. (eds.)(2018). Principles and Techniques of Biochemistry and Molecular Biology. 8th edn. Cambridge University Press.
- Lesk, A."Introduction to Protein Science: Architecture, Function, and Genomics". Oxford University Press, 2017.
- Roca, P. y cols. (2003). Bioquímica. Técnicas y Métodos. Editorial Hélice
- Freifelder, D. (2003). Técnicas de Bioquímica y Biología Molecular. Editorial Reverté.
- García-Segura, J.M. y cols. (2002). Técnicas instrumentales de análisis en Bioquímica. Editorial Síntesis

Detailed bibliography

- Boyer, R. F. (2009). Biochemistry laboratory: modern theories and techniques. Pearson Education.
- Serdyuk, I.N., Zaccai, N. Zaccai, J. Methods in molecular biophysics Ed. Cambridge University Press, 2007.

Journals

The journal of biological chemistry, Crc critical reviews in biochemistry, European journal of biochemistry/febs, Journal of biochemical and biophysical methods, Bioscience, biotechnology, and biochemistry, Progress in biochemical pharmacology, Archives of biochemistry and biophysics, European journal of medicinal chemistry, Clinical physiology and biochemistry, J capillary electrophor, , Appl theor electrophor, J. of chromatography, Analytica chimica acta.

Web sites of interest

http://ocw.mit.edu/OcwWeb/web/home/home/index.htm
http://www.sciencedirect.com/science/journal/00219673
http://workbench.concord.org/database/
http://www.springerprotocols.com/Abstract/doi/10.1007/978-1-59745-376-9_6
http://www.ncbi.nlm.nih.gov/pubmed
https://apps.webofknowledge.com/

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOQU30 - Bachelor`s Degree in Biochemistry and Molecular Biology	**Year**	Third year

COURSE

26724 - Bio-IT	**Credits, ECTS:** 6

COURSE DESCRIPTION

Bioinformatics is the only subject on the Biochemistry and Molecular Biology degree in which the general principles of Bioinformatics are specifically studied; however, this is a rapidly growing area and bioinformatics is widely used as a tool in other areas.

The great technological advances in the field of Molecular Biology have generated a huge amount of experimental data, and have led to the birth of new areas of knowledge, such as genomics, proteomics, transcriptomics, lipidomics, glycomics, metabolomics, and interactomics. Therefore, computers, software and algorithms need to be used to store, manage, and analyze all this information. Bioinformatics can be defined as the scientific field that uses computational methods to answer biological questions.

Basically, Bioinformatics covers three types of activities:
1.- The creation of databases capable of storing and managing large amounts of biological data. Preferably, the databases should be accessible through the Internet and have an intuitive design that facilitates their use.

2.- The development of algorithms that allow to model, visualize, extract and establish relationships between biological data (for example: methods to compare sequences or patterns of gene expression).

3.- The development and implementation of intuitive and easy-to-use computer tools that allow the selection, organization and analysis of biological data and facilitate the interpretation of the information.

The main objectives of the course are:
1.- Familiarize students with the resources available in the main bioinformatics portals available online (NCBI, SIB, EBI) so that they are able to extract all the information they may need quickly and efficiently.
2.- Provide students with solid knowledge related to the most widely used databases and tools in Bioinformatics.
3.- Train students capable of interpreting the information obtained with criteria to determine its relevance and biological meaning.

The subject uses various training resources that are carried out in teams, which facilitate autonomous learning, stimulate interest in the subject, and encourage critical thinking and reasoning.

In-depth knowledge of computer science is not required to take this subject. However, it is recommended that students have taken the compulsory subjects of Genetics and Proteomics, Protein Structure and Engineering (the 2nd year), and Methods in Molecular Biology (first semester of the third year), to understand the type of biological data with which they are going to work, as well as the methods by which they are obtained. The contents of this subject are of interest to advance in different optional subjects taught in the last year, such as Extension of Molecular Biology, Systems Biology, Genomics, or Molecular Evolution.

The subject is very useful for the professional career of any Biosciences graduate. The bioinformatician profile is now in high demand, both in public research centers and in private companies because – in addition to being essential for managing the large amounts of data now common in research projects –in silico experiments (requiring the use of computers) are possible and allow progress in research with considerable savings in time and money.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The skills acquired from the course are:
General competences:
T5 - Strengthen the skills to apply the knowledge acquired to the professional world
T17. Develop the ability to quantitatively analyze biological processes.
T20. Analyze and properly interpret data and experimental results of the area

Specific competences:
MO4.6 - Extract information from bibliographic sources and biological databases, and analyze it with bioinformatics tools

Cross-cutting skills:
T1 - Develop the capacity for analysis, synthesis and critical reasoning in the application of the scientific method
T2 - Develop autonomous learning and adaptation to new situations
T3 - Transmit ideas and communicate them to a professional and non-professional audience, encouraging the use of foreign languages, especially English

T4 - Collaborate and work in multidisciplinary and multicultural teams respecting gender equality

At the end of the subject, the specific and measurable learning outcomes that will be assessed are:
1.- Students manage the various molecular databases both to enter data and to extract information quickly and efficiently.
2.- Students analyze protein or nucleic acid sequences to extract the maximum amount of information possible.
3.- Students understand how sequences are compared to establish homology relationships and to identify patterns, motifs, and conserved domains.
4.- Students use prediction tools (structural or functional) and critically evaluate the results obtained.
6. Students know the bases of the analysis of data obtained from Next Generation Sequencing projects and other omics.
7. Students plan and carry out simple in silico research projects as a team and critically interpret and evaluate the results obtained from a biological point of view.
8.- Students communicate fundamental aspects of their professional activity to other professionals in their area, or similar areas, and to a non-specialized public.

Theoretical and Practical Contents

1.- THEORETICAL CONTENT
Thirty sessions (50 minutes each) will be devoted to explaining the following topics:

PART I - INTRODUCTION
Topic 1.- Introduction. Definition and applications of Bioinformatics.
Topic 2.- Biological sequences. Information in nucleic acids and proteins. Mathematical models of biological sequences. Statistical analysis of sequences.

PART II - DATABASES AND SEQUENCE ANNOTATION
Topic 3.- Introduction to databases. Sequence annotation. Sequence formats.
Topic 4.- Annotation of nucleotide sequences. Location of coding sequences. Location of regulatory elements.
Topic 5.- Primary databases of nucleic acids: GenBank-ENA-DDBJ. Record structure. Features table. Search strategies.
Topic 6.- Annotation of protein sequences. Determination of its physical-chemical parameters. Protease breakpoints. Sites of post-translational modification. Signal sequences. Domains.
Topic 7.- Primary protein databases: UNIPROT-KB. Record structure. Features table. Search strategies.

PART III - SEQUENCE ANALYSIS
Topic 8.- Comparison of sequences. Homologous sequences (orthologous, paralogous, xenologous). Alignment types. Scoring systems. Substitution matrices (PAM, BLOSUM). Penalties.
Topic 9.- Alignment of two sequences. The Brute Force algorithm. Point matrices (dot plots). Dynamic programming algorithms. Heuristic algorithms.
Topic 10.- The NCBI BLAST tool. Program variants. Analysis of the results.
Unit 11.- Multiple sequence alignment (MSA). Dynamic programming algorithms. Heuristic algorithms. Alignment editing.
Topic 12.- Analysis of conserved motifs: motifs, patterns, rules, fingerprints, blocks, profiles, hidden Markov models. Secondary databases.
Topic 13.- Phylogenetic analysis.

PART IV - ANALYSIS OF NGS DATA AND OMIC APPROXIMATIONS
Topic 14.- Analysis of DNA sequences. Genomics.
Topic 15.- Analysis of gene expression. Transcriptomics.
Topic 16.- Proteomics.
Topic 17.- Introduction to bioinformatic analysis at the level of families and routes.

2.- COMPUTER PRACTICAL CLASSES
5 sessions (4 hours each) will be devoted to carrying out practical exercises:
1.- Primary databases of nucleotide sequences (GenBank)
2.- Primary databases of protein sequences (Uniprot-KB)
3.- Alignment of two sequences
4.- Multiple alignment of sequences
5.- Omic studies

3.- CLASSROOM PRACTICAL CLASSES
Five classes (50 minutes each) will be devoted to solving various types of problems:
1.- Sequence analysis
2.- Hidden Markov Motives (HMM)
3.- Sequence alignment using dynamic programming algorithms
4.- Position-specific scoring matrices (PSSM)

4.- SEMINARS
Five classes of 50 minutes each will be dedicated to the presentation by the students of a topic related to the content of the subject that is prepared in groups. Participation and debate will be encouraged. The teacher will act as moderator.

Possible topics for seminars:
Hidden Markov Motifs
Alignment scoring matrices
Alignment Penalty Systems
Dynamic programming algorithms
Primary databases
Localization of coding sequences
Analysis of conserved motifs
NGS data analysis
Neural Networks and Artificial Intelligence

TEACHING METHODS

Theoretical classes (30 in-person hours and 45 remote hours)
They are taught in the classroom and are based on the teaching material made available to the student on the eGela platform. These are basically presentations with the most relevant subject contents.
Classroom practical classes (5 in-person hours and 7.5 remote hours)
They are taught in the classroom and consist of solving problems related to the subject syllabus.

Computer practical classes (20 in-person hours and 30 remote hours)
They are taught in the computer room and consist of using the resources offered by the Internet to work in teams to complete a series of practical exercises related to the subject's agenda. The methodology used for this section consists of project-based learning.
Seminars (5 in-person hours and 7.5 remote hours)
They are taught in the classroom. For each seminar, the students must prepare the proposed topic using the documentation. Participation and debate among students will be encouraged. The teacher will act as moderator.

Students can make use of the tutorial classes to clarify any doubts they may have.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	5	5		20				
Horas de Actividad No Presencial del Alumno/a	45	7,5	7,5		30				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 25%
- Multiple choice test 25%
- Exercises, cases or problem sets 10%
- Teamwork assignments (problem solving, Project design) 30%
- Oral presentation of assigned tasks, Reading¿ 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The assessment of the subject will be mixed: continuous assessment during the semester and a final exam. The following criteria will be adopted:

1. Final exam (50%): The exam will consist of multiple-choice questions, problems and short questions. To pass the subject it is necessary to obtain a grade equal to or greater than 5 (out of 10). Otherwise, the score obtained in the other teaching modalities will be maintained for the following assessment sessions.
2. Computer practical classes (30%): attendance (missing the class penalizes) and the presentation of the corresponding exercises.
3. Classroom practical classes (10%): attendance (missing the class penalizes) and the presentation of the solved problems.
4. Seminars (10%): attendance (missing the class penalizes), the presentation of the seminar, and the active participation in class.

These criteria may be modified depending on how the program develops throughout the course. Any change will be notified to the students prior to the exam.

In any case, students will have the right to be assessed through the final assessment system, regardless of whether or not they have participated in the continuous assessment system. To that end, students must submit the waiver of continuous assessment to the teaching staff responsible for the subject, within 9 weeks from the beginning of the semester, in accordance with the academic calendar of the center.

In the case of students on both continuous and final assessments, not taking the written test will be qualified as "not presented" in the final grade for the course.

The use of books, notes, phones, electronic devices, computers, or other equipment is not allowed during assessment tests.

If any academic dishonesty or fraudulent practices are detected, the rules of the UPV/EHU will be enforced.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The assessment criteria will be the same as in the ordinary exam. In exceptional situations, the criteria will be established with the student.
The passing grades of the continuous assessment obtained by the student during the course are kept. In case of failing grades, the final assessment test will constitute 100% of the grade. Not taking the written test will be qualified as "not presented" in the final grade for the course.

The use of books, notes, phones, electronic devices, computers, or other equipment is not allowed during assessment tests.

If any academic dishonesty or fraudulent practices are detected, the rules of the UPV/EHU will be enforced.

MANDATORY MATERIALS

Teaching content available on eGela

BIBLIOGRAPHY

Basic bibliography

1.- Understanding bioinformatics. Marketa Zvelebil & Jeremy O. Baum. Garland Science (2008)
2.- Bioinformatics and Functional Genomics (3rd edition). Jonathan Pevsner. Wiley Blackwell (2015)
3.- Bioinformatics. Sequence and genome analysis (2nd edition). David W. Mount. CSHL Press (2004)
4.- Essential bioinformatics. Jin Xiong. Cambridge University Press (2006)
5.- Bioinformatics for dummies (2nd edition). Jean-Michel Claverie & Cedric Notredame. Wiley Publishing Inc. (2007)
6.- Introduction to Bioinformatics. Anna Tramontano. Chapman & Hall-CRC (2007)
7.- Advances in Bioinformatics. Vijai ¬Singh & Ajay¬Kumar. Springer (2021)
8.- Essentials of Bioinformatics, Volume I. Understanding Bioinformatics: Genes to Proteins. Noor¬ Ahmad¬ Shaik, Khalid ¬Rehman¬ Hakeem, Babajan¬ Banaganapalli & Ramu Elango. Spinger (2019)

Detailed bibliography

1.- Biological sequence analysis. Probabilistic models of proteins and nucleic acids. R. Durbin, S. Eddy, A. Krogh y G. Nitchison. Cambridge University Press (2006)
2.- Introduction to computational genomics. Nello Cristianini y Matthew W. Hahn. Cambridge University Press (2007)
3.- Essentials of Bioinformatics, Volume II. In Silico Life Sciences: Medicine. Noor¬ Ahmad¬ Shaik, Khalid ¬Rehman¬ Hakeem, Babajan¬ Banaganapalli & Ramu Elango. Spinger (2019)

Journals

WIREs Computational Molecular Science
Bioinformatics
PLOS Computational Biology
Briefings in Bioinformatics
Database
Nucleic Acid Research (Database issue)

Web sites of interest

1.- http://www.ncbi.nlm.nih.gov/

2.- http://www.ebi.ac.uk/
3.- http://www.expasy.org/
4. https://usegalaxy.org/

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOQU30 - Bachelor`s Degree in Biochemistry and Molecular Biology	**Year**	First year

COURSE

26725 - Histological Techniques & Cell Cultures	**Credits, ECTS:**	6

COURSE DESCRIPTION

In this course, students will learn the main techniques for cell and tissue study, including preparation, staining and microscopic observation of biological samples, as well as basic culture techniques and in vitro tests with animal cells and their specific applications.
The acquired knowledge will be the basis to understand the organization and functioning of any organism. This knowledge will help the student to deal with other related subjects such as Physiology, Immunology, Human Genetics, Clinical Biochemistry, Molecular Pathology or Tissue Engineering.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

- Apply the main techniques of preparation, staining and observation of biological samples
- Understand organisms at the cellular and molecular level.
- Know the histological structure of the different organs of the animal and plant organism, and understand their participation in physiology and structure-function relationships.
- Identify and describe the different animal tissues in histological preparations using microscopic techniques, and interpret the results.
- Make cell cultures and use them for cell function studies.
- Apply their knowledge to their work or vocation in a professional manner and possess the skills that are usually demonstrated through the discussion and the resolution of problems within their area of study.
- Properly handle basic knowledge of instrumental techniques to obtain information, design experiments and interpret results.
- Develop the capacity for analysis, synthesis and critical reasoning in the application of the scientific method.
- Develop autonomous learning and adaptation to new situations.

Theoretical and Practical Contents

THEORETICAL SYLLABUS

Topic 1. PREPARATION OF BIOLOGICAL MATERIALS FOR MICROSCOPIC OBSERVATION.
Topic 2. BASES AND INSTRUMENTATION IN MICROSCOPY.
Topic 3. CONCEPT OF HISTOLOGY.
Topic 4. HISTOLOGY.
Topic 5.- EPITHELIAL TISSUE.
Topic 6. CONNECTIVE TISSUE.
Topic 7. MUSCULAR TISSUE.
Topic 8. NERVOUS TISSUE.
Topic 9. INTRODUCTION TO ANIMAL CELL CULTURES.
Topic 10. The CELL CULTURE ENVIRONMENT.
Topic 11. THE CELL CULTURE LABORATORY.
Topic 12. PRIMARY CULTURES.
Topic 13. CELL LINES.
Topic 14. BIOLOGY OF IN VITRO CELLS.
Topic 15. TYPICAL PARAMETERS IN CELL CULTURES.
Topic 16. CHARACTERIZATION AND CONSERVATION OF CELLS.
Topic 17. SPECIFIC CELL CULTURES

LABORATORY PRACTICE SYLLABUS
Practice 1. Preparation of samples for optical microscopy.
Practice 2. Histological stains
Practice 3. Observation and interpretation of histological sections
Practice 4. Study of the lining epithelial tissue
Practice 5. Study of glandular epithelial tissue
Practice 6. Study of connective tissue, I.
Practice 7. Study of connective tissue, II.
Practice 8. Study of the muscular and nervous tissue.
Practice 9 Cell cultures.
CLASSROOM PRACTICE
Practice 1. Resolution of practical cases on histological processing.

Practice 2. Tissue observation: ultrastructure vs optical microscopy.
SEMINARS
Seminar 1. Applications of histological techniques and cell cultures I.
Seminar 2. Applications of histological techniques and cell cultures II.

TEACHING METHODS

The subject is taught through lectures, laboratory practice, seminars and classroom practices.
The lectures aim to introduce the concepts and theoretical foundations necessary to carry out the rest of the activities. In these sessions, the explanation by the teaching staff also promotes the active participation of the student.
The laboratory practice consists of 9 sessions, dedicated to the 3 fundamental aspects of the subject: histological preparation, tissue biology and cell cultures. Given the eminently practical nature of the subject, a methodology that seeks involvement will be used. As support for the preparation of the practices, the groups of students will be tutored.
The practical sessions are complemented by classroom practice and seminars whose objective is to apply the knowledge acquired in the laboratory practice and relate it to the theoretical foundations.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	2	4	24					
Horas de Actividad No Presencial del Alumno/a	62	8	8	12					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 45%
- Multiple choice test 10%
- Exercises, cases or problem sets 35%
- Oral presentation of assigned tasks, Reading¿ 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

ORDINARY SITTING:
A) CONTINUOUS EVALUATION SYSTEM:
- There will be questionnaires in e-Gela for the different sections of the content of the subject.
Percentages and evaluation criteria:
- Written exam (45%): this exam will be on the subject taught in the lectures and practice (theoretical-practical program). Questionnaire activities will have a value of 10% of the final grade.
- Classroom Practice and Seminars (10%).
- Laboratory practices (35%): Includes the relevance of the work carried out in practice, presentation of reports and the achievement of objectives.
Attendance at seminars, classroom and laboratory practice will be mandatory.
A minimum of 5 points will be required in each section to obtain "pass" grade.

.- OPTING OUT OF CONTINUOUS ASSESSMENT: According to current regulations, students who wish to opt out of the continuous assessment system and want to do a final assessment must formally notify the faculty responsible for the subject within a period of 9 weeks after the beginning of the course.
B) FINAL EVALUATION SYSTEM
Students who have opted out of the continuous evaluation will have a final evaluation exam. It will consist of a theoretical-practical final exam.
- Written exam (50%): on the subject taught in the lectures (theoretical program).
- Practical exam (50%): on the subject taught in the practice (laboratory and classroom)

Opting out of the evaluation sitting: In this subject the percentage of the final test is greater than 40% of the total grade; thus, any student not present on the official test date will obtain a the final grade for the subject of "not sat".
During evaluation, the use of books, notes or electronic devices will be prohibited. The protocol on "academic ethics and prevention of dishonest or fraudulent practices in assessment tests and in academic work" of the UPV/EHU will be

activated in the event of dishonest or fraudulent practices.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY SITTING:
This will consist of a theoretical-practical exam.
- Written exam (50%): on the subject taught in the lectures (theoretical program).
- Practical exam (50%): on the subject taught in the practice (laboratory and classroom).

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

- David JM (2002) Basic Cell Culture: A Practical Approach Oxford University Press
- Fawcett DW. 1999. Compendio de Histología. Interamericana McGraw Hill. Madrid.
- Fresney, R.I. (2005) Culture of animal cells: a manual of basic technique (5ª ed). Wiley-Liss.
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- Kühnel W. 2005. Atlas Color de Citología e Histología. 11ª Edición. Ed. Médica Panamericana.
- Junqueira LC, Carneiro J. 2005. Histología Básica. 6ª Edición, Masson SA, Barcelona.
- Masters JRW (2000) Animal Cell Culture: A Practical Approach Oxford University Press
- Mather JP, Barness D (1998) Animal Cell Culture Methods. Academic Press
- Paniagua P, Nistal M. 1983. Introducción a la histología animal comparada. Labor. Barcelona.
- Paniagua R, Nistal M, Sesma P, Álvarez-Uría M, Fraile B, Anadón R, Sáez FJ. 2007. Citología e Histología Vegetal y Animal. Volumen 2. 4ª Edición. McGraw-Hill-Interamericana, Madrid.
- Ross MH, Kaye GI, Pawlina W. 2005. Histología. Texto y Atlas Color con Biología Celular y Molecular. 4ª Edición. Ed. Médica Panamericana. Buenos Aires.
- Young B, Heath JW. 2000. Wheater¿s Histología funcional. Texto y atlas en color. 4ª Edición. Harcourt, Churchill Livingstone, Madrid.

Detailed bibliography

- Butler M (2004) Animal Cell Culture & Technology. BIOS Scientific Publishers
- Catell, J.V. & Gómez-Lechón, M.J. (eds.) (1992) In vitro alternatives to animal pharmoco-toxicologyFarmaindustria, Madrid.
- Doyle A, Stacey GN, Ferro M. (2002) Cell Culture Methods for in Vitro Toxicology. Kluwer Academic Pub.
- Doyle, A. Wiley (1998) Cell and tissue culture. Laboratory procedures.
- Griffihs, B. (1997) Cell culture essential techniques. Essential Techniques series. Wiley.
- Harris, J.R, Graham, J & Rickwood, D (eds) (2006) Cell Biology protocols.. John Wiley & Sons, Ltd.
- Harrison MA, Rae IF, Harris A (1997) General Techniques of Cell Culture. Cambridge University Press.
- Helgason, C.D. & Miller, C.L. (ed.) (2005) Basic cell culture protocols (3ª ed). Methods in molecular biology. Human Press.
- Jeanne F. Loring, Robin L. Wesselschmidt and Philip H. Schwartz (eds) 2007. Human Stem Cell Manual A Laboratory Guide. Elsevier Ltd.
- Jolles, G. & Cordier, A. (eds.) (1992) In vitro methods in Toxicology. Academic Press, London.
- Lanza R, Gearhart J, Hogan B, Melton D, Pedersen R, ThomsonJ, West M. 2004. Handbook of Stem Cells. Elsevier Inc.
- Lubiniecki AS (1990) Large-scale Mammalian Cell Culture Technology Ediciones Marcel Dekker
- Mitsuhashi, J (2002) Invertebrate tissue culture methods. Springer Lab Manual.
- Mothersill, C & Austin, B. (2001) Acuatic invertebrate cell culture. Springer.

Journals

Web sites of interest

Hisyology atlas.
http://www.uni-mainz.de/FB/Medizin/Anatomie/workshop/EM/EMAtlas.html
https://campus.usal.es/~histologia/histologia.htm
https://histology.medicine.umich.edu/
https://histologyguide.com//index.html
http://wzar.unizar.es/acad/histologia/paginas/Atlas_inicio.htm
https://www.uv.es/histomed/odontologia/index.htm
https://mmegias.webs.uvigo.es/

https://www.kenhub.com/en/library/anatomy/introduction-to-histology
https://vmicro.iusm.iu.edu/

General:
http://www.ncbi.nlm.nih.gov/books/
https://archive.org/details/HistologyATextAndAtlasRoss/page/n649/mode/2up

OBSERVATIONS

Coordinator: Oihane Diaz de Cerio (oihane@diazdecerio@ehu.eus)

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOQU30 - Bachelor`s Degree in Biochemistry and Molecular Biology	**Year**	Fourth year

COURSE

26746 - Genomics	**Credits, ECTS:**	4,5

COURSE DESCRIPTION

This course brings together students from the Biotechnology and Biochemistry and Molecular Biology degrees. Genomics is aimed at those students interested in delving into the area of Genetics.
In this subject the general principles of genomics in eukaryotes, bacteria and viruses are worked on. The foundations of the study of complete genomes are established. Methods for the analysis of eukaryotic genomes and critical analysis of scientific articles are worked on.
The contents that are worked on are integrated and related to various subjects in the areas of Cellular and Molecular Biology, Microbiology, Genetics, etc. The subject is basic for the professional practice of any graduate in Biosciences.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The knowledge and skills acquired by the students after successfully completing the subject are detailed below:
1. Know the fundamentals of Genomics and master the procedure to follow for annotating a genome (T8).
2. Know the most appropriate methodological approach to each biological question and be able to apply appropriate genomic analyzes to the specific requirements of the genomic study of animals, plants, viruses, as well as the microbiome. (T2; T6).
3. Understand the complexity of the annotation process and its limitations and know different strategies to overcome them (T6).
4. Know how to use the bioinformatics tools developed for genome annotation (T2; T20).
5. Know how to read scientific articles on Genomics research. Knowing how to critically read and interpret articles on different methodologies, being able to understand the reasons for the differences in workflows in each case. Ability to perform a critical reading of articles and papers (T4; T20; T24).
6. Know different graphs to represent results and know how to make presentations through a web page (T22).
The competences/learning results are related to the following competences of the Biochemistry and Molecular Biology and Biotechnology degree:
T2. Develop the capacity for autonomous learning and adaptation to new situations.
T6. Develop the ability to create and undertake: formulate projects, design and manage, search for and integrate new knowledge and behaviors.
T8. Know the scientific foundations to understand the behavior, properties and interactions of Biological Molecules.
T20. Analyze and interpret appropriately data and experimental results specific to the area.
T22. Know the procedures commonly used by the scientific community to create, transmit and disseminate scientific information.
T24. Evaluate and interpret the scientific literature of the area.
Likewise, the competencies worked on in this subject are related to the transversal competencies of the faculty, especially "teamwork", "the capacity for creation and entrepreneurship" and "autonomy and responsibility". (https://www.ehu.eus/eu/web/ztf-fct/transversal-competences)

Theoretical and Practical Contents

GENOMES PROJECT ORGANIZATION AND OBJECTIVES
UNIT 1.-Basic objectives of genomics. Mapping genomes. Genetic maps. Physical maps
UNIT 2.-Human genome project: Objectives. History. Perspectives the human genome project. Internet resources.
UNIT 3. ENCODE project: Historical context. Objectives. Experiments. Phases. Cell lines. Conclusions. Criticisms.
UNIT 4.- Animal genome projects. Rodentia. Other vertebrates. Invertebrate genome projects
UNIT 5.- Plant genomes project: Arabidopsis thaliana. Legumes. other plants
UNIT 6.- Microbial genome projects. Sequencing microbial genomes. Yeast genomes. Parasite genome. Minimal Genome concept. Metagenomics and environmental genomics
GENOME SEQUENCING AND ANNOTATION
UNIT 7.- Automatic sequencing. Sanger's method. NGS. Masive sequencing by Next Generation Sequiencing (NGS) and Third Generation Sequencing (TGS). Sequence assembly.
UNIT 8.- Genome sequencing. Hierarchical Sequencing, Shotgun, Sequence Check
UNIT 9.- Structural annotation. Location of genes in the sequence of a genome. Gene search: extrinsic, intrinsic and integrated methods. Localization of genes in prokaryotic organisms. ORF search. Search for genes in eukaryotic organisms. Location of functional RNA genes.
UNIT 10.- Comparative genomics. Clustering of sequences by homology. Orthologous genes. phylogenies.
UNIT 11.- Determination of the function of the genes. Computerized analysis of gene function. Gene Ontology. Assignment of functions by experimental analysis. Annotation. Genome comparison

UNIT 12.-Functional annotation. Identification of regulatory sequences, other non-protein-coding genes.
ANALYSIS OF GENOMIC VARIATION
UNIT 13.- Genetic variation. Types of markers: SNPs and copy number changes (CNV). Nature of the variations. Classification and distribution. Linkage disequilibrium and haplotypic maps
UNIT 14.-Technology. Discovering new SNPs. SNP genotyping. Genome-Wide Association Studies (GWAS). SNPs and complex diseases.
UNIT 15.- Pharmacogenomics. Other SNP genotyping applications in Forensics, Nutrigenetics. Sport Genetics and Genetic Doping.
ANALYSIS OF GENOMIC EXPRESSION. TRANSCRIPTOMIC
UNIT 16.- Analysis of expression microarrays. Types and methods. Experimental design. Statistical analysis. Data mining. RNA Sequencing (RNA-Seq) and single cell RNA-Seq (scRNA-Seq). eQTL analysis.
UNIT 17.- Validation of array and RNA-Seq results. Single gene analysis (qRT-PCR, etc). Expression databases
UNIT 18.- Epigenomics. Epigenetic marks: histone modifications and DNA methylation. DNA methylation analysis: methylation arrays and Whole Genome Bisulphite Sequencing (WGBS). mQTL analysis.
PRACTICAL PROGRAM
1. Sequence alignment
2. ORF search, gene search (homology analysis), analysis of repetitive sequences
3. Transcrptomics.
4. Search and analysis of SNPs
5. Global genome analysis, bioinformatic tools.

TEACHING METHODS

The teaching methodology is based on student participation in the development of the subject. We encourage the interaction with the student by asking questions about specific aspects both addressed to the class in general and to part of the student body in particular.
In the theoretical classes, in addition to the teacher's explanations, analysis of scientific articles on various topics will be interspersed. The student must analyze a minimum of 5 articles during the course. Students must comment and discuss various readings that are proposed during the course. This analysis of scientific articles will be carried out both individually and in groups.
Genomics Project: Students will have to assemble and annotate a problem genome.
The research project will be guided, but since each group can follow different strategies in the analysis of the genome, the path and rhythms of each group will be respected. Each group has a different genome, with its own specifications, therefore, there is no single workflow, so that each group can follow its own strategy, following a methodology and using specific software, etc. There are different ways to approach the same problem.
The teacher makes a guide but does not provide protocols. For each session, a common objective is established for the groups and each one must find a way to overcome it. So it is the responsibility of each group to find the right tools and workflow, explaining the processes and software followed, as well as the reason for their strategy.
The teacher will make sure that each group manages to overcome the challenge, providing in each case the help that is necessary for it.
The way to prove that the challenge is met is to provide the teacher with a small report (200 words maximum) with the results of each session. The teacher will give them feedback so that each group knows if they have passed the challenge or not, pointing out their strengths and weaknesses.
By the tenth week of class, they will have the results of all the challenges, and from that moment until the end of the course, they will have 5 weeks to work on their presentation. In that time interval, each group will have two tutorials to explain her work in detail to the teacher.
Reading articles
The articles have to be read individually, underlining the 10 main ideas and agreeing on these ideas as a group. Subsequently, the selection of these ideas is defended against the rest of the class. So each group presents their ideas and the article is underlined among all. The reason for each idea is analyzed in class. The teacher helps to carry out a critical reading of the article, validating or rejecting the underlined ideas.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	5			10				
Horas de Actividad No Presencial del Alumno/a	45	7,5			15				

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 50%
- Teamwork assignments (problem solving, Project design) 50%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The written exam is 50% of the qualification and the other 50% is the group work "genomics project". It is necessary to obtain a grade of 4 or higher to pass the course in both sections (exam and group work).
For the students, subject to both continuous and final evaluation, it will be enough to not take the final test for the final grade of the subject to be "not presented".
During the development of the evaluation tests, the use of books, notes or notes, as well as telephone, electronic, computer or other devices or devices, by the students will be prohibited. In any case of dishonest or fraudulent practice, the provisions of the protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and academic work at the UPV/EHU will be applied.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation criteria will be the same as in the ordinary exam. In exceptional situations the criteria will be established with the student.
For the students, subject to both continuous and final evaluation, it will be enough to not take the final test for the final grade of the subject to be not presented or not presented.
During the development of the evaluation tests, the use of books, notes or notes, as well as telephone, electronic, computer or other devices or devices, by the students will be prohibited. In any case of dishonest or fraudulent practice, the provisions of the protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and academic work at the UPV/EHU will be applied.

MANDATORY MATERIALS

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BIBLIOGRAPHY

Basic bibliography

Greg Gibson, Spencer V. Muse (2004) A primer genome science 2nd edition. Editorial Sinauer

Detailed bibliography

Terry A. Brown, Ed Panamericana (2008) Genomas. 3º Edición
Malcolm Campbell, Laurie J. Heyer (2006) Discovering Genomics, Proteomics, and Bioinformatics. Editorial Cold Spring Harbor Laboratory Press, 2ª edición
Reece R.J. (2004) Analysis of Genes and Genomes Ed. Wiley

Journals

Nature
Science
Nature Review Genetics
Genomics

Web sites of interest

http://www.biomedcentral.com/bmcgenomics/
http://www.biomedcentral.com/bmcmedgenomics/
http://genomebiology.com/
http://www.ebi.ac.uk/microarray-as/ae/
http://www.hapmap.org/
http://www.ncbi.nlm.nih.gov/sites/entrez?db=pubmed
http://www.ncbi.nlm.nih.gov/sites/entrez?db=Genome&itool=toolbar
http://www.ensembl.org/index.html

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOQU30 - Bachelor`s Degree in Biochemistry and Molecular Biology	**Year**	First year

COURSE

27806 - Physics	**Credits, ECTS:**	9

COURSE DESCRIPTION

Any Science focused on the understanding and description of Nature needs a solid foundation on Physics. Physics studies Nature at its most fundamental level.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

In general:

-Explain and analyze the essential phenomena, concepts, principles and theories related to Biology, Geology and Biochemistry.
-Know, describe, analyze and evaluate the physical environment.
-Know and apply the physical and chemical principles of Biology, Geology and Biochemistry.

Transversal competences:
G001 - Ability to analyze and synthesize and reason critically in the application of the scientific method.
G002 - Ability to solve problems.
G005 - Learning and continuous autonomous work, promoting initiative and adaptation to new situations.
M01C18 - Process and interpret data from observations and measurements according to explanatory models.

Specific competences:
Degree in Biology:
M04C03 - Know and apply the physical and chemical principles of Biology.
M04C05 - Demonstrate a basic knowledge of mathematics and statistics applied to Biology.
Degree in Geology:
M01GM1.3 - Development of spatial vision and the capacity of abstraction.
Degree in Biochemistry and Molecular Biology:
MO1.1 - Understand and apply the basic knowledge of Physics, Mathematics and Chemistry to biological systems
MO1.7 - Master the basic terminology of the different physical quantities, and correctly use the systems of international units and their equivalences
Degre in Biotechnology:
M01CM1.1 - Understand and apply the basic knowledge of Physics, Mathematics and Chemistry to the biological and engineering systems.

Theoretical and Practical Contents

1. GENERAL CONCEPTS
Unit systems. Dimensional analysis. Laws of scale.

2. INTRODUCTION TO MECHANICS
Uniform movement. Movement uniformly accelerated. Linear momentum. Force. Static Biomechanics. Newton's laws. Work, Energy and Power. Elastic properties of materials.

3. FLUIDS
A) Hydrostatics. Density. Pressure. Atmospheric pressure. Floatation.
B) Hydrodynamics. Flow in ideal fluids. Bernoulli equation. Venturi effect.
C) Flow in viscous fluids. Law of Poiseuille. Reynolds number. Law
of Stokes. Blood circulation.
D) Surface tension. Law of Laplace. Capillarity.

4. THERMODYNAMICS
Temperature scales. Heat. Heat capacity. Calorimetry. First Law of thermodynamics. Entropy. Second principle of thermodynamics. Phase transitions and phase diagrams. Heat transmission: Conduction, convection, radiation.

5. DISSEMINATION PROCESSES
Collisions and average free travel. Law of Fick. Stationary diffusion. Thermal diffusion: Fourier's Law. The diffusion with drag. Diffusion in solutions. Law of Nerst. Osmosis.

6. ELECTRICITY AND MAGNETISM
Electric charge Coulomb law. Electric field and potential. Gauss's theorem. Electric capacity and capacitors. Electric dipoles. Electric current. Ohm's law. Resistance. Sources of electric power. Power in electrical circuits. Circuits Nervous driving Magnetic field. Force on a moving load.
Mass spectrometer.

7. WAVES AND OPTICS
Wave motion. Types of waves. Wave pulses and periodic waves. Interference of waves and standing waves. Doppler effect. Sound and ultrasound. Electromagnetic waves. Electromagnetic spectrum. Refractive index. Reflection and refraction of light. Diffraction. Polarization. Mirrors and lenses. The optical microscope. The human eye

8. RADIACTIVITY

The atomic nucleus Mass number and atomic number. Isotopes. Law of disintegration. Radioactive activity Radioactive dating Interaction of radiation with matter. Biological effects

TEACHING METHODS

Master lessons and practical problem-solving classes.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	54	5	31						
Horas de Actividad No Presencial del Alumno/a	81	7,5	46,5						

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Both in the partial (that will take place at the end of the first quarter) and in the final exams, there will be theoretical questions as well as problems to be solved. Students that pass the partial exam can choose not to answer the questions corresponding to the material of the first quarter in the final exam. In that case, the mark of the partial exam will count 1/3 over the final mark, whereas the other 2/3 will be taken from the mark of the final exam. Students that do not pass the partial exam will have to perform the complete final exam. The mark for the students that perform the complete final exam will be given by the mark obtained in this exam. Failing to take the final call exam (ordinary call) is equivalent to waiving the call.

During the evaluation tests it is not allowed to use books, notes or notebooks, as well as any kind of mobile phone, computer or electronic devices. Only didactic material, devices or computer authorized by the teaching team may be used. If unethical or dishonest behaviour is detected the protocol dealing with academic ethics and prevention of fraudulent and dishonest behaviour in evaluation test and academic assessments in the UPV/EHU will be applied.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

All students that take the resit exam will have to perform the complete exam, even if they had passed the partial exam. The extraordinary call exam counts 100% of the grade. Failure to take the exam (extraordinary call) is equivalent to waiving the call.

During the evaluation tests it is not allowed to use books, notes or notebooks, as well as any kind of mobile phone, computer or electronic devices. Only didactic material, devices or computer authorized by the teaching team may be used. If unethical or dishonest behaviour is detected the protocol dealing with academic ethics and prevention of fraudulent and dishonest behaviour in evaluation test and academic assessments in the UPV/EHU will be applied.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Physics for Scientists and Engineers. P. M. Fishbane, S. Gasiorowicz, and S. T. Thornton. (Prentice Hall, 1996)
Física para ciencias de la vida. Jou i Mirabent, David. McGraw-Hill (2009).
Física. W. Kane y M.M. Sternheim. Reverté (2ª edición 1996)
Física para las Ciencias de la Vida. A. Cromer. Reverté (2ª edición 1996)

Detailed bibliography

Physics. 8th Edition, Cutnell & Johnson. (John Wiley & Sons, INC, 2009)
Física para Ciencias e Ingeniería. (2 volúmenes) R. A. Serway y J. W. Jewett. Thomson-Paraninfo (2005)
Física biológica: energía, información, vida. P. Nelson. Reverté (2005).
Física. (2 volúmenes) P. A. Tipler Reverté (4ª edición 2000).
Física de los procesos biológicos. F. Cussó, C. López y R. Villar. Ariel. (1ª edición 2004).
Introducción a la Física y a la Biofísica. J. González Ibeas. Alhambra (1974).
Física. D. Tilley y W. Thumm. Fondo Educativo Interamericano (1976).

Journals

Web sites of interest

http://www.sc.ehu.es/sbweb/fisica/
http://www.colos.org/
http://webphysics.davidson.edu/Applets/TaiwanUniv/index.html

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOQU30 - Bachelor`s Degree in Biochemistry and Molecular Biology	**Year**	Second year

COURSE

26856 - Regulation of the Metabolism	**Credits, ECTS:**	6

COURSE DESCRIPTION

DESCRIPTION OF THE COURSE ON REGULATION OF METABOLISM

At the University of the Basque Country, the course on Regulation of Metabolism is focused on the study of human metabolic regulation. This course comprises 19 lessons of various hours each depending on each particular theme. The lectures will mainly address the following topics: a) The mechanisms of metabolic regulation in response to hormonal or extracellular stimuli (first messengers): activation or inhibition of cell receptors, generation of second messengers, regulation of protein and lipid phosphorylation, modulation of cell responses; b) integration and regulation of major metabolic pathways, namely metabolism of carbohydrates, lipids, aminoacids, nucleotides and proteins; c) biochemical mechanisms of metabolic adaptation to different physiologic (at times extreme) situations; d) regulation of cell proliferation, survival, cell migration and cell death; e) metabolic dysregulation leading to disease, namely cardiovascular diseases including atherosclerosis, obesity, insulin resistance and type II diabetes, or cancer.

The course on Regulation of Metabolism is fundamental for students aiming at developing their future careers in biomedicine, including both biomedical research or applied (bench to bed) biomedicine, and clinical biochemistry.

The acquired knowledge on this course will set up the basis for a better understanding of other courses namely Cell Biology, Immunology and Cell Signaling courses.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCES AND OBJECTIVE

Students will:

Have knowledge of cellular metabolism, and the regulation of central catabolic and anabolic pathways.

Understand the principals and importance of metabolic control, and be able to describe the main mechanisms through which metabolic processes are controlled.

Understand how different control mechanisms may be integrated to coordinate cell metabolism and function.

Understand how metabolism is integrated in mammals, and have knowledge of how disturbances in metabolism contribute to disease.

AIMS

To provide knowledge of the essential features of cellular metabolism, and an understanding of the mechanisms through which general metabolism is controlled. This will be achieved using specific examples and model situations to illustrate principal control mechanisms. Diseases caused by defects in metabolism will be studied to emphasize the importance of metabolic control. The course will focus on mammalian, namely human, systems.

Theoretical and Practical Contents

SYLLABUS

1.- Introducción a la regulación del metabolismo.
1.1. Catabolismo y anabolismo.
1.2. Visión de conjunto del metabolismo
1.3. Regulación y Control del metabolismo
1.4. Métodos para el estudio del metabolismo y su regulación.

2.- Aspectos generales del metabolismo humano.
2.1. Requerimientos dietéticos. Composición química de los alimentos. Vitaminas.
2.2. Digestión y absorción intestinal
2.3. Parámetros importantes en metabolismo: cociente respiratorio (CR), metabolismo basal (MB) y metabolismo total (MT).

3.- Rutas metabólicas.
3.1. Distribución subcelular de las rutas metabólicas.
3.2. Biosíntesis de ATP. Translocación del ATP. Cadena respiratoria mitocondrial.
3.3. Oxidación del NADH+H+ citosólico. Lanzaderas: malato/aspartato y glicerol-3-P
3.4. Fosforilación oxidativa.

4.- Principales vías metabólicas celulares: El ciclo de Krebs. Regulación.

5.- Principales vías metabólicas celulares: catabolismo y anabolismo de azúcares.
5.1. La glicolisis y su regulación.
5.2. Metabolismo del etanol.
5.3. Metabolismo de la fructosa.
5.4. Ciclo de Cori y ciclo de la alanina
5.5. Metabolismo del sorbitol, galactitol, glucuronato y xilitol.
5.6. Regulación de la gluconeogénesis.
5.7. Regulación de la ruta de las pentosas fosfato.
5.8. Metabolismo de la glucosa hacia la producción de grasa: Ácidos grasos y TAG.
5.9. Metabolismo de la glucosa hacia la producción de glucógeno (glicogénesis).
5.10.Regulación del metabolismo del glucógeno.

6.- Principales vías metabólicas celulares: catabolismo y anabolismo de ácidos grasos y triacilglicéridos.
6.1. Degradación y síntesis de ácidos grasos.
6.2. Cetogénesis a partir de ácidos grasos.
6.3. Elongación e insaturación de ácidos grasos.
6.4. Biosíntesis de triacilglicéridos.
6.5. Control del metabolismo de triacilglicéridos: a) cuando la acción de la insulina es alta; b)en condiciones de stress metabólico.
6.6. Formación de ácido araquidónico y síntesis de eicosanoides. Mecanismos de acción de los anti-inflamatorios no esteroideos (AINES)

7.- Principales vías metabólicas celulares: catabolismo y anabolismo de fosfolípidos.
7.1. Regulación de la síntesis de fosfatidilcolina.
7.2. Regulación de la síntesis de fosfatidiletanolamina
7.3. Regulación de la síntesis de fosfatidilserina.
7.4. Regulación del catabolismo de fosfolípidos: Fosfolipasas.
7.5. Los fosfolípidos como precursores de segundos mensajeros celulares.

8.- Principales vías metabólicas celulares: catabolismo y anabolismo de esfingolípidos.
8.1. Bases esfingoides, cerámidos y esfingomielina
8.2. Regulación del metabolismo de esfingolípidos
8.3. La esfingomielina como precursor de segundos mensajeros celulares.
8.4. Glucoesfingolípidos: síntesis y degradación

9.- Principales vías metabólicas celulares: Metabolismo del colesterol. Lipoproteínas.
9.1. Regulación metabólica del colesterol.
9.2. Estructura y función de las lipoproteínas.
9.3. Metabolismo de las lipoproteínas. Regulación.
9.4. Perturbación del metabolismo de lipoproteínas. Aterosclerosis

10.- Principales vías metabólicas celulares: catabolismo y anabolismo de aminoácidos (aa).
10.1. Integración del catabolismo y el anabolismo de aminoácidos.
10.2. Metabolismo de proteínas

11.- Principales vías metabólicas celulares: Catabolismo y anabolismo de nucleótidos.

12.- Regulación hormonal del metabolismo:
12.1. Mecanismos de acción hormonal.
12.2. Órganos y hormonas más importantes en la regulación del metabolismo: Hígado, tejido adiposo, páncreas, glándula pituitaria, tiroides, glándulas adrenales. Gónadas.
12.3. Diabetes mellitus

13.- El sistema nervioso y el metabolismo.
13.1. Fisiología básica del sistema nervioso. El cerebro. El cerebelo. El tallo cerebral.
13.2. Sistema nervioso autónomo: simpático, parasimpático, somático

13.3. Neurotransmisores y receptores: transnisión adrenérigica y colinérgica.
13.4. El sistema nervioso autónomo y la secreción hormonal.

14.- Regulación del metabolismo en situaciones extremas.
14.1. Movilización rápida de material energético
14.2. Ayuno prolongado.
14.3. El metabolismo durante el ejercicio físico (aeróbico y anaeróbico)

15.- Equilibrio energético y regulación del peso corporal.
15.1. Balance energético.
15.2. Gasto energético. Medida y components del gasto energético.
15.3. Obesidad. Definición y desarrollo de la obesidad. Implicaciones patológicas.
15.4. Alteraciones metabólicas en la obesidad.

16.- Síndrome metabólico.

17.- Principios de señalización celular.

18.- Regulación del crecimiento y muerte celular.

19.- Integración del metabolismo: carbohidratos, grasas y proteínas
19.1. Situaciones anterior y posterior a la ruptura del ayuno. El estado Post-absortivo.
19.2. Puntos de conexión entre el metabolismo de azúcares, grasas y poteínas. Interacciones metabólicas entre los ácidos grasos y la glucosa. Interacciones entre el metabolismo de carbohidratos y a minoácidos: ciclo glucosa-alanina.
19.9. Visión integrada del metabolismo

TEACHING METHODS

METHODOLOGY

The following activities will be developed during this course:

1. Lectures of all themes indicated in the syllabus

2.Laboratory practical sessions

3. Essays (two) on the regulation of metabolism (topics to be selected by the teacher)

4.Preparing, presenting and discussing a relevant topic on the regulation of metabolism, freely selected by the student.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	4	8	12					
Horas de Actividad No Presencial del Alumno/a	52	12	16	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 methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 42%
- Multiple choice test 38%
- Exercises, cases or problem sets 5%
- Individual assignments 5%
- Oral presentation of assigned tasks, Reading¿ 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

FINAL EVALUATION SYSTEM – ASSESSMENT

The written exam is worth 80% of the overall mark: short questions are worth 42% and the multiple choice component is worth 38%

Laboratory practical sessions (two 4-hour sessions) are worth 5% of the overall mark.

Two individual essays are worth 5% of the overall mark.

One power-point presentation is worth 10% of the overall mark

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The current legislation will strictly be followed.

MANDATORY MATERIALS

Teaching sources include power point presentations by the lecturer for each independent lesson. PDF files of all themes will be made accesible to all students registered in the subject. Likewise, specific tables for exercises will be provided.

BIBLIOGRAPHY

Basic bibliography

RECOMMENDED READING 1

- Biología Molecular de la Célula. Alberts, Johnson, Lewis, Raff, Roberts & Walter (2002) (4ª edición). Editorial Omega
- Bioquímica. Stryer. 6ª ed. (2008). Editorial Reverté.
- Bioquímica. Mathews & Van Holde. 3ª ed. (2002) Ed. Addison Wesley.
- Bioquímica. Libro de Texto con Aplicaciones Clinicas. Vol. 1 y 2. Devlin. 4ª ed (2004) Ed. Reverté.
- Biología Celular y Molecular. Lodish et al. (2002) Ed. Médica Panamericana.
- Bioquímica. Texto y Atlas. Koolman y Röhm 3ª ed. (2004) Ed. Médica Panamericana
- Lehninger Principles of Biochemistry, (2008) 5th Edition D.L. Nelson & M. M. Cox. Freeman and Company, New York.
- Fundamentos de Bioquímica. La vida a nivel molecular. Voet, D., Voet, J.G. y Pratt, C.W. 2ª Ed. (2007). Panamericana.
- Bioquímica. Voet, D. y Voet, J.G. 3ª Ed. (2006). Panamericana.

Detailed bibliography

RECOMMENDED READING 2

- Albi, E., Viola-Magni, M.P. (2006). Sphingolipids and cell function. Research Signpots Ed. Trivandrum. Kerala. India.
- Fell, D. (1997). Understanding the control of metabolism. (K. Snell; Frontiers in Metabolism 2; 1st ed.). Portland Press, London.
- Frayn, K. N. (1996). Metabolic regulation. A human perspective. (K. Snell; Frontiers in Metabolism 1; 1st ed.). Portland Press, London.
- Beckett, G.J., Walker, S.W., Rae P., Ashby P. (2005). Clinical Biochemistry. (An illustrated colour text). (7 th ed.). Blackwell Publishing. Willinstone, VT, USA
- Gomperts, B.D., Kramer, I.M., Tatham, P.E.R. (2003). Signal Transduction (2nd Ed). Academic Press. Elsevier Science, Orlando, FL, USA
- Liscovitch, M. (1994). Signal-activated phospholipases. (1st ed.). R.G. Landes Company. Austin, TX.
- Macarulla, J.M. (1992). Bioquímica Cuántica. Cuestiones sobre metabolismo. (Vol. II, 1st ed.). Editorial Reverté. Barcelona.
- Salway, J. G. (1994). Metabolism at a glance. (1st ed.) Blackwell Science, Oxford.
- Sperelakis, N. (2001). Cell Physiology source book. A molecular approach. Ed: Academic Press (3 rd ed). New York (USA)
- Vance, D.E. & Vance, J. (2008) Biochemistry of Lipids, Lipoproteins and Membranes (5th edition) Elsevier Science Publishers B.V.
- White, D. A., & Baxter, M. (1994). Hormones and metabolic control. (2nd ed.). Edward Arnold, London.

Journals

RECOMMENDED JOURNALS

Annual Review of Cell and developmental Biology
Annual Review of Biochemistry
Annual Review of Nutrition
Hormones and Vitamins
Journal of Molecular Biology

Metabolism-Clinical and Experimental
Molecular and Cellular Biology
Molecular Endocrinology
Endocrinology

Annual Review of Biochemistry
Annual Review of Nutrition
Hormones and Vitamins
Journal of Molecular Biology
Metabolism-Clinical and Experimental
Molecular and Cellular Biology
Molecular Endocrinology
Endocrinology

Annual Review of Cell and developmental Biology
Annual Review of Biochemistry
Annual Review of Nutrition
Hormones and Vitamins
Journal of Molecular Biology
Metabolism-Clinical and Experimental
Molecular and Cellular Biology
Molecular Endocrinology
Endocrinology

Web sites of interest

http://www.ncbi.nlm.nih.gov/sites/entrez
http://fbio.uh.cu/metabol/Conceptos_basicos.htm
http://www.biologia.arizona.edu/biochemistry/problem_sets/carbomet/carbomet.html
http://tratado.uninet.edu/c0504i.html
http://www.uv.es/jcastell/5%20Regulacion_hepatica_metabolismo.pdf
http://efdeportes.com
http://www.femede.es
http://femede.com
http://setrade.info
http://wwwbioq.unizar.es/
http://wbiomed.curtin.edu.au/teach/biochem/
http://www.nature.com/nature/index.html

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOQU30 - Bachelor`s Degree in Biochemistry and Molecular Biology	**Year**	Third year

COURSE

26857 - Clinical Biochemistry and Molecular Pathology	**Credits, ECTS:** 6

COURSE DESCRIPTION

La asignatura está enfocada al ejercicio profesional bien en un laboratorio de análisis clínico bien en una institución pública o privada que realice I+D para el desarrollo de nuevos métodos diagnósticos para la salud humana. Por tanto, la asignatura tiene un marcado enfoque hacia la salud humana y el conocimiento del medio sanitario.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Los conocimientos y competencias que el alumno debe adquirir se han organizado en tres módulos:

-El primer módulo recoge las características de los laboratorios clínicos y el trabajo en el ámbito de la salud humana. Los temas a abordar incluyen la introducción al laboratorio clínico, validación analítica y diagnóstica y la garantía de calidad en el laboratorio.

-Un segundo módulo proporciona una visión integral de cada área del laboratorio clínico, desde la anatomo-fisiología del órgano afectado, su patología general, los métodos diagnósticos, y por supuesto el papel del laboratorio en el diagnóstico, pronóstico y seguimiento de los pacientes. Los temas a desarrollar incluyen el estudio de la función hepática, renal, las alteraciones del metabolismo lipídico, el diagnóstico bioquímico del infarto de miocardio, el estudio de las enfermedades endocrinas y en particular la diabetes, las proteinas plasmáticas, el equilibrio hidroelectrolítico y ácido-base, los marcadores de inflamación y tumorales, la monitorización de fármacos y la farmacogenética.

-Un tercer módulo de seminarios prácticos abarca el estudio de casos clínicos estudiados en la asignatura, así como la visita a un laboratorio de análisis clínicos y la extracción y transporte de muestras biológicas.

Los objetivos concretos a alcanzar son por tanto:

1.Conocer las bases bioquímicas y moleculares de las enfermedades.

2.Proporcionar conocimientos sobre la fisiopatología de las enfermedades más comunes.

3.Proporcionar conocimientos para interpretar los resultados analíticos más habituales

Theoretical and Practical Contents

Generalidades del laboratorio clínico El laboratorio clínico. Obtención de muestras biológicas. Validación analítica y diagnóstica. Garantía de calidad.
Bioquímica clínica y patología molecular Proteinas plasmáticas. Enzimas séricos; infarto agudo de miocardio. Equilibrio hidroelectrolítico y ácido base; iones. Función e integridad hepática. Función renal. Función gástrica, intestinal y pancreática. Estudio de las enfermedades endocrinas. Marcadores tumorales. Bases de la patología molecular. Errores congénitos del metabolismo. Diabetes mellitus. Metabolismo lipídico. Enfermedades por depósito amiloide. Enfermedades neurológicas. Enfermedades músculo-esqueléticas. Marcadores de inflamación. Hematimetría. Monitorización de fármacos. Farmacogenética.
Seminarios y prácticas Interpretación de un análisis clínico. Casos clínicos. Visita a un laboratorio de análisis clínicos.

TEACHING METHODS

El enfoque de la asignatura reforzará el aprendizaje por el propio alumno, dotándole de las herramientas necesarias que le permitan resolver por sí mismo los casos que se le puedan presentar. Así, se combinará la metodología docente tradicional con la docencia basada en problemas. Por supuesto, no se pretenderá la memorización de los valores de referencia de las magnitudes biológicas, sino la interpretación de esa alteración, de forma individual y en conjunto con toda la visión general de los resultados.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	40	5	5						10
Horas de Actividad No Presencial del Alumno/a	60	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 methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 10%
- Multiple choice test 30%
- Individual assignments 5%
- Teamwork assignments (problem solving, Project design) 40%
- Oral presentation of assigned tasks, Reading¿ 10%
- parte hartze aktiboa foroetan eta gelan 5%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Los sistemas de evaluación incluye un examen escrito tipo test, el seguimiento de la realización de practicas (ejercicios, casos o problemas) y trabajos en grupo que serán expuestos en público.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

La no presentación a la prueba fijada en la fecha oficial de exámenes
supondrá la renuncia automática a la convocatoria correspondiente.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

BIBLIOGRAFÍA GENERAL

Libro de FISIOLOGÍA HUMANA

Libro de PATOLOGÍA GENERAL

ESPECÍFICOS DE BIOQUÍMICA CLÍNICA Y PATOLOGÍA MOLECULAR

oBaynes JW, Diminiczak MH. BIOQUIMICA MEDICA. Elsevier España SA

oFuentes Arderiu, et al. BIOQUÍMICA CLÍNICA Y PATOLOGÍA MOLECULAR. Reverté, Barcelona.

oGonzalez de Buitrago JM, et al. BIOQUÍMICA CLÍNICA. Interamericana-McGraw-Hill, Madrid.

oGonzalez de Buitrago JM, et al. PATOLOGÍA MOLECULAR. Interamericana-McGraw-Hill, Madrid.

Detailed bibliography

- Baynes JW, Diminiczak MH. BIOQUIMICA MEDICA. Elsevier España SA
- Fuentes Arderiu, et al. BIOQUÍMICA CLÍNICA Y PATOLOGÍA MOLECULAR. Reverté, Barcelona.
- Gaw A ed. BIOQUÍMICA CLÍNICA ILUSTRADA. Harcourt 2001.
- Gonzalez de Buitrago JM, et al. BIOQUÍMICA CLÍNICA. Interamericana-McGraw-Hill, Madrid.
- Gonzalez de Buitrago JM, et al. PATOLOGÍA MOLECULAR. Interamericana-McGraw-Hill, Madrid.

Journals

- Revista del Laboratorio clínico.
- Clinical Chemistry

Web sites of interest

- www.labtestonline.es: aplicación de libre acceso con información de pruebas analíticas.
- Programa EPIDAT: www.sergas.es/. Sowftware de uso libre que permite la evaluación de pruebas diagnósticas.

OBSERVATIONS

Durante el desarrollo de las pruebas de evaluación quedará prohibida la utilización de libros, notas o apuntes, así como de aparatos o dispositivos telefónicos, electrónicos, informáticos, o de otro tipo, por parte del alumnado. Ante cualquier caso de práctica deshonesta o fraudulenta se procederá aplicando lo dispuesto en el protocolo sobre ética académica y prevención de las prácticas deshonestas o fraudulentas en las pruebas de evaluación y en los trabajos académicos en la UPV/EHU.

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GBIOQU30 - Bachelor`s Degree in Biochemistry and Molecular Biology	Year	Third year

COURSE

26859 - Spectroscopy of Bio-molecules	Credits, ECTS:	6

COURSE DESCRIPTION

Spectroscopic techniques are frequently used to identify and determine the structure and function of molecules and biological systems. In this subject, you will learn the fundamentals of these techniques.
You will carry out activities intended to make you develop your critical thinking when selecting a spectroscopic technique for the structural characterization of a particular molecular system.
"Spectroscopy of Biomolecules" is connected to "Proteomics, Structure and Protein Engineering" (2nd year), as it allows to increase your knowledge of protein structure. It is also directly linked to "Structural Biology: Biomedical Applications" and "Advanced Methods in Biochemistry" (3rd year).
The deepen in this subject will train you in your future professional performance as it will give you tools in the fields of analytical biochemistry, structural biology and drug design.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

- Properly handle basic knowledge of instrumental techniques to interpret the information obtained after spectroscopic measurements on molecular or cellular systems.
- Design experiments, obtain information and interpret the results.
- Be able to analyze, synthesize and use critical thinking in the application of the scientific method.
- Develop the ability to argue and use technical terminology when transmitting ideas and own conclusions after evaluating information.

Theoretical and Practical Contents

1. Fundamentals of spectroscopy. Electromagnetic radiation. Interaction of radiation with matter. Molecular energy levels. Electromagnetic spectrum. Main spectroscopic techniques. Associated energy transitions.
2. UV-VIS Absorption Spectroscopy. Fundamentals. Chromophores in biological systems. Biological applications of UV-VIS spectroscopy.
3. Emission spectroscopy. Basic principles of Fluorescence. Extinction of the emission. Resonance energy transfer. Polarization / Anisotropy of fluorescence. Most common fluorophores used in biological systems. Lifetimes and time-resolved fluorescence. Examples of applications of fluorescence to biological systems.
4. Circular dichroism in UV-VIS. Fundamentals and applications. Secondary structure of proteins.
5. Vibrational spectroscopy. Molecular vibrations. Infrared spectroscopy. Raman spectroscopy. Biological applications: Secondary structure of proteins. FT-IR.
6. Dispersion. Fundamentals and applications.
7. Nuclear resonance techniques. Fundamentals. Parameters and structure of proteins.

Experimental work
A. Application of UV-VIS spectroscopy to determine the reduction state of cytochrome C. How to calculate the redox potential
B. Development of a protocol to measure the effect of the solvent polarity in the emission of a fluorescent probe.
C. Effect of the solvent polarity in the emission of a fluorescent probe.
D. Development of a protocol to determine the mechanism underlying the fluorescence extinction of a protein.
E. Fluorescence extinction of a protein

TEACHING METHODS

Master Classes (M): The teacher will explain the foundations of the different spectroscopic techniques.
Classroom practices (PA): Some contents of the subject will be worked in practical sessions in the classroom. There you will be asked to describe, analyze and discuss some experiments and results contained in research papers published in international journals. You will also prepare protocols used in experimental works and elaborate and defend a poster that explains a published research work.
Laboratory practices (PL): You will perform the experiments contained in the protocols, either supplied or created by the students, for which you will need to develop your decision making and team working capacities. After the practical sessions, you will have to analyze and discuss the results you previously obtained in the lab.
During the computer practices (PO) you will analyze IR spectra using the software supplied. In order to do so, you will apply spectral resolution methods: spectral subtraction, application of derivatives, deconvolution and estimation of secondary structure content in proteins. Finally, using these tools, you will identify different types of serum lipoproteins.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	35		10	10	5				
Horas de Actividad No Presencial del Alumno/a	52,5		15	15	7,5				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 55%
- Exercises, cases or problem sets 10%
- Individual assignments 10%
- Teamwork assignments (problem solving, Project design) 15%
- Oral presentation of assigned tasks, Reading¿ 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation system will be as follows:
1. Practices (compulsory) and final report of the practices carried out during the course. The presentation date will be notified on the first day of the semester. The teacher will give feed-back to the students after the correction of the first draft.
The evaluation rubric will be available for the students. It contains explanations on what the teacher evaluates in the report.
2. Presentation and defense of exercises and applied cases. Identification of lipoprotein types by spectral analysis (Compulsory). Personal work of a real case extracted from literature.
3. Final exam of the subject.

The final mark of the subject will be calculated by adding the partial marks obtained in each section. In order to be able to pass the subject, it is necessary to obtain 40% of the maximum mark in the final exam.

If a student wants to renounce the ordinary call, regardless he/she is under continuous or final evaluation system, it will be enough not to take the final exam on the official date, so that she/he will have the final mark "No Presentado" ("No show").

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

If a student wants to renounce the extraordinary call it will be enough not to take the final exam on the official date, so that she/he will have the final mark "No Presentado" ("No show").

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

- Spectroscopy for the Biological Sciences. Hammes, GG (2005) Wiley Interscience
- Biological Spectroscopy. Campbell, ID and Dwek, RA (1984), Benjamin Cummings
- Biophysical Chemistry. Part II: Techniques for the study of biological structure and function. Cantor, CR and Schimmel, PR (1980) W. H. Freeman and Company

Detailed bibliography

- Estructura de proteínas. Gómez-Moreno C, Sancho J (2003), Ariel Ciencia
- Energy levels in Atoms and Molecules. Richards WG and Scott PR (1994) Oxford University Press
- Molecular Spectroscopy. Brown JM (1998) Oxford University Press.
- Foundations of Spectroscopy. Duckett S and Gilbert B. (2000) Oxford University Press
- Spectrometry and Spectrofluorimetry. A Practical Approach. Baschford CL and Harris DA (1987) IRL Press
- Spectrophotometry and Spectrofluorimetry. Gore MG (2000) Oxford University Press
- Principles of Fluorescence Spectroscopy. Lakowicz JR (1999) Plenum Press
- Introduction to Biophysical Methods for Protein and Nucleic Acid Research. Glasel JA and Deutscher MP (eds.) (1995) Academic Press
- Protein Structure: a practical approach. Creighton TE (1990) IRL Press at Oxford University Press
- Cell and Molecular Biology: concepts and experiments. Karp G (1996) J. Wiley and Sons, Inc

- Methods in Molecular Biophysics. Structure, dynamics, function. Serdyuk IN, Zaccai NR, Zaccai J (2007) Cambridge

Journals

- Nature
- Science
- Biochemical Education

Web sites of interest

http://www.nature.com/nature/index.html
http://www.biology.arizona.edu/default.html
http://www.bioq.unizar.es/
http://www.sebbm.es
http://biomodel.uah.es/lab/dc/inicio.htm
http://www.chem.queensu.ca/FACILITIES/NMR/nmr/webcourse/index1.htm

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOQU30 - Bachelor`s Degree in Biochemistry and Molecular Biology	**Year**	Fourth year

COURSE

26860 - Advanced Methods in Biochemistry	**Credits, ECTS:**	6

COURSE DESCRIPTION

"Advanced Methods in Biochemistry" is a fundamentally practical subject designed to consolidate the theoretical foundations acquired in the previous courses of the degree. It will allow you to learn how to use spectroscopic techniques in the study of biomolecule structures and intermolecular interactions. In addition, you will deepen the knowledge of protein-cell membrane interactions, as the spectroscopic studies will be complemented with immunochemical techniques and assays in eukaryotic cells. The theoretical contents of the course focus on X-ray crystallography, and on the physical and mathematical foundations behind it. This high-resolution technique allows determining the structures of biomolecules, mainly proteins, at atomic level.

"Advanced Methods in Biochemistry" is directly linked to "Spectroscopy of Biomolecules" (3rd year), since it involves the practical development of the theoretical foundations previously learned in it. It is also connected to "Structural Biology: Biomedical applications" (4th year), as it allows to deepen the knowledge of protein structure. Finally, the practical sessions are oriented to understand the signaling processes originated after the protein-cell membrane interaction, which strongly complements "Cellular Signaling" (2nd year).

In this subject, you will study and experience the principles, instrumentation and applications of the spectroscopic techniques commonly used in research and diagnostic laboratories. This will allow you to interpret the processes that take place in biological systems and will train you for your future professional practice.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

- Know the principles, the instrumentation and the applications of the main techniques used in Biochemistry and Molecular Biology
- Gain ability to separate isolated substances from living cells, and determine their structures and chemical and functional properties
- Interpret the results obtained by spectroscopic techniques in terms of dynamic conformation of biomolecules

Theoretical and Practical Contents

- Protein conformational stability: Denaturation of a protein with different agents. Variation of Gibbs free energy of the process. Cm comparison
- FT-IR spectrum analysis: Secondary structure of proteins
- Analysis of circular dichroism spectra of macromolecules: secondary structure of proteins and nucleic acids
- Effect of the environmental polarity on the fluorescence spectrum: Emission properties of free probes and probes localized/bound to biomolecules
- Protein-ligand interaction: Kd of the binding by fluorescent parameters. Anisotropy, extinction, life times. Characterization of hormonal receptors
- Detection of Ca^{2+} by fluorescence: Kd and kinetics
- FRET: Calculation of intermolecular distances
- Protein detection by immunofluorescence.
- Cell viability analysis.
- Applications of fluorescence polarization: experiments related to the technique
- Analysis of Nuclear Magnetic Resonance Spectra: 3D resolution of protein structure
-Introduction to X-ray diffraction 3D resolution of protein structure

TEACHING METHODS

The master classes (M) we will be used to explain the information that was not included in the course "Spectroscopy of Biomolecules" as well as to explain the practice protocols.

The contents of the subject are also worked throughout laboratory practices (PL) and computer practices (PO), where you will process your own data obtained in the laboratory or real experimental data we will provide you. In another set of PO you will perform in silico practices in order to become familiar with instrumentation not accessible to the laboratory.

Finally, you will be asked to prepare and present seminars where you will explain more complex or recent techniques of your choice to other students in the class.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	10	5		35	10				
Horas de Actividad No Presencial del Alumno/a	15	7,5		52,5	15				

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Teamwork assignments (problem solving, Project design) 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

According to current regulations, students have the right to renounce the continuous evaluation system and to be assessed by a final exam. To do so, they should communicate it in writing to the faculty responsible for the subject, in a period of time that will never be longer than 9 weeks from the beginning of the semester.

If a student wants to renounce the ordinary call it will be enough not to take the final exam on the official date, so that she/he will have the final mark "No Presentado" ("No show").

The evaluation system will be as follows:
- Practical work (PL + PO) and final report of the laboratory and computer practices: 75%
- Individual work and seminars on a current topic related to the contents of the subject: 10%
- Crystallography (theoretical exam + computer practices): 15%

These sections will be evaluated according to the following criteria:
- Adequate implementation of the practice protocol; correct analysis, interpretation and presentation of the results obtained
- Correct approach and development of the exercises; elaboration and presentation of the entrusted tasks
- Attendance to laboratory and computer practices is mandatory and will be subject to control

The final mark will be obtained by adding the partial marks obtained in each section. In order to be able to pass the subject, it is necessary to obtain 40% of the maximum mark in each of the aforementioned sections. The subject will be considered as passed when the sum of all the partial marks reaches a final mark of 5 out of 10.

If the student doesn´t pass the subject in the ordinary call, she/he will NOT have to repeat those sections with marks above the threshold of 40% in the extraordinary call of the current year (July).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Students will have the right to be evaluated through the final evaluation system, regardless of whether or not they have participated in the continuous evaluation system. To do this, students must submit in writing to the teaching staff responsible for the subject the waiver of continuous assessment, for which they will have a period of 9 weeks from the beginning of the semester

If a student wants to renounce the extraordinary call it will be enough not to take the final exam on the official date, so that she/he will have the final mark "No Presentado" ("No show").

MANDATORY MATERIALS

Moodle page of the course: http://moodle3.ehu.es/course/view.php?id=2652
In that link, you will find the practice protocols posted. You must carefully read these protocols before you go to the practical session, and bring them with you to the lab.
The moodle plataform will also be used for the delivery, correction and evaluation of the reports and work that you will be asked to present during the course.

BIBLIOGRAPHY

Basic bibliography

- Estructura de proteínas. Gómez-Moreno C, Sancho J (2003) Ed. Ariel Ciencia
- Biological Spectroscopy. Campbell ID, Dwek RA (1984) Benjamin Cummings
- Methods in Molecular Biophysics. Structure, dynamics, function. Serdyuk IN, Zaccai NR, Zaccai J (2007) Cambridge

Detailed bibliography

- Principles of Physical Biochemistry. van Holde KE, Johson WC, Shing PH (2006) 2nd ed. Prentice Hall
- Physical Chemistry. Principles and Applications in Biological Sciences. Tinoco I, Sauer K, Wang JC (2001) 4th ed. Prentice Hall
- Biomolecular Crystallography: Principles, Practice, and Application to Structural Biology. Rupp B (2010) Garland Sciences
- Spectroscopy for the Biological Sciences. Hammes GG (2005) Wiley Interscience
- Principles of Fluorescence Spectroscopy. Lakowicz JR (2006) 3rd ed. Springer
- Molecular Spectroscopy. Brown JM (1998) Oxford University Press
- Introduction to Biophysical Methods for Protein and Nucleic Acid Research. Glasel JA, Deutscher MP (1995) Academic Press
- Biophysical Chemistry. Part II: Techniques for the study of biological structure and function. Cantor CR, Schimmel PR (1980) W. H. Freeman and Company.

Journals

- Nature
- Nature Methods
- Annual Review o0f Biophysics
- Biophysical Journal
- Biochemistry

Web sites of interest

X-ray crystallography
http://www.ruppweb.org/Xray/101index.html
http://www.mpibpc.mpg.de/groups/de_groot/compbio/p3/index.html#x-ray
http://www.biop.ox.ac.uk/coot/
http://www.ysbl.york.ac.uk/%7Ecowtan/sfapplet/sfintro.html

NMR:
http://nmrwiki.org/wiki/index.php?title=Materials_for_teaching_NMR

Circular dichroism:
http://pcddb.cryst.bbk.ac.uk/home.php
http://biomodel.uah.es/lab/dc/inicio.htm

OBSERVATIONS

If any students cannot carry out the assessment in the terms described above due to sanitary conditions, they will have to follow the assessment guidelines issued by the Rectorate at the time of sitting the exam.

In order to achieve the best results possible, it is recommended to have passed 3rd year’s subject "Spectroscopy of Biomolecules"

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25

Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOQU30 - Bachelor`s Degree in Biochemistry and Molecular Biology	**Year**	Fourth year

COURSE

26865 - Molecular Pharmacology	**Credits, ECTS:**	4,5

COURSE DESCRIPTION

MOLECULAR PHARMACOLOGY

Faculty of Science and Technology / Degree in Biochemistry and Molecular Biology

Academic year: 2020/21 Year: 4 ECTS Credits: 4.5

Module lecturers: Rebeca Diez-Alarcia, PhD (Coordinator for 2023/24 course), Rafael Rodríguez-Puertas, PhD, and Leyre Urigüen, PhD. All of them are Staff Scientist at the Department of Pharmacology of the School of Medicine and Nursing of the University of the Basque Country (UPV / EHU).

Context: The Degree in Biochemistry and Molecular Biology, aims to train professionals who have the theoretical and practical training necessary to:
- Understand, generate and communicate knowledge related to biological processes at the molecular level.
- Apply this knowledge to the experimental work carried out in research laboratories.

The fourth and last course of the degree, where Molecular Pharmacology is included as an optional module, allows the student to deepen their knowledge of advanced aspects of Biochemistry and Molecular Biology and their professionalization, especially through the end-of-degree work and the optional modules.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Molecular Pharmacology seeks to understand the cellular and molecular mechanisms of basic biological processes, as well as their dysfunction under pathophysiological conditions, and their relation with the action of drugs. For developing these aims, a multidisciplinary approach is applied, exploring these biological processes both in vitro and in vivo.
The syllabus of the Molecular Pharmacology course covers the general common processes of drugs, referring to Pharmacodynamics (action and mechanism of action) and Pharmacokinetics (processes of absorption, distribution, metabolism and excretion of drugs), as well as the molecular aspects of the interaction of drugs with their biological targets. These concepts are structured in several introductory lectures (ADME), to then go on to more specific lectures focused on the: Introduction to the pharmacology of the vegetative and peripheral nervous system, Pharmacology of the central nervous system, analgesic, anti-inflammatory and immunomodulatory drugs, Pharmacology of the digestive, respiratory and cardiovascular systems, Pharmacology of antimicrobials and anticancer drugs, Pharmacogenomics, and Development of new drugs.

Theoretical and Practical Contents

LECTURES
- INTRODUCTION to PHARMACOLOGY
LECTURE 1. Introduction to Pharmacology. General concepts. General cycle of drugs in the body.

- BASIC PRINCIPLES OF BIOAVAILABILITY AND PHARMACOKINETICS (ADME)
LECTURE 2. Absorption and distribution of drugs. Passage of drugs through biological barriers (Blood-brain barrier. Placental barrier). Diffusion through lipids. Transport mediated by transporters. Administration routes. Absorption kinetics. Bioavailability. Distribution of drugs into the body. Volume of distribution.
LECTURE 3. Metabolism and excretion of drugs. Pharmacological metabolism. Biotransformation sites and pathways. Factors that modify the metabolism of drugs. Renal excretion and excretion by other routes. Elimination kinetics.

- MOLECULAR ASPECTS OF THE INTERACTION OF DRUGS and THEIR BIOLOGICAL TARGETS.
LECTURE 4. Mechanisms of action of drugs. Fundamentals of drug-receptor interaction. Nomenclature and classification of receptors. Concept of agonism and antagonism in relation to the pharmacodynamic effect. Quantification of the response: dose-effect curve. Radioligand binding studies.
LECTURE 5. Molecular aspects of the interaction of drugs with their pharmacological targets. Places of action of drugs. Ion channels. Enzymes. Transporter families. Receptors. Other targets of drug action.

- DRUGS THAT ACT ON RECEPTORS, CHANNELS AND TRANSPORTERS:
LECTURE 6. Introduction to the pharmacology of the autonomic nervous system. Organization of the autonomic nervous system. Neurotransmission. Concept and characteristics of neurotransmitters.
LECTURE 7. Cholinergic and muscarinic receptors. Pharmacology of the parasympathetic nervous system. Direct and

indirect action of parasympathomimetic drugs. Cholinomimetic and muscarinic drugs.
LECTURE 8. Alpha and beta adrenergic receptors. Pharmacology of the sympathetic nervous system. Sympathomimetic amines with indirect action. Sympatholytic drugs. Alpha-1 and 2-receptor antagonists. Beta-1 and 2-receptor antagonists. Drugs that modulate noradrenergic transmission.
LECTURE 9. Introduction to the pharmacology of the central nervous system. Mechanism of action of synapses and neurotransmitters.
LECTURE 10. Opioid receptors as a molecular target. Opioid drugs. Classification of opioid analgesics: mu opioid receptor agonists (morphine and others). Opioid antagonists.
LECTURE 11. The GABAA receptor as a molecular target. Anxiolytic and hypnotic drugs. Anxiolytic drugs: benzodiazepines. Sedative-hypnotic drugs.
LECTURE 12. Enzymes, receptors and transporters of biogenic amines as molecular targets. Antidepressant, antimanic and antipsychotic drugs.
LECTURE 13. Pharmacology of neurological disorders. Antiepileptic drugs. Drugs used in Parkinson's disease. Drugs used in Alzheimer's disease. Antioxidant drugs used in neurodegenerative processes.
LECTURE 14. Voltage-dependent sodium channel. Local and general anaesthetics.
LECTURE 15. Intracellular receptors as pharmacological targets. Steroidal anti-inflammatory drugs. Mineralocorticoids and glucocorticoids.
LECTURE 16. The proton pump and other useful targets in the pharmacology of the digestive and respiratory system.

- ENZYMES AS TARGETS OF DRUG ACTION.
LECTURE 17. Cyclooxygenase. Non-steroidal anti-inflammatory drugs (NSAIDs).
LECTURE 18. The Renin-Angiotensin System, guanylate cyclase and other useful targets in the pharmacology of Cardiovascular System.

- OTHER PHARMACOLOGICAL TARGETS / ANTI-INFECTIOUS AND ANTI-TUMOR CHEMOTHERAPY.
LECTURE 19. Pharmacological targets for anti-infective chemotherapy. Beta lactam antibiotics. Aminoglycosides. Tetracyclines. Chloramphenicol. Macrolide antibiotics and other antibiotics.
LECTURE 20. Pharmacological targets for antiviral treatment. Antiviral drugs for HIV (antiretrovirals). Other antiviral drugs.
LECTURE 21. Pharmacological targets for antineoplastic treatment. Cytostatics. Hormones. New drugs in oncology.

- BIODRUGS / PHARMACOGENETICs.
LECTURE 22. Pharmacogenetics and pharmacogenomics. Principles of gene therapy. Pharmacogenetics. Genetics factors influencing response to drugs. Genetic polymorphisms in pharmacokinetics and pharmacodynamics.

- DEVELOPMENT OF NEW DRUGS.
*LECTURE 23. Development of new drugs. Identification and validation of pharmacological targets. Preclinical research and clinical research.
*This subject has been replaced by a visit to the laboratories of the pharma company FAES FARMA S.A. which would take place at the end of the lecture sessions.

TEACHING METHODS

DELIVERY: Lectures and student-driven presentations.

LECTURES
_ 23 lectures
_ 3 research talks (seminars, S). Each lecturer gives a talk focused on areas of active research within the field of MOLECULAR PHARMACOLOGY, which seek to delve into the most practical and translational aspects of the theoretical concepts.
S1. Pharmacology of neurological disorders. R&D in Alzheimer's disease. R. Rodríguez
S2. Functional selectivity. R. Diez-Alarcia
S3. Cannabis and psychosis. L. Urigüen
_ VISITS to LABORATORIES*
Two VISITS to the RESEARCH LABORATORIES (2.5 hours each) of the Pharmacology Department of the Faculty of Medicine are established:
1- Simulation of three types of radioligand binding experiments for drug screening.
2- Visits to the research facilities of the Neuropsychopharmacology, and Neurochemistry and Neurodegeneration groups at the Medical School, describing the different experimental techniques and methodologies that are routinely used and their relevance within research in molecular pharmacology.

_ COMPUTER SESSIONS (2 sessions, 2.5 hours each):
1- Data analysis of the radioligand binding experiments seen in Visit 1.
2- Use of search engines and specialized databases for the resolution of cases and problems based on the knowledge acquired in lectures.

Notes:
- Attendance at lectures and participation in class are not compulsory but considered for the evaluation.
- Both laboratory visits and computer sessions are mandatory.
- Both for visits to the laboratories and computer sessions, students will be divided into two groups.

STUDENT-DRIVEN PRESENTATIONs
Each student should present in class a critical review of an up to date and relevant scientific article related to Molecular Pharmacology. The presentation will last approximately 10 minutes and should include not only the description of the article, but also its benefits and shortcomings of its approach and development, and its bench to bedside relevance.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30		5	5	5				
Horas de Actividad No Presencial del Alumno/a	45		10	5	7,5				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Individual assignments 30%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONSTINUOUS ASSESSMENT

OFFICIAL EXAMINATION PERIOD // ASSESSMENT METHOD: Coursework 1, Examination 1
_ Examination will consist of a written exam (10 short questions) weighting 70% of the final mark. Failure to attend to the official exam will be considered as a resignation (for both, the mixed and the final assessment method). In this case, the mark will be "not taken".
_ Coursework will consist of an oral presentation weighting 30% of the final mark. Student-driven presentation of a critical review of an up to date and relevant scientific article related to Molecular Pharmacology.

Students will have the right to be evaluated through the final evaluation system, regardless of whether they have participated or not in the continuous evaluation system. Students must submit a signed document to the coordinator lecturer during the first 9 weeks of the semester asking for a Final Assessment Method.

Attendance and class participation will be taken into account without a certain proportion for slight variations during the evaluation process.

COVID-19: In the event that sanitary conditions prevent the face-to-face evaluation, a non-face-to-face evaluation will be activated. Students will be informed promptly.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY CALL

_ Examination will consist of a written exam (10 short questions) weighting 100% of the final mark.

MANDATORY MATERIALS

Laboratory coat is required for laboratory visit 1.

BIBLIOGRAPHY

Basic bibliography

1. Pharmacology. 8th Ed. Rang & Dale. Ed. Elsevier. ISBN-10: 0702053627; ISBN-13: 978-0702053627
4. Principles of Pharmacology. The phathophysiologic basis of drug therapy. Third Edition. David E. Golan, Armen H. Tashjian, Ehrin J. Armstrong, and April W. Armstrong. 2012. ISBN 978-1-60831-270-2.
5. General and Molecular Pharmacology: Principles of Drug Action. Ed. Francesco Clementi and Ed. Guido Fumagalli. Wiley, 2015. ISBN: 978-1-118-76857-0.

Detailed bibliography

1. Goodman & Gilman’s The Pharmacological Basis of Therapeutics. Ed. L Brunton, B Chabner, B KnollmanEd. Mac Graw Hill (2011). ISBN 9780071624428.
2. The Biochemical Basis of Neuropharmacology. JR Cooper, FE Bloom, RH Roth. Oxford University Press (2003). ISBN: 9788415419501.
3. From molecules to networks. An introduction to cellular and molecular neurosciencie. JH Byrne, R Heidelberger, MN Waxham (2014). Academic Press. ISBN: 9780123741325.
4. Neurobiology of Brain Disorders. Biological Basis of Neurological and Psychiatric Disorders. M Zigmond, J Coyle, L Rowland (2014). Academic Press. ISBN: 9780123982704.

Journals

Reviews:
- Nature Reviews Drug discovery
- Trends in Pharmacological Sciences
- Current Opinion on Pharmacology
- Pharmacogenetics

Web sites of interest

http://www.pharmgkb.org/index.jsp
http://www.iuphar.org/

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GBIOLO30 - Bachelor`s Degree in Biology	Year	First year

COURSE

26710 - Biochemistry I	Credits, ECTS:	6

COURSE DESCRIPTION

In Biochemistry I, students will acquire basic knowledge of the molecular structures and functions making up living organisms. They will also develop essential laboratory skills to conduct simple biochemical experiments, and learn how to accurately describe, analyze, and critically interpret their findings.

Biochemistry I is a critical subject that, along with Biochemistry II, lays the groundwork for many of the subsequent courses in this field. It provides students with a strong foundation in the basic principles of biochemistry, which are essential to understand complex topics in the future.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIES / LEARNING OUTCOMES

Cross-cutting skills:

· Develop the ability for analysis, synthesis and critical reasoning in the application of the scientific method.

· Develop autonomous learning and adaptation to new situations.

· Develop ethical commitment and the ability to participate in social debate.

Specific skills:

· Acquire structural and functional knowledge of the molecules making up living beings, including their basic components and polymeric structures.

· Recognize the structures of different types of biomolecules.

· Understand the fundamentals of enzymatic reactions, including the concepts of catalysis, kinetics, and enzymatic inhibition.

· Apply acquired knowledge to solve qualitative and quantitative problems.

· Develop basic laboratory skills required to conduct simple biochemical experiments.

Theoretical and Practical Contents

Theoretical and practical contents

Syllabus:

Topic 1. Concept of biochemistry. Its historical evolution. Place of Biochemistry among the experimental sciences. Objectives of Biochemistry.

Topic 2. Bioelements and biomolecules. Functional groups and bonds. Three-dimensional structure of biomolecules: isomerism and stereospecificity. Configuration and conformation.

Topic 3. Water as a solvent. Colligative properties. pH and buffers. Buffers of biological interest.

Topic 4. Proteins. Amino acids. The peptide bond. Peptides: structure and properties. Structural levels in proteins. Protein sequencing. Native structure and denaturation. Protein functions. Basic concepts for protein purification. Purity criteria.

Topic 5. Enzymes. Nomenclature and classification. Catalysis: thermodynamic and kinetic aspects. Enzyme kinetics. Michaelis-Menten equation. Graphical determination of Vmax and Km. Units of enzyme activity. Enzyme inhibition and regulation. Concept and types of inhibition. Covalent modifications of enzymes. Allosteric enzymes.

Topic 6. Carbohydrates. Functions and classification. Simple monosaccharides and derivatives. Oligosaccharides. Polysaccharides.

Topic 7. Nucleic acids. Concept and biological interest. Pyrimidine and pyrimidine bases. Nucleosides and nucleotides.

Polynucleotides: primary, secondary and tertiary structure. Nucleic acid sequencing. Free nucleotides with specific functions. Intermediates of cellular chemical energy, cofactors of enzymatic reactions, cellular communication.

Topic 8. RNA. Composition and structure. Types of RNA: heterogeneous nuclear, small nuclear, transfer, ribosomal, messenger, viral. Catalytic RNA.

Topic 9. DNA. Structure and properties. Levels of structuring: A, B and Z helices. DNA as genetic material. Chromatin structure. Optical properties of DNA: fusion and renaturation. DNA hybridization. DNA-RNA hybrids.

Topic 10. Lipids. Functions and classification. Saponifiable and non-saponifiable lipids.

Topic 11. Biological membranes. Lipid bilayers. Composition, structure and properties. Membrane proteins. Dynamics of components. Liposomes.

The theoretical content described above will be applied to solve exercises and problems in class, as well as in laboratory sessions. During these laboratory sessions, students will have the opportunity to apply the knowledge they have acquired and develop their practical skills in a supervised setting.

1st session. Learning the use of automatic pipettes, pH measurement and preparation of buffer solutions.

2nd session. Quantification of sugars and use of a sucrose standard curve.

3rd session. Quantification of sucrose in breakfast cereals.

4th session. Separation of macromolecules by Gel Filtration Chromatography.

TEACHING METHODS

Topics 1 to 11 outlined in the syllabus will be explained in detail during lectures (M).

In classroom practices (GA), students will solve qualitative and quantitative exercises and problems related to the concepts covered in the lectures. In seminars (S), students will work on solving a simple biochemical question using the techniques they have learned.

In the laboratory sessions, students will carry out the four practical activities described above. Attendance to the practical sessions is mandatory.

In computer practical session, students will use the Jmol program to visualize biomolecules, including their isomerism and their structural and functional variability.

The theoretical content described above will be applied to solve exercises and problems in class, as well as in laboratory sessions. During these laboratory sessions, students will have the opportunity to apply the knowledge they have acquired and develop their practical skills in a supervised setting.

1st session. Learning the use of automatic pipettes, pH measurement and preparation of buffer solutions.

2nd session. Quantification of sugars and use of a sucrose standard curve.

3rd session. Quantification of sucrose in breakfast cereals.

4th session. Separation of macromolecules by Gel Filtration Chromatography.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	37	2	6	12	3				
Horas de Actividad No Presencial del Alumno/a	55,5	3	9	18	4,5				

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Exercises, cases or problem sets 35%
- Teamwork assignments (problem solving, Project design) 5%
- praktiken azterketa (garatu beharreko galderak eta ariketak) 60%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EVALUATION SYSTEM

Final evaluation system

QUALIFICATION TOOLS AND PERCENTAGES

· Practical sessions (exercises, problems…) 35%

· Teamwork (problem solving, Project design) 5%

· Written exam (multiple choice questions + short questions) 60%

ORDINARY ASSESSMENT SESSION: GUIDELINES AND OPTING OUTANCE

The assessment of the Biochemistry I course is divided into three sections:

a) 60% Written exam (multiple-choice questions and short questions).

b) 35% Laboratory, classroom and computer practical sessions (20% GL+10% GA+5% GO).

c) 5% Teamwork (problem solving, project design, etc).

The criteria for assessing the sections are as follows:

· Appropriateness of the answers, integration of information, approach to and development of the problem exercise, correct use of units of measurement, and clarity and precision of language.

· Adequate execution of the experimental protocol, analysis and interpretation of

results, and effective presentation of findings.

· Correct approach and execution of exercises, as well as thorough completion and presentation of assigned tasks.

The final grade for the course will be calculated by adding the partial grades of each assessed section. To pass the course and to have your overall grade calculated, you must obtain a minimum percentage of the maximum grade in each of the following sections:

a) Written test: 50%.

b) Laboratory practice test: 40%.

c) Classroom practice test: 30%.

Attendance to laboratory session is mandatory.

Waiving: Failing to take the final exam is sufficient to waive the final grade.

Not taking the final exam is enough to receive a grade of "not presented" for the course.

The use of books, notes, phones, electronic devices, computers, or other equipment is not allowed during assessment tests (except for a calculator*). If any academic dishonesty or fraudulent practices are detected, the protocol on academic ethics and prevention of such practices at UPV/EHU will be enforced.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY ASSESSMENT SESSION: GUIDELINES AND OPTING OUT

The final grade will be calculated by adding the grades obtained in the following sections:

a) Written exam (multiple-choice test and short questions) (70%)

b) Laboratory sessions (20%)

c) Classroom practical sessions (10%)

The grades of the sections passed will be kept for the extraordinary assessment session of that school year (until July) if the subject is failed in the ordinary call. Neither the computer practices nor the seminars will be assessed in the extraordinary session; however, if these sections are passed in the ordinary session, those grades will be maintained for the extraordinary session and the corresponding percentage will be deducted from the written test.

The final grade of the course will be obtained by adding the grades of each assessed section. In order to pass the subject, and averaged with the other sections of the subject, the minimum percentage over the maximum grade must be obtained in the following sections:

a) Written test: 50%.

b) Laboratory practice test: 40%.

c) Classroom practice test: 30%.

Attendance of laboratory sessions is mandatory. Students that do not attend those laboratory sessions during the ordinary session, will not have another chance to do so during the extraordinary session.

Not taking the written test will be qualified as "not presented" in the final grade for the course.

The use of books, notes, phones, electronic devices, computers, or other equipment is not allowed during assessement tests (except for a calculator*). If any academic dishonesty or fraudulent practices are detected, the protocol on academic ethics and prevention of such practices at UPV/EHU will be enforced.

MANDATORY MATERIALS

MATERIALS REQUIRED

The eGela webpage (http://egela.ehu.eus) will be used to publish the course guide and information about the activities performed in the laboratory, computer room and classroom.

Before entering the laboratory, students must carefully read the protocol for the corresponding session. This protocol will be uploaded to eGela.

BIBLIOGRAPHY

Basic bibliography

RECOMMENDED READINGS

Basic bibliography

Lehninger Principles of Biochemistry, (2012) 6th Edition, Nelson D.L. & Cox. M. M., Freeman and Company, New York.

Bioquímica (2013) (6ª ed) Stryer L., Berg J. M. & Tymoczko J. L., Editorial Reverte, Barcelona.

Bioquímica curso básico (2014) Tymoczko J. L. , Berg J. M., Stryer L., Editorial Reverte, Barcelona

BIOQUÍMICA Las bases moleculares de la vida (2009) 4 Ed., McKee T. & McKee. J.R., McGraw Hill Interamericana Editores, México.

Detailed bibliography

In-depth bibliography

Molecular Biology of the Cell (2008) (5th ed) Alberts A., Johnson A., Lewis J., Raff M., Roberts K. & Walter P., Garland Science, New York.

Fundamentals of Biochemistry (2006) 2nd ed., Voet D., Voet J.G. & Pratt CW., John Wiley & Sons, New York.

Bioquímica (2002) 3ª edición, Mathews, C.K. & van Holde, K.E., McGraw Hill Interamericana, Madrid.

Journals

Journals

· Nature

· Science

· Investigación y Ciencia

Web sites of interest

http://www.biology.arizona.edu/default.html
http://wwwbioq.unizar.es/
http://www.zientzia.net
http://www.ehu.es/biomoleculas
http://www1.euskadi.net/euskalterm/indice

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOLO30 - Bachelor`s Degree in Biology	**Year**	Second year

COURSE

26714 - Genetics	**Credits, ECTS:**	6

COURSE DESCRIPTION

The subject of Genetics is the first one related to the study of the transmission of biological characteristics in the Degrees of Biology, Biochemistry and Molecular Biology, and Biotechnology. For this reason, in this subject the basic contents of genetic inheritance are presented: the types of hereditary transmission, as well as the analysis of methodologies that are applied in the different types of organisms.
The course focuses mainly on the genetic analysis of eukaryotic organisms, where the fundamentals of Mendelian inheritance and other more complex situations that alter the genotype/phenotype relationship are analyzed. The effects caused by changes in the gene sequence and in the structure and number of chromosomes, the bases of genetic improvement in animals and plants, and general aspects of Population Genetics are also considered. Less exhaustively, the mechanisms of transfer of genetic information in bacteria and viruses, and their evolutionary and health effects, are evaluated. Procedures for the resolution of practical cases are also worked on, using examples of heritable characters, real or fictitious, in different species of eukaryotes, including the human species. The subject uses various training resources worked in teams, which facilitate autonomous learning, stimulate interest in the subject, promote individual responsibility in cooperative work, develop verbal and written communication skills, and encourage critical thinking and reasoning.
Previous knowledge in Genetics is not required, but it is advisable to have studied Biology in High School and have a basic knowledge of some subjects of the 1st year of the degrees in Biosciences (subjects such as Cellular Biology and Biochemistry), and the calculation of probabilities worked in Biostatistics, as well as in High School Mathematics. Given its basic nature, the contents of this subject are essential to advance in the compulsory and/or optional subjects in the Genetics area and in subjects from other related areas that participate in the Biosciences Degrees, such as Molecular Biology, Cellular Biology, Anthropology or Microbiology.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

When students finish this subject:
1. They understand the basic principles of inheritance and apply them for the correct resolution of simple cases of transmission of characters.
2. They know the influence that the existence of physically linked genes has on heredity, the effect of multiple genes involved in the same character and the environment on phenotypic expression, and are able to recognize and reasonably interpret biological characters that show forms of complex transmission.
3. They understand the molecular mechanisms involved in genetic and epigenetic changes and recognize their effects on phenotypic expression.
4. They identify factors that influence the inheritance of quantitative traits and the evolution of populations, and are able to predict in a basic way what will happen to traits subjected to selective forces or other evolutionary factors.
5. They cooperatively solve simple cases of genetic counseling using specialized databases.
6. They plan, design, and carry out simple research projects as a team, which they later present in the form of a scientific article.
7. They develop skills for safe work in the laboratory and for the correct handling of chemical compounds and biological agents, and of the chemical and biological residues that are generated.
8. They critically develop valid conclusions (reasoned and justified) through efficient and comprehensive management of the information acquired.

Theoretical and Practical Contents

THEORIA
INTRODUCTION
1.- History of Genetics. Definition of Genetics. Parts of Genetics. Basic concepts.
CELL DIVISION, MENDELISM AND THE CHROMOSOME THEORY OF INHERITANCE
2.- Topography of chromosomes and Cell Division. Mitosis and cell cycle. Meiosis and sexual reproduction.
3.- Basic principles of the inheritance of a single gene. Mendelian inheritance. Mendel's experimental method. Monohybrid cross: principle of equivalent allelic segregation. Dominance and recessiveness. The test cross and its importance. Probability and genetic events. Pedigree analysis.
4.- Basic principles of the inheritance of several independent genes. Principle of independent segregation. Dihybrid and polyhybrid cross. The test cross with several genes. Evaluation of genetic data: Chi-square analysis. Chromosomal theory of heredity.
MODIFICATIONS TO MENDELISM: EFFECT OF THE LOCATION OF THE GENE IN THE CHROMOSOME
5.- Genes located in sexual chromosomes: Linkage to sex. Pedigree analysis. Gene determination and sexual

differentiation. Other situations: genes located in mitochondria and chloroplasts.
6.- The inheritance of linked genes. Complete or partial linkage of genes located on the same chromosome. Meiotic recombination and genetic mapping. Three point mapping. Interference and coincidence coefficient.
MODIFICATIONS TO MENDELISM: INTERACTION AND VARIATION IN PHENOTYPIC EXPRESSION 7.- Allelic and gene interaction. Allelic interaction: complete dominance, partial dominance and codominance. Multiple alleles and lethal alleles. Pleiotropy. Gene interaction: epistasis, new phenotypes, other modifications. Complementation analysis.
8.- Variation of the phenotypic expression. Penetrance and expressiveness. Influence of the genetic background and influence of the environment. Epigenetics: Imprinting, X chromosome inactivation. Influenced and sex-limited inheritance.
9.- Quantitative Genetics. Polygenic inheritance. Statistical methods for the analysis of quantitative characteristics. Heritability and estimation methods.
CHROMOSOMAL ALTERATIONS IN EUKARYOTES
10.- Changes in the structure of chromosomes. Mechanisms and types. (a) Deletions (b) Duplications (c) Pericentric and paracentric inversions (d) Translocations
11.- Changes in the number of chromosomes. (a) Euploidy: monoploid, diploid, polyploid. Autopolyploidy and allopolyploidy. (b) Aneuploidy: nullisomies, monosomies and trisomies. (c) Somatic aneuploidies: mosaicism vs. chimerism.
POPULATION GENETICS
12.- Population Genetics. Allelic and genotypic frequencies. Hardy - Weinberg equilibrium. Balance test. Non-random crosses: consanguinity. Processes that change gene frequencies. Mutation. Migration. Genetic drift: founder effect and bottlenecks. Natural selection, fitness and alteration of allelic frequencies.
GENETIC ANALYSIS IN BACTERIA
13.-Recombination in Bacteria. Gene transfer mechanisms: (a) Conjugation: F+ and Hfr strains. F' factors and sexduction. (b) Transformation: phases. (c) Generalized and specialized transduction. Genetic maps in bacteria. Recombination in bacteriophages and genetic maps in viruses.
PROGRAMMING OF LABORATORY PRACTICES (P) AND SEMINARS (S)
P1- Observation and analysis of the human karyotype
S1- A practical case of genetic counseling
P2- Identification of mutants in Drosophila
S2- Experimental design in Drosophila to determine the inheritance of two phenotypic characters
P3- Directed crosses in Drosophila and phenotypic analysis of the offspring

TEACHING METHODS

The subject uses four face-to-face teaching modalities (master classes, classroom practices, laboratory practices and seminars) in which various activities are performed.
- In the master classes, fundamental theoretical concepts of Genetics are worked on and their application to the resolution of practical cases of transmission of characters with qualitative and quantitative variation, and their application to problem solving.
- In seminar classes, laboratory practices and classroom practices, the student is introduced to the bases of genetic counseling and the principles of experimentation (hypothesis development, experimental design, execution of the experiment, analysis of results, discussion and conclusions and preparation of scientific articles). These activities are carried out in groups of four people whose composition is maintained for the entire course.
The teaching team is fully coordinated in terms of the types of activities that are performed and the schedules of the different activities, both between groups of the same subject and between subjects of the same course.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	35	5	5	15					
Horas de Actividad No Presencial del Alumno/a	55	15	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 methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 20%
- Multiple choice test 20%
- Exercises, cases or problem sets 20%
- Teamwork assignments (problem solving, Project design) 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The continuous evaluation system includes the evaluation of training activities carried out in teams and a final individual test in the form of an exam.
1) The written tests worked in teams include the resolution of theoretical and practical problems and the preparation of reports related to the laboratory and seminar sessions (40% of the overall grade). The evaluation of each member of the team will be individualized based on the level of commitment and personal involvement. To pass the subject, a minimum participation in team activities of 80% and a minimum mark of 5 are required.
2) The final written test, whose evaluation constitutes 60% of the overall mark for the subject, consists of test questions, short questions and two problems. To pass the subject, a minimum of 4 (out of 10) is required in each of the sections.
Students under continuous evaluation can refuse exam call at any time until a month before the ending of the classes. However, it is recommended to declare the intention to renounce continuous evaluation before the end of the third week of teaching period.
During the development of the final test, the use of books, notes, as well as telephone, electronic, computer or other devices, by students will be prohibited. Only calculator is allowed. In case of dishonest or fraudulent practice, the protocol of UPV/EHU with regard to academic ethics and prevention of dishonest or fraudulent practices will be applied.
For all students (regardless of whether they take a continuous or final assessment), it will be enough not to attend the final test to be <<Not Presented>>.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary call, the evaluation system will be similar to that followed in the ordinary call. The positive results of the continuous assessment obtained by the students during the course are saved. In case of negative results in the continuous evaluation, the final evaluation test will constitute 100% of the mark for the subject. During the development of the final test, the use of books, notes, as well as telephone, electronic, computer or other devices by students will be prohibited. Only calculator is allowed. Only calculator is allowed. In case of dishonest or fraudulent practice, the protocol of UPV/EHU with regard to academic ethics and prevention of dishonest or fraudulent practices will be applied.
For all students (regardless of whether they take a continuous or final assessment), it will be enough not to attend the final test to be <<Not Presented>>.

MANDATORY MATERIALS

Teachers will provide students with the following material:
THEORY SCHEMES AND FIGURES COLLECTION to facilitate the monitoring of classes on theoretical content.
COLLECTION OF PROBLEMS: this collection will be the basic material for learning how to solve cases. It will be used during master classes and must be used by the student as material for personal work.
LABORATORY PRACTICE PROTOCOL: including the objectives of each activity, its technical development and some questions that each student must answer during or after completion of the corresponding practice. It is mandatory to read the protocol before carrying out the corresponding practice.
PROTOCOL FOR THE SEMINARS: the objectives of each activity and the necessary documentation are included.
All this documentation will be available to the students in the virtual classroom of the subject, sufficiently in advance.

BIBLIOGRAPHY

Basic bibliography

.- BROOKER RJ (2017) Genetics. Analysis & Principles. 6/e. McGraw Hill (978-1259921650)
.- GRIFFITHS AJF, WESSLER SR, CARROLL SB, DOEBLEY J (2015) An introduction to genetic analysis. 11/e. FREEMAN AND CO (978-1429229432)
.- HARTL DL, JONES EW (2017) Genetics. Analysis of Genes and Genomes. Jones and Bartlett Publishers 9/e. (978-1449635962)
.- HARTWELL L, GOLDBERG L, FISCHER JA, HOOD L, AQUADRO CF (2017) Genetics. From Genes to Genomes. 6nd edition. McGraw-Hill (978-0073525310)
.- KLUG WS, CUMMNINGS MR, SPENCER CA, PALLADINO MA. KILLIAN D (2019) Concepts of Genetics (978-1292265322)
.- PIERCE BA (2020) Genetics: A Conceptual Approach. Freeman & Company. 7/e
.- PIERCE BA (2021) Genetics Essentials. Concept and Connections. 5/e. MacMillan 9781319383367

Detailed bibliography

.- CONKITE, D. (2008) A problem-based guide to Basic Genetics. Ed. Thomson.

Journals

Nature Review Genetics
Nature
Science

Web sites of interest

https://ocw.ehu.eus/course/view.php?id=397
https://www.ucm.es/genetica1/apuntes-de-genetica
www.segenetica.es/docencia.php
www.ncbi.nlm.nih.gov/sites/entrez?db=omim
www.biologia.arizona.edu/mendel/mendel.html
www.genome.gov/sglossary.cfm
teknopolis.elhuyar.org/
www.zientzia.eus/

OBSERVATIONS

https://ocw.ehu.eus/course/view.php?id=397
https://www.ucm.es/genetica1/apuntes-de-genetica
www.segenetica.es/docencia.php
www.ncbi.nlm.nih.gov/sites/entrez?db=omim
www.biologia.arizona.edu/mendel/mendel.html
www.genome.gov/sglossary.cfm
teknopolis.elhuyar.org/
www.zientzia.eus/

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GBIOLO30 - Bachelor`s Degree in Biology	Year	.

COURSE

26813 - Molecular Evolution	Credits, ECTS:	4,5

COURSE DESCRIPTION

In this subject, the evolutionary bases of DNA and gene products are studied, and the use of genetic data in the evolutionary analyses of different species. It begins with a theoretical introduction to the essential evolutionary processes, and then the evolution of molecular sequences and genomes is analyzed. In addition, this subject has a critical practical component since essential bioinformatics is worked on and molecular phylogenetics tools are used.
This course is helpful for students interested in Molecular Evolution and those who want to work on Molecular Taxonomy or Molecular Analysis of Populations.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Skills:
1) They know and adequately use scientific terminology and the basic concepts of Molecular Evolution
2) They know the origin and distribution of genetic variability in populations or species and its evolutionary importance.
3) Interpret the processes of molecular evolution through sequence analysis, bioinformatics techniques, and construction of phylogenetic trees
4) They analyze and interpret the evolution of genomes according to the modification of their size and structure.
5) Evaluate, interpret, and synthesize data and biological information
6) They creatively integrate knowledge taught and learned independently, which allows the resolution of biological problems by applying the scientific method.

Theoretical and Practical Contents

THEORY PROGRAM

BASES
Topic.- 1 Introduction. What is evolution? Evolutionary theories.

Topic.- 2 Importance of variation in evolution. Techniques for the study of variability. Variability quantification. Neutral evolution and adaptation.

Topic.- 3 Dynamics of genes in populations. Basic concepts. Hardy-Weinberg equilibrium. evolutionary mechanisms
BIOINFORMATICS
Subject.- 4 Comparison of sequences. Sequence alignments Types of alignments. Alignment methods in pairs. Multiple Alignments. Alignment assessment methods.

Topic.- 5 Bioinformatics and molecular evolution. Introduction to bioinformatics. Gene and protein databases. Comparison of sequences and genomes using bioinformatics techniques.
EVOLUTION OF MOLECULAR SEQUENCES
Topic.- 6 Evolution of protein sequences. Estimation of the number of amino acid substitutions. Substitution matrices: position-dependent and position-independent substitution methods. Genetic codes. Codon usage. Codon usage bias. The molecular clock. Variations in the rate of molecular evolution. Lineage effects. Estimation of divergence time between species.

Topic.- 7 Evolution of nucleic acid sequences. Estimation of nucleotide substitution rates. Jukes-Cantor method. Kimura's 2-parameter method. Nucleotide substitution matrices. Tamura method. Gamma distance. Synonymous and non-synonymous substitutions. Evaluation of the methods. Selection detection. Variations in substitution rates in different regions of DNA. Mitochondrial and chloroplast DNA

PHYLOGENETICS
Topic.- 8 Molecular phylogenetics. Terminology. Orthologous, paralogous, and homologous genes. Topology and types of phylogenetic trees.
Topic.- 9 Genetic distance. Metric and Euclidean distances. Distances and identities of Nei. Examples.
Topic.- 10 Reconstruction of phylogenies. Construction methods based on grouping: UPGMA and Neighbor-Joining. Construction methods based on optimization: Minimum evolution, Parsimony, and Likelihood. Assessment of the reliability of a tree. Applications of phylogenetic analysis.
EVOLUTION OF GENOMES

Topic.- 11 Evolution of the size and complexity of genes. Gene duplication. Shuffling of exons and domains.
Topic.- 12 Evolution of genomes. Structure of the composition of the genome. C-value paradox. Evolution of repeated sequences. Horizontal gene transfer. Genome evolution by duplication.

INTERNSHIP PROGRAM

1) Search for DNA and protein sequences in molecular databases.
2) Search for genetic variations in molecular databases.
3) Homology analysis of DNA and protein sequences.
4) Construction and interpretation of phylogenetic trees.

TEACHING METHODS

Different teaching modalities are used in this subject.
- In the master classes, the theoretical concepts and some practical examples will be explained.
- The computer practices and the seminars will be carried out in groups. The use of molecular databases, the analysis of molecular sequences, and the reconstruction of phylogenetic trees will be studied in depth.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	25	5			15				
Horas de Actividad No Presencial del Alumno/a	35	15			17,5				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Exercises, cases or problem sets 10%
- Teamwork assignments (problem solving, Project design) 20%
- Oral presentation of assigned tasks, Reading¿ 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

(A) Continuous evaluation
The evaluation system includes written tests of different modalities (60% of the final mark), including theoretical concepts and problem-solving, and reports related to practices and in-depth work that are developed (40% of the Final note).
There will be no partial exam. It will be necessary to obtain a 4 out of 10 on the exam to compute the final grade.
The qualifications obtained in memories and works will be saved for the extraordinary call if the student so wishes.
* 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 date of the teaching period for the subject. This resignation must be submitted in writing to the teaching staff responsible for the subject.
(B) In the case of the final evaluation, students must submit in writing to the teaching staff responsible for the subject the waiver of continuous evaluation within a maximum period of 9 weeks from the beginning of the subject.

For students subject to continuous and final evaluation, it will be enough not to take the final test for the final grade for the subject to be "not submitted" or "not submitted."
academic ethics
During the development of the evaluation tests, the use of books, notes, or notes, as well as telephone, electronic, computer, or other devices or devices, by the students will be prohibited. Only a calculator is allowed. In any case of dishonest or fraudulent practice, the provisions of the protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and academic work at the UPV/EHU will be applied.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

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MANDATORY MATERIALS

The evaluation system will be the same as in the ordinary call. Failure to submit to the final test will mean renouncing the evaluation call and will be recorded as a Not Presented.

academic ethics
During the development of the evaluation tests, the use of books, notes, or notes, as well as telephone, electronic, computer, or other devices or devices, by the students will be prohibited. Only a calculator is allowed. In any case of dishonest or fraudulent practice, the provisions of the protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and academic work at the UPV/EHU will be applied.

BIBLIOGRAPHY

Basic bibliography

Fontdevila, A., Moya, A. 2003. Evolución. Origen, adaptación y divergencia de las especies. Ed. Síntesis. Madrid.
Freeman, S., Herron, J.C. 2002. Análisis evolutivo. Pearson Educación S.A. Madrid
Graur, D., Li, W.-H. 2000. Fundamentals of Molecular Evolution. Sinauer Associates.
Hedrick, P. W. 2005. Genetics of Populations. 3rd ed. Jones and Bartlett Pub. Boston.
Higss, P.G., Attwood, T.K. 2005. Bioinformatics and Molecular Evolution. Blackwell Publishing.
Li, W.-H. 1997. Molecular Evolution. Sinauer. MS.
Nei, M., Kumar, S. 2000. Molecular Evolution and Phylogenetics. Oxford University Press.

Detailed bibliography

Attwood, T.K. & D.J. Parry-Smith. 1999. Introduction to Bioinformatics. Addison Wesley Longman Limited, Edimburgo.
Baxevanis, A.D., Ouellette, B.F.F. 2001. Bioinformatics. A practical guide to the analysis of genes and proteins. 2nd ed. Wiley-InterScience
Brown, T.A. 2007. Genomes 3rd ed. Garland Science
Gibson, G., Muse, S.V. 2004. A primer of genome science. 2nd ed. Sinauer
Harvey, P.H., Leigh Browin, A.J., Maynard Smith J, Nee, S. 1996. New uses for new phylogenies. Oxford
Higgins, D., Taylor, W. 2000. Bioinformatics. Sequence, structure and databanks. Oxford University
Mount, D.W. 2001. Bioinformatics. Sequence and Genome analysis. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York
Salemi, M., Vandamme, A.-M. 2005 The Phylogenetic Handbook. A practical approach to DNA and Protein phylogeny. Cambridge University Press. Cambridge.

Journals

Nature, Science, Proceedings of the National Academy of Science
Trends in Ecology and Evolution, Trends in Genetics, Ann. Rev. Ecol. Evol.
Biology and Molecular Evolution, Evolution, Journal of Molecular Evolution, Molecular Phylogenetics and Evolution
BMC Evolutionary Biology, BMC Genomics, Genome Biology

Web sites of interest

Historia de la evolución: http://www.ucmp.berkeley.edu/history/evolution.html
Darwin en la red: http://pages.britishlibrary.net/charles.darwin
Darwin y Wallace: http://www.inform.umd.edu/PBIO/darwin/darwindex.html
Mendel: http://www.mendelweb.org/
Historia de la Genética: http://www.es.embnet.org/~lmc/Genética3.html
http://evolution.berkeley.edu
http://www.eseb.org
http://www.nature.com/scitable/topic/Evolutionary-Genetics-13
http://wps.prenhall.com/esm_freeman_evol_3/12/3315/848837.cw/index.html
http://www.ncbi.nlm.nih.gov/Entrez

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOLO30 - Bachelor`s Degree in Biology	**Year**	.

COURSE

26815 - Zoogeography	**Credits, ECTS:**	4,5

COURSE DESCRIPTION

ZOOGEOGRAPHY, or biogeography in a broader sense, is a fundamental subject of biology and deals with the relationships between geographical space (changing throughout the Earth's history, and also due to climate and the human species throughout the planet) and living beings. Biodiversity is nothing more than the geographical embodiment of evolution.
Evolutionary processes (speciation, diversification, extinction) cannot be interpreted without geography (continental drift, orography, climatology).
Zoogeography studies the distribution of living beings on Earth, as well as the processes involved in its creation and those causing its changes and eventual disappearance.
It is an interdisciplinary, synthetic and engaged science, incorporating the understanding and management of man-made changes throughout the biosphere. It is also a historical science, and attempts to unravel processes that occurred in the past but which shape the structure and composition of biodiversity.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

1. Understanding the basic concepts, knowing the fundamentals and properly using the terminology of the discipline in order to be able to understand and correctly interpret the scientific literature related to Zoogeography.
2. Knowing and contextualising the historical circumstances and scientists who have shaped biogeography in order to understand its current multidisciplinary approach.
3. Understanding the relationship between the ecological niche and its geographical distribution in order to properly interpret the observed chorological patterns.
4. Understanding and interpreting biogeographical patterns as a result of tectonic and evolutionary as well as climatic and ecological episodes and processes, in order to understand that biogeography is the spatial reflection of evolution.
5. Understanding the dynamic island equilibrium model and its application in species management and conservation for subsequent practical application.
6. Selecting, compiling and processing bibliographic sources and faunal data to produce distribution maps and their subsequent analysis using biostatistical and geographical software.

Theoretical and Practical Contents

Introduction
1. The Science of Biogeography
2. History of Biogeography
Physical environment and basic biogeographical patterns
3. The physical location
4. Distribution of isolated species
5. Geography of communities
Earth history and basic biogeographical processes
6. Dispersal and immigration
7. Speciation, diversification and extinction
8. Plate tectonics and Earth history
9. Pleistocene glaciation and biogeographic dynamics
Evolutionary history of lineages and biotas
10. Geography of diversification
11. Reconstructing the history of the lineages
12. Reconstructing the history of biotas
Ecological biogeography
13. Biogeography of islands: patterns of specific richness
14. Assembly and evolution of island communities
15. Areography, ecogeographic rules and diversity gradients
Conservation biogeography
16. Biodiversity and the geography of extinction
17. Biogeography for conservation
18. Biogeography of humanity

PRACTICAL PROGRAMME

Laboratory practicals.
1. Cartography and chorology
2. Sources and processing of biogeographical data
3. Species chorology of a given area
4. Analysis and synthesis of chorological information

Field work
DISTRIBUTION OF ENDEMISMS. Planning of faunal sampling. Carrying out the sampling in the assigned grid and taxonomic determination. Preparation of the report with the results.

Seminars
1. Instructions for carrying out the field work (planning, sampling, taxonomic determination) and of the resulting report (structure and content)
2. Instructions for individual in-depth work on biogeographical concepts, patterns and processes

TEACHING METHODS

The subjects of the programme are teaching units of different lengths, so they are not developed in equal time slots.
For personal work, a basic knowledge of English is essential in order to be able to handle information in English.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	2		10					3
Horas de Actividad No Presencial del Alumno/a	30	20		5					12,5

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 20%
- Multiple choice test 50%
- Individual assignments 15%
- Teamwork assignments (problem solving, Project design) 15%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS ASSESSMENT
The final mark will be the sum of the following marks:
1/ THEORY (70%). Final exam.
2/ ASSIGNMENTS AND HOMEWORK (30%):
A-Individual work on biogeographical patterns and processes.
B-Team work on a Basque endemism (design, sampling and report).
C-The possibility of including the reading, and subsequent preparation of a report, of a book related to the subject will be considered.

Criteria for the assessment of work: organisation and structuring of information, use of scientific terminology, capacity for analysis and synthesis, appropriate use of resources. Attendance at laboratory practicals is compulsory in case of continuous assessment.

FINAL ASSESSMENT: Theoretical-practical exam (100%).
Students will have the right to be assessed using the final assessment system, regardless of whether they have participated in the continuous assessment system. To do so, students must submit a written waiver of continuous assessment to the lecturer responsible for the subject, for which they will have a period of 9 weeks from the beginning of the term, in accordance with the academic calendar of the centre.

OPTING OUT OF CALLS: in accordance with current regulations.

During the development of the assessment tests, the use of books, class notes or cheat sheets, as well as telephone, electronic, computer or other devices by students will be prohibited. In the event of any dishonest or fraudulent practice, the provisions of the "Protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and academic work at the UPV/EHU" will be applied.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The final mark will be established following the protocol described in the ordinary exam.
In exceptional situations, the assessment system may be customised.
Failure to take the test will be considered and recorded as a "No show".

MANDATORY MATERIALS

Appropriate clothing and footwear for field trips.

BIBLIOGRAPHY

Basic bibliography

LOMOLINO, RIDDLE, WHITTAKER & BROWN. 2010. Biogeography (4th ed) Sinauer Ed.
ZUNINO & ZULLINI. 2003. Biogeografía. Fondo de Cultura Económica.
HUGGETT. 1998. Fundamentals of Biogeography. Routledge Ed.
COX, MOORE & LADLE. 2016. Biogeography: An Ecological and Evolutionary Approach (9th ed) Wiley-Blackwell.

Detailed bibliography

AKÇAKAYA et al. 2004. Species Conservation and Management. Case Studies. Oxford UP.
BLONDEL & ARONSON. 1999. Biology and wildlife of the Mediterranean Region. Oxford UP
BRIGGS. 1995. Global Biogeography. Elsevier Ed.
CRISCI, KATINAS & POSADAS. 2003. History Biogeography. An introduction. Harvard UP
GANDERTON & COKER. 2005. Environmental Biogeography. Pearson
LOMOLINO & HEANEY. 2004. Frontiers of Biogeography. Sinauer Ed.
MAC ARTHUR & WILSON. 1967. The Theory of Island Biogeography. Princeton UP
MACDONALD. 2003. Biogeography. Space, Time and Life. John Wiley Ed.
MORRONE. 2009. Evolutionary Biogeography. Columbia UP.
MÜLLER. 1979. Introduction to Zoogeography. Ed. Blume.
NELSON & PLATNICK. 1981. Systematics and Biogeography. Cladistics and Vicariance. Columbia UP
WILSON. 1992. The diversity of life. Harvard UP
SPELLERBERG & SAWYER. 1999. Applied Biogeography. Cambridge UP
VARGAS, REAL & ANTUNEZ. 1992. Biogeographical objectives and methods. Monographs Herpetology,2 (Asociación Herpetológica Española, MNCN)
WHITTAKER. 1998. Island Biogeography. Oxford UP

Journals

Journal of Biogeography
Biodiversity & Conservation
Global Ecology and Biogeography
Diversity and Distributions
Biodiversity Data Journal
Ecography.

Web sites of interest

International Biogeography Society http://www.biogeography.org/index.html
Webpage of Dr. Ron Blakey http://jan.ucc.nau.edu/rcb7/index.html
Biodiversity Heritage Library http://www.biodiversitylibrary.org
Aragonese Entomological Society http://www.sea-entomologia.org/
Global Biodiversity Information Facility http://www.gbif.org/
Digital Climate Atlas of the Iberian Peninsula http://opengis.uab.es/wms/iberia/

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GBIOLO30 - Bachelor`s Degree in Biology	Year	.

COURSE

26817 - Limnology	Credits, ECTS:	6

COURSE DESCRIPTION

Limnology is the study of inland waters, which may include lakes, streams, rivers, estuaries and wetlands. The history of Limnology goes hand in hand with that of Ecology. Modern limnologists are interested in the advancement of their science, but also in its application to the conservation and improvement of aquatic ecosystems. The Limnology program is organised by presenting the physics, chemistry and biology of water bodies, and then develops aspects of ecosystem structure and function and addresses the causes and possible solutions of environmental problems.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Specific competences:
An ability to understand the physical environment in order to interpret the structure and functioning of ecosystems and to evaluate, plan, manage, conserve and restore inland populations and aquatic ecosystems.
An ability to manage the knowledge of instrumental subjects that allow us to obtain information, designing experiments and interpreting results in Limnology.

Horizontal competences:
An ability to provide services and direct, write and execute projects within the scope of one’s professional skills, as well as in dissemination to the scientific community and society.
An ability to develop the ability to analyse, synthesise, organise and plan to allow for decision-making.
An ability to acquire tools for continuous autonomous learning and the promotion of initiative, innovation, motivation for quality and sensitivity to environmental issues.
An ability to develop skills in interpersonal relationships that encourage teamwork and progress in critical thinking.

Expected results in the field of Limnology:
Managing appropriate concepts and terminology
Expressing oneself orally and in writing in a suitable manner
Managing appropriate techniques and equipment
Acquiring habits in the search and selection of scientific information
Understanding the possibilities and current world trends in research in different areas
Preparing reports on solved problems
Other expected results:
Developing meticulousness, rigour, curiosity and an attitude of seeking and analysing to contribute to the general training of a Biologist as a future professional.

Theoretical and Practical Contents

Theoretical lecture programme

1. Introduction. Limnology: aims of the study
2. Water as a medium
3. Introduction to the chemistry of freswater
4. Nutrients
5. Primary producers and primary production
6. Consumers
7. Organic materia and decomposers
8. Rivers
9. Lakes
10. Reservoirs
11. Wetlands and other freshwater environments
12. Environmental problems and ambientales and applied limnology

Practicals programme

1-Study of rivers: Dynamic of the organic materia and related organisms
2-Study of reservoirs: Temperature profiles. Analysis of dissolved nutrients. Analysis of pigments and suspended matter. Interpreting hydrodynamics and trophic states.
Field trip: continental aquatic systems.

TEACHING METHODS

Lectures
Combined Field and Laboratory practicals
Field trip
Tutorials
Evaluation tests Final exam on lectures (minimum 80% of the total mark). Papers on field and laboratory practicals. Practicals are compulsory regardless of their value.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36			18					6
Horas de Actividad No Presencial del Alumno/a	54			27					9

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Teamwork assignments (problem solving, Project design) 30%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Continuous assessment:

The evaluation will be based on a written theoretical exam (multiple choice multiple choice questions, short questions, interpretation of schemes and problems) that will be worth 70% of the final mark and based on the work on practices, which will be worth the 30% of the final mark. To pass the subject it will be necessary to pass the theoretical exam and the practices. The correctness and precision in the answers and the coherence in the approaches will be valued. In the case of reports on practices, their adequacy to the scientific standard will also be assessed.

-Final evaluation:
Students who waive continuous assessment and opt for a final assessment must submit their resignation in writing to the teacher responsible for the subject within 9 weeks from the start of the subject. In this case, the evaluation will be based on the written theoretical exam (multiple choice multiple choice questions, short questions, interpretation of schemes and problems) that will be worth 70% of the final grade and a practical exam that will be worth 30% of the final mark. Final mark in which the student will have to demonstrate that they have the knowledge, skills and practical competences of the subject. To pass the subject it will be necessary to pass the theoretical and practical exam.

For students, for both continuous and final assessment, it will enough to not take the final test for the final grade for the subject to be <<Not Presented>>.

During the development of the evaluation tests, the use of books, notes, as well as telephone, computer or other devices or devices, by the students will be prohibited. [Only a calculator is allowed*]. In any case of dishonest or fraudulent practice, the provisions of the protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and academic work at the UPV/EHU will be applied.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

-Continuous assessment:
For the extraordinary evaluation in July, the part passed will be kept, if any, and the part not passed will be repeated. The characteristics of the exam and the evaluation criteria will be the same as those of the ordinary call.

-Final evaluation:
The characteristics of the theoretical and practical exams, and the evaluation criteria, will be the same as those of the ordinary call.

For students, for both continuous and final assessment, it will enough to not take the final test for the final grade for the subject to be <<Not Presented>>.

During the development of the evaluation tests, the use of books, notes, as well as telephone, computer or other devices or devices, by the students will be prohibited. [Only a calculator is allowed*]. In any case of dishonest or fraudulent practice, the provisions of the protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and academic work at the UPV/EHU will be applied.

MANDATORY MATERIALS

Documentation provided by the teacher in the lectures
Practical lessons guidelines

BIBLIOGRAPHY

Basic bibliography

DODDS, W.K., 2002. Freshwater ecology. Concepts and environmental applications. Academic Press, San Diego.
HORNE, A.J. & GOLDMAN, C.R., 1994. Limnology (2nd. ed.). McGraw-Hill, New York.
JEFFRIES, M. & MILLS, D. 1990. Freshwater ecology: Principles and applications. Belhaven Press, New York.
LAMPERT, W. & SOMMER, U. 1997. Limnoecology: The ecology of lakes and streams. Oxford University Press, New York.
MARGALEF, R., 1983. Limnología. Omega, Barcelona.
MOSS, B., 2001. Ecology of fresh waters: Man and medium (3rd. ed.). Blackwell, London.
WETZEL, R.G., 2001. Limnology (3rd. ed.). Academic Press. New York.

Detailed bibliography

ALLAN, J.D. & CASTILLO, M.M., 2007. Stream Ecology: Structure and function of running waters. 2nd. Ed. Springer, Dordrecht.
BRÖNMARK, C. & HANSSON, L.A., 2005. The Biology of Lakes and Ponds. Oxford University Press.
COOKE, G.D., WELCH, E.B., PETERSON, S.A. & NEWORTH P.R., 2005. Restoration and management of Lakes and Reservoirs. Lewis Publishers.
DARBY, S. & SEAR, D (Eds.), 2008. River Restoration. Jonh Wiley & Sons.
DOBSON, C. & BECK, G.G., 1999. Watersheds. A practical handbook for healthy water. Firefly, Willowdale, Ontario.
DOWNES, B.J., BARMUTA, L.A., FAIRWEATHER, P.G., FAITH, D.P., KEOUGH, M.J., LAKE, P.S., MAPSTONE, B.D. & QUINN, G.P., 2002. Monitoring ecological impacts. Concepts and practice in flowing waters. Cambridge, Cambridge.
FRANCE, R.L., 2009. Aquatic Responses to Watershed Clearcutting. CRC Press.
HAKANSON, L., 2005. Lakes: Form and Function. Blackburn Press.
MITSCH, W.J., GOSSELINK, J.G. & ZHANG, L., 2009. Wetland Ecosystems. John Wiley & Sons.
NAIMAN, R.J., DECAMPS, H. & McCLAIN, M.E., 2005. Riparia. Ecology, Conservation, and Mangement of Streamside Communities. Elsevier, Ámsterdam.

Journals

Limnology & Oceanography
Hidrobiología
Freshwater Biology
Canadian Journal of Phisheries and Aquatic Sciences
Journal of the North American Benthological Society
Limnetica

Web sites of interest

www.uv.es/ael
www.aslo.org/lo/toc
www.limnology.org
www.uragentzia.euskadi.net
www.marm.es

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOLO30 - Bachelor`s Degree in Biology	**Year**	.

COURSE

26818 - Marine Ecology	**Credits, ECTS:**	6

COURSE DESCRIPTION

Marine ecology is a branch of Ecology focused on the study of marine organisms and environment, and their interactions. This course shows to the student the evolution of the marine ecology through the description, experimentation and integration stages. The aim is to ensure the student knows main patterns of environmental variability in oceans, seas and transitional coastal systems, as well as marine life variety, global and local patterns of diversity and biogeography, in addition to the marine processes and their relation to biogeochemical cycles. Main ecosystems’ structure and function, and the human impact on them due to resource exploitation, pollution and climate change are also explained, as well as the contribution of contemporary marine ecology to marine resources management, biodiversity conservation and ecosystem services development.
Students attending this course need to have basic knowledge of Ecology, Botany, Zoology and Physiology in order to obtain good use of the course.
The knowledge and skills achieved by the students of this course, which includes both theoretical and practical training, would contribute to the student employability in several professional fields such as primary and higher education, scientific and technical advice, marine resources management and environmental conservation, and scientific job’s performance.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SPECIFIC COMPETENCES:
1. To know the peculiarities of marine environments and organisms, and those of main biotic and abiotic processes they are involved in
2. To identify the main habitats and communities of the littoral, the pelagic system, the marine bottom and peculiar environments (estuaries, polar and abyssal zones)
3. To understand the function of main marine pelagic and benthic ecosystems and the interactions between them
4. To be aware of the services of marine ecosystems, mainly in that concern to living resources and its management
5. To identify and assess main environmental problems in marine systems, as well as the causes and the measurements to prevent, correct or minimize them
6. To achieve personal and technical skills to carry out environmental measurements, organisms sampling and data treatment in marine research

TRANSVERSAL COMPETENCES:
1. To be able to obtain relevant information, interpret it and draw valid conclusions from data sets
2. To be able to transmit ideas, orally and in writing, in a clear and convincing way by using scientific and technical language specific of the marine ecology
3. To be efficient in problem solving to individual level and in-group working.
4. To develop critical capacity and capacity for knowledge dissemination

Theoretical and Practical Contents

THEORETICAL PROGRAMME

Part I. General aspects
1. Marine Ecology development
Competencies. Study of the marine environment: phases. Institutes and organizations. Field and laboratory infrastructures. Methods of measurement and detection: recent advances.
2. Marine environment
The marine space. Zonation of marine environments. Environmental patterns: main physicochemical factors. Circulation. The marine bottom.
3. Organisms and communities
Classification of marine biota by habitats. Plankton, nekton, benthos and demersal fauna: composition and study methods. Birds and mammals. Global biodiversity. Marine biogeography.
4. Processes
Primary production: limiting factors. Global patterns. Microbial decomposition. Key microorganisms. Secondary production. Secondary production drivers. Measuring primary and secondary production.

Part II. Systems

5. Rocky and sandy shores
Littoral features: environmental gradients. Rocky communities: zonation and trophic structure. Communities living in littoral sediments: organization and function. Interaction with pelagic communities.
6. Saltmarshes, mangrove forests and seagrass meadows
Introduction. Global distribution. Saltmarshes, mangrove forests and seagrass meadows: communities, zonation and trophic webs. Bioregions and diversity.
7. Estuaries
Classification and types. Habitats and communities: zonation. Patterns of diversity. Productivity: determining factors. Matter fluxes. Other brackish-water systems.
8. Continental shelf seabed
Environmental features. Characterization of communities. Functional roles of the biota. Trophic webs. Specific habitats.
9. Coral reefs
Features and relevance. Distribution and development. Antiquity and diversity. Corals and coral communities. Productivity and trophic pathways. Reef growth and bioerosion.
10. Pelagic ecosystems
Environmental features. Classification. Spatial and temporal variability. Planktonic succession. Regime shifts. Trophic transfers. Primary production-fisheries relationships.
11. The deep sea
Environmental features. Food supply. The organisms of the deep sea. Hydrothermal vents-islands in the deep sea.
12. Polar regions
Artic vs Antartic features. Life in the ice. Sea-ice edges. Bentho-pelagic coupling. Endemism and gigantism in polar environments. Polar birds and mammals.

Part III. Human actions
13. Exploitation of resources
Types. Fishery: species. Fishing methods: detrimental effects. Fish stock assessment. The management process. Aquaculture: species, cultivation systems and impact. The role of biotechnology.
14. Environmental impact
Ecological role of disturbance. Marine pollution: types and effects. Climate change. Interaction of multiple factors. Impact assessment.
15. Conservation and restoration
Services of marine ecosystems. Economics of conservation. Conservation policy and legislation. Conservation actions. Restoration of marine habitats.

PRACTICAL PROGRAMME

I. Field practicals
1. Description of intertidal habitats and sampling of benthos from littoral sediments
Inspection of physical and biological features of intertidal habitats at low water. Identification of environmental heterogeneity and stratified sampling of benthic communities
2. Identification of habitats and communities and human impact assessment in coastal systems
Tour of a coastal system to identify and record the different habitats, communities and human activities, and to assess conservation status and impact.

II. Laboratory practicals
1. Taxonomic analysis of phytoplankton samples
Inspection under the microscope. Identification by using guides
2. Taxonomic analysis of zooplankton samples
Sample splitting. Inspection under the stereomicroscope. Identification by using guides and individual count in Bogorov plates
3. Taxonomic analysis of benthos samples from intertidal sediments
Inspection under the stereomicroscope. Identification by using guides

III. Computer practicals
1. Analysis of between-variable relationships in marine and estuarine environments
Plot graphs and relate statistically the vertical variations of abiotic and biotic variables in the water column measured in different environments and seasons

TEACHING METHODS

Teaching methods include:

• Master classes:
The aim is to transmit the theoretical contents of the course by mean of oral presentations of the lessons based on audiovisual materials, and interact with the students by making questions and promoting discussion

• Seminars:
They are devoted to train students in (1) preparing topics of current interest in marine ecology, (2) presenting them to the audience and (3) replying questions on the topic
• Field practicals:
Their specific aims are that students (1) develop observational skills to identify habitats and communities, (2) perform stratified sampling activities and (3) gain capacity to identify human activities and assess the impact.

• Laboratory practicals:
Their specific aims are that students (1) achieve skills in the use of samples and set of instruments to analyse different-type marine organisms that requires microscopy, (2) become familiar with the use of taxonomic guides to identify plankton and benthos and (3) be able to recognize visually the main components of the phytoplankton, the zooplankton and the infauna of sediments of the coastal systems of the Basque country.

• Computer practicals:
In computer sessions the students are expected to (1) gain experience in graph performance and data treatment by using computer tools and (2) be able to get results suitable for exploration and interpretation to draw valid conclusions.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	4		6	2				12
Horas de Actividad No Presencial del Alumno/a	54	6		9	3				18

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 35%
- Multiple choice test 35%
- Exercises, cases or problem sets 25%
- Oral presentation of assigned tasks, Reading¿ 5%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Evaluation system:

1. Continuous evaluation
At the end of the four-month period, on a given date, students will be called to perform a written exam that comprises a multiple-choice test, short questions and diagrams to interpret. This exam means 70% of the final mark. In addition, students should present a written report on the practical works (25% of the final mark) and make an oral presentation on a given topic (5% of the final mark).
Practials’ mark is added to the exam mark only when the last one has been passed, that is, a mark of 5 out of 10 was obtained.
Practicals may be failed as a result of no-justified lack of attendance to any of the scheduled activities in field, laboratory, computer or seminar, not to hand in the practicals’ report in due time (the deadline established at the beginning of the school year) or due to fail of the practicals’ report (less than 5 out of 10). In such a case the student is allowed to present a new practicals’ report at the time of the extra session.
The correctness and accuracy of the answers, and the consistency of the proposals will be valued. In the case of the practicals’ report, the accommodation to scientific standards will be also valued.
To renounce the continuous evaluation and choose the final evaluation, students should present the written resignation to the teacher responsible for the subject within 9 weeks after the course started.

2. Final evaluation
The students who opted for the final evaluation should make a written exam about the theoretical and practical contents of the programme. They will respond to multiple-choice test questions, short questions, diagrams to interpret and practical exercises. The theoretical part is the 70% of the final mark, and the practical part the 30%.
The practical part is considered for the final mark only when the theoretical part has been passed, that is, a mark of 5 out of 10 was obtained.

3. Rules to follow carrying out evaluation tests
During the exam is forbidden the use of books or notes, as well as the use of telephones, computers or any other type of

electronic equipment, by the students. In the presence of any case of dishonest or fraudulent practice, the protocol about academic ethics and prevention of dishonest and fraudulent practices in evaluation probes and academic works in the UPV/EHU will be implemented.

4. Renounce to the call
The lack of attendance to the exam is taken as renounce both for the continuous and the final evaluation.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Evaluation system:

1. Continuous evaluation
In the extra session the same type of exam and the same evaluation criteria than for the ordinary examination session will be applied.
If the practicals’ report assessment was passed, the mark obtained in the ordinary call will be kept up or a new report can be handed in.
The mark obtained for the oral presentation in the ordinary call will be kept up.
If the written exam was passed, the mark obtained in the ordinary call will be kept up and the studet should just hand in the new practicals´ report.

2. Final evaluation
The same than in the ordinary session
.
3. Rules to follow carrying out evaluation tests
The same than in the ordinary session

3. Students, in both the modalities of continuous and final evaluation, not attending the final exam will obtain the "Not attending" final mark.

4. Renounce to the call
The lack of attendance to the exam is taken as renounce both for the continuous and the final evaluation.

MANDATORY MATERIALS

Practical guides and every material given to the students by the teacher to be used during the course.

BIBLIOGRAPHY

Basic bibliography

Baretta-Bekker, H. J. G., Duursma, E. K. & Kuipers, B. R. 1998. Encyclopedia of Marine Sciences. Springer.
Castro, P & Huber, M. 2012. Marine Biology. McGraw-Hill.
Kaiser et al., 2011. Marine Ecology: processes, systems and impacts. Oxford University Press.
Lalli, C.M. & Parsons, T.R. 2000. Biological oceanography: an introduction. Butterworth- Heinemann.
Levinton, J.S. 2009. Marine biology. Function, biodiversity, ecology. Oxford University Press.
Nybakken, J.W. & Bertness, M.D. 2005. Marine biology: an ecological approach. Benjamin Cummings.

Detailed bibliography

Borja, A. & Collins M. 2004. Oceanography and Marine Environment of the Basque Country. Elsevier.
Carter, R.W.G. 1988. Coastal Environments. An Introduction to the Physical, Ecologcal and Cultural Systems of Coastlines. Academic Press.
Longhurst, A. 1998. Ecological Geography of the Sea. Academic Press.
McLusky, D. S. & Elliott, M. 2006. The Estuarine Ecosystem. Ecology, Threats and Management. Oxford University Press.
Stenseth, N. Ch., Ottersen, G., Hurrell, J. W. & Belgrano, A. 2004. Marine Ecosystems and Climate Variations. Oxford University Press.
Trujillo, A. P. & Thurman, H. V. 2014. Essentials of Oceanography. Prentice Hall.
Rallo, A. & Orive, E. 2004. El litoral marino de Bizkaia. Bizkaiko itsasaldea. Instituto de Estudios Territoriales. Diputación Foral de Bizkaia.

Journals

Botanica Marina
Journal of Experimental Marine Biology and Ecology
Journal of Marine Pollution
Journal of Marine Systems
Journal of Plankton Research

Journal of Sea Research
Limnology and Oceanography
Marine Ecology Progress Series

Web sites of interest

(www.mhhe.com/castrohuber6e)
(www.oxfordtextbooks.co.uk/orc/kaiser)
(www.prenhall.com/thurman)
(www.oup.com/us/levinton)
(www.aw.com/nybakken)

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOLO30 - Bachelor`s Degree in Biology	**Year**	.

COURSE

26819 - Forest Ecology	**Credits, ECTS:**	4,5

COURSE DESCRIPTION

Forests play a fundamental role in our well-being, but they are in a critical situation. This subject addresses the knowledge of the ecological bases of this type of ecosystem and what is necessary for the management of problems related to the environmental conditions that limit the structure and functioning of forests, the physical and chemical characteristics and dynamics of the environment, forest biodiversity, production and biogeochemical cycle, and service flows for social welfare and the learning of the functions of different forest ecosystems.
Climate change and sustainable management criteria in forest ecosystems. Final aspects of the use of forest ecology, changes suffered by forests, usually by human action. Simultaneously, the management contemplating solutions of conservation and restoration or regeneration.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SPECIFIC COMPETENCES
- Knowledge of biodiversity, production and biogeochemical cycles of forests.
- Knowledge of the peculiarities of forests, of the organisms inhabiting these systems and their importance in the functioning of forests: primary producers, consumers and decomposers.
- To know the functions of different forest ecosystems and the flows of services provided for the welfare of society.
- Interpret global change and sustainable management criteria in forest ecosystems.
- The capacity of the ecological use of forests to manage, preserve and find restoration or regeneration solutions.

TRANSVERSAL COMPETENCES
- Ability to evaluate, interpret and synthesize biological data and information
- Processing and interpretation capacity according to explanatory models of data obtained from observations and measurements
- Capacity for technical and scientific reporting
- Competence to properly communicate the biological knowledge necessary for the training and dissemination of the area of education at all levels
- Use appropriate techniques and equipment

Theoretical and Practical Contents

THEORETICAL CLASSES
1-Structure and distribution of the main types of ecosystems in the world.
2-Basic measurements for forest management.
3-Managed ecosystems.
4-forest management.
5-Landscape biodiversity.
6-Carbon balance.
7-Water and nutrient balance in forest ecosystems.
8-Biomass and forestry production.
9-Changes
10-Forest pests.
11-Basque forestry reality and management strategies.

INTERNSHIP PROGRAMME
1.- Forest study: structure, plant biodiversity indices, soil organic matter, biomass and production calculations, service assessment (0.3 credits).
2.- Plantation studies: structure, plant biodiversity indices, soil organic matter, biomass and production calculations, service assessment (0.3 credits).
3. Rural practice: characteristics of forest and crop ecosystems (0.8 credits).
4. Seminar (0.3 credits): Rural practices and laboratory

TEACHING METHODS

Different methodologies are used in this area:
Classes: its objective is to transmit the theoretical contents of Forest Ecology and are directed to all students enrolled in the subject. In this type of teaching, the teacher uses audiovisual media.

Classroom practices: They complement, consolidate and apply the contents developed in the classes. Individually or in small groups, students see problems and applied cases of Forest Ecology.

Practices and procedures: practices coordinated with seminars. They are developed in small groups and the aim is for students to carry out a full ecological research. Both in the field and in the laboratory, students use the basic methodology and tools of Forest Ecology to analyze the responses of communities to changes in environmental variables.

Seminars: Seminars are related to field and processing practices. For the development of a Forest Ecology project, the analysis of the data obtained in rural and laboratory practices and the discussion of the results.

Field trips: Students observe and learn different examples of forest management.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	27			10	3				5
Horas de Actividad No Presencial del Alumno/a	40,5			15	4,5				7,5

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Teamwork assignments (problem solving, Project design) 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

During the development of the evaluation tests it shall be prohibited the use of books, notes or notes, as well as of apparatus or telephone, electronic, computer or other devices, by students. In any case of dishonest practice or the protocol on academic ethics and prevention of dishonest practices or fraudulent evaluation tests and academic work in the UPV/EHU.

-Continuous assessment:
The assessment will be made on the basis of a written theoretical examination (short questions, interpretation of schemes and problems) worth 60% of the final note and on the basis of work on practices, which will amount to 40% of the final note. To pass the subject it will be necessary to pass the theoretical examination and the practices. Correctness and precision in responses and consistency in approaches will be assessed. In the case of practice reports, their suitability to the scientific standard will also be assessed.

- Final evaluation:
Students who drop out of the continuous assessment and opt for a final evaluation must submit their written resignation to the teacher responsible for the subject within nine weeks of the beginning of the four-month period. In this case the assessment will be based on the written theoretical examination (test questions with multiple answers, short questions, interpretation of schemes and problems) which will be worth 60% of the final note and a practical examination which will be worth 40% of the final note in which the student will have to demonstrate that he or she gathers the knowledge, skills and practical skills of the subject. To pass the subject it will be necessary to pass the theoretical and practical examination.

- Failure to attend the exam will be interpreted as resignation.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

During the development of the evaluation tests it shall be prohibited the use of books, notes or notes, as well as of apparatus or telephone, electronic, computer or other devices, by students. In any case of dishonest practice or the protocol on academic ethics and prevention of dishonest practices or fraudulent evaluation tests and academic work in the UPV/EHU.

Special call

-Continuous assessment:
For the July special assessment the grades of the course’s practical work will be kept and the written test will have to be repeated. The characteristics of the examination and the assessment criteria shall be the same as the ordinary call.

-Final evaluation:
The characteristics of the theoretical and practical examinations and the assessment criteria shall be the same as those of the ordinary call.

MANDATORY MATERIALS

Documentation provided by the teacher in the master class
Subject practice protocols

BIBLIOGRAPHY

Basic bibliography

Aber DA & Melillo JM. 2001. Terrestial ecosystems. Harcourt Academic Press. New York.
Kent, M. & Coker,P. 1992. Vegetation Description and analysis. A Practical Approach. Belhaven Press.
Kimmins, J.P. 2003. Forest Ecology: foundations for sustainable management. Prentice Hall. Nueva Jersey.
Likens, G.E., Bormann, R. S., Pierce, R.S., Eaton, J.S. and N.M. Jhonson. 1977. Biogeochemistry of a Forested Ecosystem. Springer-Verlag, New york.
Reichle, D.E. (Ed.). 1981. Dynamic properties of forest ecosystems. International Biological Programme 23. Cambridge University Press.
Smith, R. Smith, T. 2002. Ecology and Field Biology: Hands-On Field Package. Kluwer Academic Publishers.

Detailed bibliography

Bailey, G. 2002. Ecoregion-Based Design for Sustainability. Springer.
Costanza, R., Mageau, M., Norton, B. & Patten, B.C. 1998. What is Sustainability? Pp. 231-239. En: Rapport, D., Costanza, R., Epstein, P.R., Gaudet, C. & Levins, R. (eds). Ecosystem Health. Blackwell Science.
Dudley, N., Schlaepfer, R., Jeanrenaud, JP., Jackson, W. and Stolton, S. 2006. Forest Quality - Assessing forests at a landscape scale. Earthscan.
Gliessman, S.R. 2001. Agroecosystem Sustainability: Developing Practical Strategies. CRC Press LLC. Florida. EEUU.
Innes, JL., Hickey, G., Hoen,HF. 2005. Forestry and Environmental Change: Socioeconomic and Political Dimensions. CABI.
Lindenmayer DB., and Hobbs, R. 2007. Managing and Designing Landscapes for Conservation, Moving from Perspectives to Principles. Murdoch University.
Mansourian, S., Vallauri, D., Dudley, N. 2005. Forest Restoration in Landscapes - beyond planting trees. Springer.
Turner, Monica G., Gardner, Robert H., O'Neill, Robert V. 2001. Landscape Ecology in Theory and Practice - Pattern and Process. Springer

Journals

Forestry, Forest Ecology and Management, Annals of Forest Science, Applied Vegetation Science, Plant Ecology

Web sites of interest

http://www.nysaes.cornell.edu/ent/biocontrol/
http://www.worldwildlife.org/
http://www.biologybrowser.org/
http://www.unep.org/
http://oils.gpa.unep.org/facts/facts.htm
http://www.ser.org/
http://www.iucn.org/
http://www.ipcc.ch/
http://highered.mcgraw-hill.com/sites/0073050822/student_view0/index.html
https://www.khanacademy.org/partner-content/crash-course1/cc-ecology

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GBIOLO30 - Bachelor`s Degree in Biology	Year	.

COURSE

26820 - Environmental Animal Physiology	Credits, ECTS:	6

COURSE DESCRIPTION

Environmental Animal Physiology is a specialization of Animal Physiology. The subject deals with the general principles of the functional organization of animals in the frame of an environmental context, in order to identify the nature of the alterations of functional order produced by environmental variables (mainly abiotic ones) and to analyse the corresponding adaptative response mechanisms displayed by the animals. The basic requirements to study this subject are the general notions of animal physiology provided by the subjects in the 3rd year of Biology Bachelor: a) Fundamentals of Animal Physiology and b) Physiology of Animal Systems. On the other hand, to understand the behaviour of animal populations, as well as certain aspects of ecosystems functioning, the contents of Biochemistry and Molecular Biology, Cellular Biology, Zoology and Genetics are relevant for this course.
This subject provides the knowledge and tools necessary to face career opportunities in the field of aquaculture or animal production, marine research or animal ecotoxicology.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SPECIFIC COMPETENCIES
C1. To analyse the physiological behaviour of animal and the nature of their functional adaptations to the environment.
C2.To integrate the physiological, cellular and molecular principles and mechanisms involved in the regulation of animal functions.

CROSS COMPETENCIES
C3. To process and to interpret data from observations and measurements according to explanatory models.
C4. To prepare and write scientific-technical reports.

LEARNING RESULTS FOR THE SUBJECT
RA1. The student uses structures and norms in specialized written communication for the preparation of academic and/or scientific documents in both official and foreign languages.
RA2. The student uses inference from experimental data to make holistic descriptions of complex physiological responses (regulation or conformation; acute or chronic response).
RA3. The student argues about the influence of environmental variables on the physiology of animals (temperature, oxygen and water and electrolytes availability).
RA4. The student draws general conclusions by critically comparing the results obtained from the experiments with the scientific literature.
RA5. The student assertively defends his/her experiences and acquired knowledge using scientific-technical language.
RA6. The student argues about the social and environmental impact of the scientific-technical actions proposed in response to a specific environmental problem in the area of knowledge.

Theoretical and Practical Contents

GENERAL INTRODUCTION
Definition of Environmental Animal Physiology. Environmental factors: The effect of environmental factors upon biological systems. Tolerance range and lethal levels. Acclimation. Physiological optimum. Regulation and Conformity: Homeostatic and homeokinetic responses. Stress consequences and criteria for evaluating it. Metabolism as integrated form of physiological response. Production and use of metabolic energy. Evaluation of energetic costs: basal costs vs. cost of activity. The allometry of basal metabolic rate. Theory on "Dynamic Energy Budget"

OXYGEN
Respiratory environment and oxygen availability: aerial vs aquatic media. Environmental hypoxia/anoxia. Oxyrregulation vs oxyconformity. Oxyrregulation mechanisms. Vascular transport of oxygen. Respiratory pigments and oxygen capacity. Dissociation curves. The role of respiratory pigments in oxyrregulation. Metabolic adaptations in relation to hypoxia and anoxia. Functional anaerobiosis vs environmental anaerobiosis.

TEMPERATURE
Responses to temperature fluctuation. Thermal effect on metabolic scope for activity. Homeotherms vs poikilotherms animals. Thermal tolerance vs. thermal compensation. Thermal acclimation in poikilotherms. Molecular mechanisms of

thermal compensation in ectotherms: positive modulation of enzymes affinity for substrates, long-term qualitative and quantitative adjustments of enzyme activities, homeosviscous adaptation. Endothermic vs ectothermic animals. Thermal equilibrium and regulation in homeotherms. The thermoneutral zone. Integrated temperature regulation system.

WATER AND SALT AVAILABILITY
Osmotic relationships. Euryhalinity and stenohalinity. Osmotic conformity. General mechanisms of osmotic regulation. Osmotic regulation and water balances in terrestrial animals. Nitrogen excretion and water economy.

LABORATORY PRACTICES SYLLABUS:
Laboratory practices will be developed in various sessions through several weeks, with a total duration of 15h.
-Thermal acclimatization of metabolism in fish.
-Development of respirometric indices for the analysis of the oxyrregulatory capacity in aquatic organisms.
-Osmotic adjustments to salinity change in an osmoconcordant marine invertebrate.

TEACHING METHODS

The development of the syllabus includes the following methodology:
1.- Basic Principles of Environmental Animal Physiology: includes the contents of the Introduction and Metabolism chapters of the syllabus, developed through lecture-based teaching (M).
2.- The section corresponding to the environmental variables (oxygen, temperature and, economy of water and electrolytes) will be addressed with a "LEARNING THROUGH PROBLEM-SOLVING" methodology in which the topics of each section will be treated within the framework of a set of experimental data that builds up a "CASE STUDY". The treatment of these case studies will include the following activities:
A.- Presentation and development of the fundamental issues analysed in each case, identifying the type of physiological response and analysing the functional relationships of the physiological parameters and indices considered. To be developed through lecture-based teaching (M).
B.- Bibliographic search and compilation of basic information to focus on the studied issue. It will be carried out in the form of seminars (S) and personal work of the student.
C.- Data treatment through calculations and graphical output through spreadsheets which will be developed in applied classroom-based groups (GA) and personal work of the student.
D.- Presentation and discussion of the functional relationships involved in data treatments, all carried out in applied classroom-based groups (GA) supervised by the teacher.
E.- Preparation of written reports in scientific article format by small groups of students (non-contact activity), which they will have to deliver and which will be evaluated by the teacher. Students will defend their work in classroom-based groups (GA) and will recived the feedback about their written reports.

3.- In applied laboratory-based groups (GL), the students will perform physiological parameter measurements and develop analytical procedures from animals treated under simple experimental conditions (e.g., subjected to changes in temperature, water salinity or oxygen availability) and carry out a preliminary data treatment obtained using a computer. Laboratory work is assessed on the basis of an individual report submitted by the student.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	35	4	6	15					
Horas de Actividad No Presencial del Alumno/a	53	10	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 methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 50%
- Individual assignments 10%
- Teamwork assignments (problem solving, Project design) 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Carrying out the laboratory practices is an essential condition to be evaluated in the rest of the activities,botu in the continuous evaluation and the final evaluation system.

The continuous evaluation of the subject will include the following sections:
Written exam of the contents: 50%
Evaluation of reports on case studies: 40%
Laboratory practice report: 10%

Special relevance is given to the written exam, it will be mandatory to attend to the written exam and obtaining a minimum grade of 4 out of 10 to take into account the rest of the activities, and to calculate the mean for the final mark.

The structure of the exam will be as follows: short questions, questions to be developed and exercises.
There will be no partial exams.

Students who renounce to the continuous evaluation and choose the End-of-course evaluation must submit their resignation in a writing to the responsible professor within 9 weeks from the beginning of the course. However, given the organization of this subject through case studies, it is recommended to communicate this decision within a period of 5 weeks since the start of the course.

Final evaluation will consist in questions and exercises about the contents (90% the mark) and a questionnaire about laboratory work (10% of the mark).

Whether or not the case study reports are made and evaluated, the non-attendance to the written exam will be considered as voluntary waiver of the evaluation call and will be recorded as a Not Presented.

During the development of the evaluation tests, the use of books, notes, as well as telephone, electronic, computer or other devices or devices, by the students will be prohibited. Only the use of a calculator is allowed. In the case of dishonest or fraudulent practices, the protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and in academic work at the UPV/EHU will be applied.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The extraordinary call is regulated by the same evaluation criteria as the ordinary call. The qualifications obtained in the case studies and practical work will be maintained.

The non-attendance to the written exam will be considered as voluntary waiver of the evaluation call and will be recorded as a Not Presented.

During the development of the evaluation tests, the use of books, notes, as well as telephone, electronic, computer or other devices or devices, by the students will be prohibited. Only the use of a calculator is allowed. In the case of dishonest or fraudulent practices, the protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and in academic work at the UPV/EHU will be applied.

MANDATORY MATERIALS

Computer that has EXCEL program. Calculator.

BIBLIOGRAPHY

Basic bibliography

HILL, R.W., WISE, G.A. & ANDERSON, M., 2006. Fisiología Animal. Harper & Row Publishers, N.Y.
RANDALL, D., BURGGREM, W. & FRENCH, K., 2002. ECKERT Animal Physiology. Mechanisms and adaptations. 5th ed. Freeman & Co.
SCHMIDT-NIELSEN, K. 1997. Animal physiology. Adaptation to environment,.5th Ed. Cambridge University Press. London.
SOMERO, G.N, LOCKWOOD B.L, TOMAMEK L., 2017. Biochemical adaptation: Response to Environmental Challenges from Lifes´s Origins to the Anthropocene. Sinauer Associates, Inc.
WILLMER, P., STONE, G.& FRENCH, K. 2005. Environmental physiology of animals. 2nd ed. Blackwell

Detailed bibliography

BLAKE, R. W. (Ed.) (1991). "Efficiency and economy in animal physiology" Cambridge University Press, Cambridge.
HOCHACHKA, PW & SOMERO, GN. 2002. Biochemical adaptation. Mechanisms and processes in biochemical evolution. Oxford University Press.
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PROSSER, C.L. (ed.) (1991). "Comparative animal physiology". Wiley, Nueva York.

Journals

ANNUAL REVIEW OF PHYSIOLOGY.
COMPARATIVE BIOCHEMISTRY AND PHYSIOLOGY.
JOURNAL OF PHYSIOLOGY.
JOURNAL OF PHYSIOLOGY AND BIOCHEMISTRY.
REGULATORY INTEGRATIVE AND COMPARATIVE PHYSIOLOGY.
PHYSIOLOGICAL AND BIOCHEMICAL ZOOLOGY.
PHYSIOLOGICAL REVIEWS.
MARINE AND FRESHWATER BEHAVIOUR AND PHYSIOLOGY.
JOURNAL OF COMPARATIVE PHYSIOLOGY.
INTEGRATIVE AND COMPARATIVE PHYSIOLOGY.
JOURNAL OF EXPERIMENTAL MARINE BIOLOGY AND ECOLOGY.
JOURNAL OF PHYSIOLOGY LONDON.
JOURNAL OF APPLIED PHYSIOLOGY.
JOURNAL OF EXPERIMENTAL ZOOLOGY.

Web sites of interest

www.pnas.org/
www.sciam.com/
www.cell.com/
www.neuron.org/
www.nature.com/index.html
www.sciencemag.org/

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GBIOLO30 - Bachelor`s Degree in Biology	Year	.

COURSE

26824 - Genetic Engineering & Molecular Genetic Analysis	Credits, ECTS:	6

COURSE DESCRIPTION

In this subject the conceptual bases of the experimental methodologies that allow the extraction, analysis, cloning and expression of nucleic acids are worked on. These methodologies are used with the aim of taking steps in the knowledge of the different cellular functions and to be able to apply this knowledge in the fields of Biology, Biomedicine and Biotechnology.
This optional subject is offered within the Specialty of Cellular, Molecular and Genetic Biology and is based on the knowledge acquired by students in basic subjects of Cellular Biology, Biochemistry, Genetics, Microbiology and Molecular Genetics. The contents that are worked on are integrated and related to various subjects of the area of Genetics and other areas such as Cellular Biology and Microbiology. The material is basic for the professional performance of any Molecular Biologist.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SPECIFIC COMPETENCES

1.Acquire a current perspective of the methodological and technological strategies used in Molecular Genetics and in the molecular analysis of genomes.
2.Understand and recognize the applications of molecular techniques and the manipulation of genomes, in the field of research in Biology, Biomedicine and Biotechnology and in the Agricultural industry
3. Know and practice basic technical procedures that allow the student to become familiar with molecular analysis.

TRANSVERSAL COMPETENCES

1.Develop the capacity for analysis and synthesis and progress in critical reasoning and ethical commitment
2.Develop the capacity for organization and planning
3. Delve into teamwork

Theoretical and Practical Contents

THEORY PROGRAM
INTRODUCTION
1.- Recombinant DNA: Definition and objectives. General system for gene analysis and manipulation. The historical development of recombinant DNA technology.

FUNDAMENTALS OF DNA, RNA AND PROTEIN ANALYSIS AND MANIPULATION
2.- Basic techniques for the analysis and manipulation of nucleic acids and proteins: DNA, RNA and protein extraction. Purification, quantification and electrophoresis. Probes. Hybridization of nucleic acids. Southern, Northern and Microarrays. Protein detection: Western, Immunohistochemistry and Proteomics. Gene editing using CRISPR/Cas9.
3.- Techniques for the in vitro amplification of nucleic acids: Description of the PCR technique. Components and conditions in the reaction. Primer design. Some applications. qPCR and RT-qPCR. Basic techniques for sequencing: Sanger and Pyrosequencing.

GENE MODIFICATION IN BACTERIA
4.- Cloning of DNA in bacteria: recombinant DNA in bacteria. Characteristics of the bacterial host. Types and characteristics of the cloning vectors. Systems of transformation in bacteria. Selection of transformants. Extraction and purification of plasmid DNA.
5.- Heterologous gene expression in bacteria. Expression vectors. Elements of the expression systems. Fusion genes. Purification and detection of proteins. Marker genes. Applications of the bacterial transformation.
6.- Genomic libraries massive sequencing technics. DNAseq and RNAseq.

GENE MODIFICATION IN BACTERIA EUKARYOTES
7.- General characteristics of DNA cloning in eukaryotes. Transient and stable transfection.
8.- Genetically modified plants: Gene transfer and gene editing in plants. Gene transfer systems. Types and characteristics of cloning vectors. Heterologous gene expression control systems. Applications.
9.- Genetic modification of mammalian cells: Characteristics of the host cells. System of gene transfer. Types and characteristics of cloning vectors in mammals. control systems expression of heterologous genes. Applications.
10.- Inactivation, silencing and editing of genes: Gene inactivation by homologous recombination. Site specific

recombination and conditional gene knockout. Gene silencing by RNA interference (RNAi): antisense oligonucleotides, siRNAs and miRNAs. Gene editing using CRISPR/Cas9.
11.- Genetically modified animals: Generation of transgenic mice: knock-out and knock-in. System for expression control. Generation of other transgenic animals: nuclear transfer. Applications.
12.- Gene therapy: Ex vivo and in vivo and somatic vs germinal gene therapy. Human cell transfection systems. Use of gene therapy in genetic diseases and acquired diseases.

PROGRAM FOR LABORATORY PRACTICE

Cloning of the lambda phage genome in the pUC18 plasmid:

a) Digestion of the phage lambda genome and the pUC18 vector. Ligation

b) Transformation of competent bacteria with the ligation product and seeding in selective medium

c) Extraction and purification of recombinant plasmids

d) Identification of the cloned fragments by analysis of the size of the cloned fragment after digestion and PCR

TEACHING METHODS

The subject includes different teaching modalities. Theoretical concepts are worked on in the lectures. The classroom practice sessions are related to the application of theoretical content to the resolution of situations, with the realization of quantitative estimations for their later experimental application, with the interpretation of experimental results, etc. In seminar sessions, students work critically on scientific texts related to the applicability of the learned methodologies and their safety and perception social.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	35	5	5	15					
Horas de Actividad No Presencial del Alumno/a	45	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 methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 35%
- Multiple choice test 15%
- Exercises, cases or problem sets 30%
- Teamwork assignments (problem solving, Project design) 10%
- Oral presentation of assigned tasks, Reading¿ 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation system includes a final exam and other tests that are part of the continuous evaluation:

1) The final written test (50% of the mark) consists of test questions (15%) and questions to develop (35%). So that the course can be approved, a minimum of 4.0 points (out of 10) will be required in each of the sections.

2) The written tests carried out in groups and that are part of the continuous evaluation include the document related to the experimental work carried out in the laboratory sessions (30%), problem solving theoretical and practical (10%) and the delivery of the report related to the work carried out in the seminar sessions (10%). The evaluation of group activities will be individualized depending on the level of commitment and involvement with the group work carried out. For the subject to be approved, a minimum of 4.0 is required points (out of 10) in each of the sections.

Waiving continuous evaluation requires an explanatory letter addressed to teachers during the first 9 weeks of the course.

During the development of the evaluation tests, the use of books will be prohibited, as well as devices or telephone, electronic, computer, or other devices, by students. You are only allowed to bring your class notes and calculator.

In any case of dishonest or fraudulent practice, the provisions of the ethics protocol from the university will be applied (Prevention of dishonest or fraudulent practices in assessment tests and assignments academics at the UPV/EHU).

The non-presentation to the final test will mean the resignation of the evaluation call and will be recorded as a No submitted.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The positive results of the continuous assessment obtained by the students during the course are kept. In case of Negative results in the continuous evaluation, the final evaluation test will contribute 100% of the qualification of the subject.

During the development of the evaluation tests, the use of books will be prohibited, as well as devices or telephone, electronic, computer, or other devices, by students. You are only allowed to take notes and calculator.

In any case of dishonest or fraudulent practice, the provisions of the ethics protocol from the university will be applied (Prevention of dishonest or fraudulent practices in assessment tests and assignments academics at the UPV/EHU).

Failure to submit to said test will mean the resignation of the evaluation call and will be recorded as a No submitted.

MANDATORY MATERIALS

THE TEACHING STAFF WILL PROVIDE THE STUDENTS WITH THE FOLLOWING MATERIAL:
A collection of problems will be used as basic material that will be delivered to the students with sufficient advance. The collection includes problems that will not be solved in the classroom and that the student must use as material for personal work.
The protocol of the practices and the necessary documentation for the realization of the seminars will be given with sufficient advance.
In the case of the practices protocol, the objectives of each activity are included. Also its rationale theory, their technical development and some questions that each student must answer during or after completion of the corresponding practice. It is mandatory to read the protocol before carrying out the corresponding practice since in the laboratory no question will be answered regarding the protocol or related to previous theoretical knowledge that should have been reviewed previously. As for the seminars, the supporting documentation corresponding to each session will be given.
All the necessary documentation will be available in the virtual classroom to support this subject.

BIBLIOGRAPHY

Basic bibliography

- Wink M. (redactor)(2021) An introduction to Molecular Biotechnology: Fundamentals, Methods and Applications. 3rd. edition. Ed. Wiley ISBN: 978-3527344147.

- Real MD, Rausell C, Latorre A(2017)Técnicas de ingeniería genética. Editorial Síntesis. ISBN: 978-84-9171-071-4.

- Klug WS, Cummings MR, Spencer CA, Palladino MA. Killian D (2019) Concepts of Genetics. 12th edition (978-1292265322).

- Brooker RJ (2021) Genetics. Analysis & Principles. 7/e. McGraw Hill (978-1260240856)

- Goldberg M, Fisher JA,Hood L, Hartwell L (2021) Genetics. From Genes to Genomes. 7th edition. McGraw-Hill (978-1260240870).

- Nicholl D.S.T. (2008) An introduction to Genetic Engineering. Cambridge University Press (3ª edición) ISBN-10: 0521615216.

-Primose SB, Twyman RM (2006) Principles of Gene Manipulation and Genomics. Wiley-Blackwell (an imprint of John Wiley & Sons Ltd); 7th Edition . ISBN: 978-1405135443.

- Stephenson F (2012) Cálculo en Biología Molecular y Biotecnología. Guía de matemáticas para el laboratorio. 2ª ed.

Elsevier. ISBN 8490220913.

Detailed bibliography

- Krebs J, Goldstein E, Kilpatrick (2018) Lewin´s Genes XII; Jones and Bartlett Publishers, Massachussets. ISBN: 978-1284104493
- Geoffrey M. Cooper (2018) The Cell: A Molecular Approach. 8ª Ed. Sinauer associates. ISBN: 1605357073
- Pierce, B.A (2017) Genetics Essentials: Concepts and Connections.(4rd Ed.).W. H. Freeman and Co. ISBN: 1319107222

Journals

Nature
Science
Nature Review Genetics

Web sites of interest

https://ocw.ehu.eus/course/view.php?id=397

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOLO30 - Bachelor`s Degree in Biology	**Year**	Third year

COURSE

26837 - Advanced Plant Physiology	**Credits, ECTS:**	6

COURSE DESCRIPTION

The subject ADVANCED PLANT PHYSIOLOGY deals with the functions of the plant as a whole organism, with special emphasis on water relations and mineral nutrition, on the one hand, on the development of biological processes throughout the life cycle and, on the other, relating them to environmental aspects and applications.

This subject and the Fundamentals of Plant Physiology lay the foundations to optional subjects of the fourth year, such as Plant Ecophysiology in the Biology degree.

From a professional point of view, this subject enables the student to integrate into teams related to research in plant biology, within the pharmaceutical or agri-food industry. In the agricultural field, the subject will be able to perform crop growth optimization tasks by designing the appropriate cultivation conditions in order to contribute to environmental conservation and food security.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SPECIFIC COMPETENCES TO:

1. Understand how plants acquire water and nutrients from the surrounding environment and their influence on the adaptation and distribution of plant species.

2. Understand the transport of carbohydrates, the development of the cell wall and the synthesis of secondary metabolites from the surrounding environment.

3. Analyze and understand the basic aspects involved in the processes of organization and development of plants to throughout its ontogenic cycle, from germination, through vegetative growth to the reproductive process.

4. Assess the effects of the main external agents, both biotic and abiotic, on the physiological processes of plants, deepening the mechanisms of adaptation of plants against changing environmental situations, as a basis for their use as bioindicators and as a tool for solving environmental problems.

5. Identify the bases of the regulation and integration of the different compounds and physiological processes to be able to apply this knowledge in different professional fields.

TRANSVERSAL COMPETENCES TO/RESULTS OF LEARNING

1. Develop the capacity for the autonomous search of the information related to the Physiology of plants and their critical analysis from different sources depending on their relevance.

2. Acquire the necessary skills to handle the common materials and techniques of Plant Physiology.

3. Build hypotheses, design experiments, interpret the results obtained, issue diagnoses and propose solutions, in a coordinated manner and developing the ability to work in teams.

4. Use the appropriate terminology both in writing and orally to communicate the different concepts of plant performance.

5. Maintain a positive attitude that allows acquiring tools for continuous autonomous learning and developing the capacity for search, analysis, synthesis, organization and planning. All these comptetences will enable decision-making and the elaboration and transmission of information related to the field of Plant Physiology

Theoretical and Practical Contents

THEORY PROGRAM

Section 1

0. Introduction
1. The plant cell wall

Section 2. Water Relations and mineral nutrition

2. Water in the soil-plant-atmosphere system. Water, osmotic and cell wall potential.
3. Absorption and transport of water through the xylem.
4. Stomatic physiology and transpiration
5. Absorption and transport of ions by the plant. Ionic cell transport.
6. Mineral nutrition. Essential mineral elements and availability in the environment.
7. Transport through the phloem.

Section 3. Growth and development

8. Growth and development of the plant. Light as a regulator of growth.
9. Embryogenesis and seed development.
10. Germination. Vegetative propagation. Bud development.
11. Primary and secondary meristems. Organogenesis and development of the vegetative body. Influence of endogenous and environmental factors.
12. Flowering. Molecular bases, endogenous and environmental factors.
13. Fruit formation: growth and maturation. Effects of plant hormones.
14. Senescence and abscission. Influence of ethylene and abscisic acid
15. Plant movements: tropisms and nastias

Section 4. Environmental and applied aspects of Plant Physiology

16. Secondary metabolism. General Functions.
17. Secondary metabolism. Terpenes, phenols, and nitrogen compounds (alkaloids and others).
18. Environmental Plant Physiology
19. Applied Plant Physiology

PRACTICE PROGRAM

1. Measurement of water relations in plants
2. Determination of plant metabolites
3. Effect of growth regulators on plant physiology
4. Effect of environmental stresses on plant physiology

TEACHING METHODS

The methodology to be followed will be a combination of three teaching modalities: master classes, seminars and laboratory practices. The master class will be used to transmit theoretical knowledge and fundamentals to a large group of students. A panoramic view of the subject will be presented, to then deepen the most theoretical aspects of the subject. Through seminars, fluid interaction between the teacher and a small group of students is facilitated. This teching modality will be used to solve problems and present simple theoretical topics. Through laboratory practices the student performs tests, experiences and practices measurements in a reduced groups, using different infrastructures in the laboratory.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	40	5		15					
Horas de Actividad No Presencial del Alumno/a	60	7,5		22,5					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 65%
- Exercises, cases or problem sets 20%
- Oral presentation of assigned tasks, Reading¿ 15%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Qualifications will be weighted, according to the various methodological sections. The student must obtain for each of the parts of the subject, a minimum score of 5 points out of 10. The marks of the practical activities will be kept during the entire course.

- Assessment of theoretical knowledge acquired (master classes, seminars), through theoretical examination (65%)
- Assessment of acquired skills, by presenting the report of practices. An evaluation may also be carried out by means of a theoretical and practical laboratory examination (20%)
- Assessment of the critical capacity, of analysis, in the oral presentation as in the preparation of seminars (15%).

During the development of the evaluation tests, the use of books, notes, as well as mobile phone, computer, or other electronic devices by students are prohibited. Only scientific calculator is allowed. In the case of any dishonest or fraudulent practice, the protocol on academic ethics and the prevention of dishonest or fraudulent practices will be applied in the evaluation tests and in the academic work at the UPV / EHU.

Students have the posibility to renounce the system of continuous evaluation and opt for the final evaluation, regardless of whether or not they have participated in the continuous evaluation. To do this, the waiver of the continuous evaluation must be submitted in written within 9 weeks from the beginning of the four-month period. In any case, the evaluation and resignation criteria will always be adjusted to what is contemplated in the Regulatory Regulations for the Assessment of Students of Degree Degrees (BOPV No. 50, March 13, 2017).

For students, subjected to both continuous and final evaluation, "no presentation" by the student to the final test, the final grade of the subject is "not presented".

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The qualification obtained in the ordinary evaluation in the practices and seminars will be kept fo the extraordinary call.

During the development of the evaluation tests, the use of books, notes, as well as mobile phone, computer, or other electronic devices by students are prohibited. Only scientific calculator is allowed. In the case of any dishonest or fraudulent practice, the protocol on academic ethics and the prevention of dishonest or fraudulent practices will be applied in the evaluation tests and in the academic work at the UPV / EHU.

- Assessment of theoretical knowledge acquired (master classes, seminars), through theoretical examination (65%).
- Assessment of acquired skills, by presenting the report of practices. An evaluation may also be carried out by means of a theoretical and practical laboratory examination (20%).
- Assessment of the critical capacity, of analysis, in the oral presentation as in the preparation of seminars (15%).

For students, subjected to both continuous and final evaluation, "no presentation" by the student to the final test, the final grade of the subject is "not presented".

MANDATORY MATERIALS

Teaching material with graphs, tables, drawings, diagrams and illustrations on the subject porvided by the teaching team. Protocols of laboratory practices. This material is prepared by the teacher and is made available to the student.

BIBLIOGRAPHY

Basic bibliography

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Thomas B, Murohy Dj., Murray BG. Encyclopedia of applied plant sciences, 2nd Edition. 2017. Elsevier

Detailed bibliography

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Brukhin V, Morozova N. 2011. Plant Growth and Development. Basic Knowledge and Current Views. Mathemathical Modelling and Natural Phenomena 6: 1-53

Christie JM, Blackwood L, Petersen J, Sullivan S. 2015. Plant Flavoprotein Photoreceptors. Plant and Cell Physiology 56:401211;413

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Fukushima K, Hasebe M. 2014. Adaxial-Abaxial polarity: the developmental basis of leaf shape diversity. Genesis 52:1-18.

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Nelissen H, Gonzalez N, Inze D. 2016. Leaf growth in dicots and monocots: so different yet so alike. Current Opinion in Plant Biology 33:72-76.

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Journals

Annual Review of Plant Biology
BMC Biotechnology
Critical Reviews in Plant Sciences
Current Opinion in Plant Biology (Reviews)
Environmental and Experimental Botany
Frontiers in plant Sciences (Reviews)
Journal of Experimental Botany
Journal of Plant Physiology
New Phytologist
Physiologia Plantarum
Plant and Soil
Plant Biotechnological Journal
Plant Cell
Plant Cell and Environment
Plant Physiology
Plant Science
Planta
Trends in Plant Sciences (Reviews)

Web sites of interest

https://www.sciencedirect.com/referencework/9780123948083/encyclopedia-of-applied-plant-sciences. Thomas B,Murohy Dj., Murray BG. Encyclopedia of applied plant sciences, 2nd Edition. 2017. Elsevier

https://plantcellbiology.masters.grkraj.org/html/Plant_Growth_And_Development13-Physiology_Of_Plant_Movements.htm http://www.plantcell.org/content/teaching-tools-plant-biology

http://ocw.uniovi.es/course/view.php?id=124§ion=4

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOTE30 - Bachelor`s Degree in Biotechnology	**Year**	Third year

COURSE

26681 - Mathematical Modelling	**Credits, ECTS:**	6

COURSE DESCRIPTION

The overall aim of the course is to encourage reflection on mathematical modelling, on the current uses and applications of mathematics and to create mathematical models. In the subject, mathematical models of physics and biology will be studied, together with applications of mathematics in the present-day information and image society. The subject will also have a practical side. Various situations will be proposed that need to be translated into mathematical language, which will then be modelled and resolved to obtain a solution. It therefore combines questions of a general nature on mathematical modelling with the study of operational models, through the construction and analysis of models. Emphasis will be placed on the fact that models are justified by their adaptation to the experimental data of the phenomenon they are describing, or due to practical validity in terms of the need that they set out to satisfy.

Particular importance will also be paid to the historical aspects of the formulation of the different mathematical models.

In the subject, mathematical models applied to problems are presented, whose solutions or approximations can be found using specially studied techniques in the subjects Numerical Methods I and II, Differential Equations, Codes and Cryptography, Extension of Numerical Methods and Mathematical Programming.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

MC07CM01 - Acquire a vision on the capacity and power of mathematics to solve practical problems, and of its applications in a wide variety of areas.
M07CM02 - Develop the ability to find solutions, take decisions and propose operational methods to other sciences or engineering disciplines.
M07CM03 - Foster the ability to use mathematics. Mathematics are also a tool that students need to learn how to use.
- Learn about interactions between different parts of mathematics towards achieving a common objective.
- Know real situations, practical problems and their mathematical modeling.
- Learn about modeling models, including their origin and their own history.
- Gain experience in decision-making when approaching a practical situation and accepting the model.

Theoretical and Practical Contents

1. INTRODUCTION TO MATHEMATICAL MODELLING.
2. MATHEMATICS IN THE PRESENT-DAY SOCIETY OF INFORMATION AND IMAGES.
Google Mathematics. Image compression. Digitalisation. Corrective codes. Secure data. Digital signature.
3. MODELS IN BIOLOGY.
Growth models in a population. Interaction models between species. Health-based models.
4. MODELS IN PHYSICS.
Deformation of a continuous medium. Conservation laws. Introduction to fluid mechanics.
5. PRACTICAL WORK.

Practical work is done with computers, implementing and applying the algorithms studied and described in the theoretical part of the subject.

TEACHING METHODS

The theoretical content will be explained in lectures, following basic references that appear in the Bibliography and material of compulsory use. Lectures are complemented with problem-solving classes (practical sessions) in which students will be asked to solve questions where the knowledge acquired in the theoretical classes will be applied.

Representative questions and examples of the subject content will be worked on seminars. These will usually be notified in advance so that the students can work on them with a view to later reflection and discussion in a dedicated session. Practical work with computers aimed at acquiring skills in the subject will also be done.

Students will do individual work on theory and problems in periodic seminars with the support of the professor.

An important part of the student's work is of an individual nature. The professors will provide guidance for this work and will encourage students to do it with regularity and enthusiasm. Students are also encouraged to make use of one-to-one tutorials to clarify any doubt of difficulty they may encounters in the subjects.

TYPES OF TEACHING

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

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Ikusi orientazioak. 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CRITERIA FOR CONTINUOUS ASSESSMENT
Written exam: 65%
Preparation, drawing up and presentation of individual work: 20%
Handing in of exercises and active participation in the different sessions: 15%
To pass the subject, the student needs to obtain a mark of 4 out of 10 in the final written exam.

CRITERIA FOR FINAL ASSESSMENT
A student who does not wish to participate in continuous assessment may officially withdraw from it in writing to the professor responsible for his/her subject, within 15 weeks of the start of the term. As well as taking the exam, a student who chooses the final evaluation modality will have to take a complementary test during the official exam period, designed for the overall assessment of the activities carried out during the year. This test may consist of an oral presentation, a computer-based demonstration or a written description of the practical knowledge acquired in the activities carried out during the year. To pass the complementary test it will be necessary to obtain at least 5 out of 10.

WITHDRAWAL:
A student who has completed the activities during the academic year but who does not present him/herself for the ordinary call will be graded as "not presented".

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation criteria will be the same as the final evaluation ones in the ordinary call.

WITHDRAWAL:

The students who have carried out the activities throughout the course or, where appropriate, have passed the complementary test, but do not attend the final test of the subject, will be graded as "Not presented."

MANDATORY MATERIALS

- The teachers will upload useful material in the eGela virtual classroom.
- Information obtained from Internet.
- Scientific software as Mathematica.

BIBLIOGRAPHY

Basic bibliography

M. BRAUN: Differential Equations and Their Applications: An Introduction to Applied Mathematics, fourth edition, Springer, 1992.
L. EDELSTEIN-KESHET: Mathematical Models in Biology, SIAM, 2005.
R. HABERMAN: Mathematical Models: Mechanical Vibrations, Population Dynamics, and Traffic Flow, SIAM, 1998.
P.C. HANSEN, J.G. NAGY Y D.P O LEARY: Deblurring Images: Matrices, Spectra, and Filtering, SIAM, 2006.
E. KALNAY: Atmospheric Modelling, Data Assimilation and Predictability, Cambridge University Press, 2004.
O. PAPINI Y J WOLFMAN: Algèbre discréte et codes correcteurs, Springer, 1995.

Detailed bibliography

Journals

Web sites of interest

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOTE30 - Bachelor`s Degree in Biotechnology	**Year**	First year

COURSE

26710 - Biochemistry I	**Credits, ECTS:**	6

COURSE DESCRIPTION

In Biochemistry I, students will acquire basic knowledge of the molecular structures and functions making up living organisms. They will also develop essential laboratory skills to conduct simple biochemical experiments, and learn how to accurately describe, analyze, and critically interpret their findings.

Biochemistry I is a critical subject that, along with Biochemistry II, lays the groundwork for many of the subsequent courses in this field. It provides students with a strong foundation in the basic principles of biochemistry, which are essential to understand complex topics in the future.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIES / LEARNING OUTCOMES

Cross-cutting skills:

· Develop the ability for analysis, synthesis and critical reasoning in the application of the scientific method.

· Develop autonomous learning and adaptation to new situations.

· Develop ethical commitment and the ability to participate in social debate.

Specific skills:

· Acquire structural and functional knowledge of the molecules making up living beings, including their basic components and polymeric structures.

· Recognize the structures of different types of biomolecules.

· Understand the fundamentals of enzymatic reactions, including the concepts of catalysis, kinetics, and enzymatic inhibition.

· Apply acquired knowledge to solve qualitative and quantitative problems.

· Develop basic laboratory skills required to conduct simple biochemical experiments.

Theoretical and Practical Contents

Theoretical and practical contents

Syllabus:

Topic 1. Concept of biochemistry. Its historical evolution. Place of Biochemistry among the experimental sciences. Objectives of Biochemistry.

Topic 2. Bioelements and biomolecules. Functional groups and bonds. Three-dimensional structure of biomolecules: isomerism and stereospecificity. Configuration and conformation.

Topic 3. Water as a solvent. Colligative properties. pH and buffers. Buffers of biological interest.

Topic 4. Proteins. Amino acids. The peptide bond. Peptides: structure and properties. Structural levels in proteins. Protein sequencing. Native structure and denaturation. Protein functions. Basic concepts for protein purification. Purity criteria.

Topic 5. Enzymes. Nomenclature and classification. Catalysis: thermodynamic and kinetic aspects. Enzyme kinetics. Michaelis-Menten equation. Graphical determination of Vmax and Km. Units of enzyme activity. Enzyme inhibition and regulation. Concept and types of inhibition. Covalent modifications of enzymes. Allosteric enzymes.

Topic 6. Carbohydrates. Functions and classification. Simple monosaccharides and derivatives. Oligosaccharides. Polysaccharides.

Topic 7. Nucleic acids. Concept and biological interest. Pyrimidine and pyrimidine bases. Nucleosides and nucleotides.

Polynucleotides: primary, secondary and tertiary structure. Nucleic acid sequencing. Free nucleotides with specific functions. Intermediates of cellular chemical energy, cofactors of enzymatic reactions, cellular communication.

Topic 8. RNA. Composition and structure. Types of RNA: heterogeneous nuclear, small nuclear, transfer, ribosomal, messenger, viral. Catalytic RNA.

Topic 9. DNA. Structure and properties. Levels of structuring: A, B and Z helices. DNA as genetic material. Chromatin structure. Optical properties of DNA: fusion and renaturation. DNA hybridization. DNA-RNA hybrids.

Topic 10. Lipids. Functions and classification. Saponifiable and non-saponifiable lipids.

Topic 11. Biological membranes. Lipid bilayers. Composition, structure and properties. Membrane proteins. Dynamics of components. Liposomes.

The theoretical content described above will be applied to solve exercises and problems in class, as well as in laboratory sessions. During these laboratory sessions, students will have the opportunity to apply the knowledge they have acquired and develop their practical skills in a supervised setting.

1st session. Learning the use of automatic pipettes, pH measurement and preparation of buffer solutions.

2nd session. Quantification of sugars and use of a sucrose standard curve.

3rd session. Quantification of sucrose in breakfast cereals.

4th session. Separation of macromolecules by Gel Filtration Chromatography.

TEACHING METHODS

Topics 1 to 11 outlined in the syllabus will be explained in detail during lectures (M).

In classroom practices (GA), students will solve qualitative and quantitative exercises and problems related to the concepts covered in the lectures. In seminars (S), students will work on solving a simple biochemical question using the techniques they have learned.

In the laboratory sessions, students will carry out the four practical activities described above. Attendance to the practical sessions is mandatory.

In computer practical session, students will use the Jmol program to visualize biomolecules, including their isomerism and their structural and functional variability.

The theoretical content described above will be applied to solve exercises and problems in class, as well as in laboratory sessions. During these laboratory sessions, students will have the opportunity to apply the knowledge they have acquired and develop their practical skills in a supervised setting.

1st session. Learning the use of automatic pipettes, pH measurement and preparation of buffer solutions.

2nd session. Quantification of sugars and use of a sucrose standard curve.

3rd session. Quantification of sucrose in breakfast cereals.

4th session. Separation of macromolecules by Gel Filtration Chromatography.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	37	2	6	12	3				
Horas de Actividad No Presencial del Alumno/a	55,5	3	9	18	4,5				

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Exercises, cases or problem sets 35%
- Teamwork assignments (problem solving, Project design) 5%
- praktiken azterketa (garatu beharreko galderak eta ariketak) 60%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EVALUATION SYSTEM

Final evaluation system

QUALIFICATION TOOLS AND PERCENTAGES

· Practical sessions (exercises, problems…) 35%

· Teamwork (problem solving, Project design) 5%

· Written exam (multiple choice questions + short questions) 60%

ORDINARY ASSESSMENT SESSION: GUIDELINES AND OPTING OUTANCE

The assessment of the Biochemistry I course is divided into three sections:

a) 60% Written exam (multiple-choice questions and short questions).

b) 35% Laboratory, classroom and computer practical sessions (20% GL+10% GA+5% GO).

c) 5% Teamwork (problem solving, project design, etc).

The criteria for assessing the sections are as follows:

· Appropriateness of the answers, integration of information, approach to and development of the problem exercise, correct use of units of measurement, and clarity and precision of language.

· Adequate execution of the experimental protocol, analysis and interpretation of

results, and effective presentation of findings.

· Correct approach and execution of exercises, as well as thorough completion and presentation of assigned tasks.

The final grade for the course will be calculated by adding the partial grades of each assessed section. To pass the course and to have your overall grade calculated, you must obtain a minimum percentage of the maximum grade in each of the following sections:

a) Written test: 50%.

b) Laboratory practice test: 40%.

c) Classroom practice test: 30%.

Attendance to laboratory session is mandatory.

Waiving: Failing to take the final exam is sufficient to waive the final grade.

Not taking the final exam is enough to receive a grade of "not presented" for the course.

The use of books, notes, phones, electronic devices, computers, or other equipment is not allowed during assessment tests (except for a calculator*). If any academic dishonesty or fraudulent practices are detected, the protocol on academic ethics and prevention of such practices at UPV/EHU will be enforced.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY ASSESSMENT SESSION: GUIDELINES AND OPTING OUT

The final grade will be calculated by adding the grades obtained in the following sections:

a) Written exam (multiple-choice test and short questions) (70%)

b) Laboratory sessions (20%)

c) Classroom practical sessions (10%)

The grades of the sections passed will be kept for the extraordinary assessment session of that school year (until July) if the subject is failed in the ordinary call. Neither the computer practices nor the seminars will be assessed in the extraordinary session; however, if these sections are passed in the ordinary session, those grades will be maintained for the extraordinary session and the corresponding percentage will be deducted from the written test.

The final grade of the course will be obtained by adding the grades of each assessed section. In order to pass the subject, and averaged with the other sections of the subject, the minimum percentage over the maximum grade must be obtained in the following sections:

a) Written test: 50%.

b) Laboratory practice test: 40%.

c) Classroom practice test: 30%.

Attendance of laboratory sessions is mandatory. Students that do not attend those laboratory sessions during the ordinary session, will not have another chance to do so during the extraordinary session.

Not taking the written test will be qualified as "not presented" in the final grade for the course.

The use of books, notes, phones, electronic devices, computers, or other equipment is not allowed during assessement tests (except for a calculator*). If any academic dishonesty or fraudulent practices are detected, the protocol on academic ethics and prevention of such practices at UPV/EHU will be enforced.

MANDATORY MATERIALS

MATERIALS REQUIRED

The eGela webpage (http://egela.ehu.eus) will be used to publish the course guide and information about the activities performed in the laboratory, computer room and classroom.

Before entering the laboratory, students must carefully read the protocol for the corresponding session. This protocol will be uploaded to eGela.

BIBLIOGRAPHY

Basic bibliography

RECOMMENDED READINGS

Basic bibliography

Lehninger Principles of Biochemistry, (2012) 6th Edition, Nelson D.L. & Cox. M. M., Freeman and Company, New York.

Bioquímica (2013) (6ª ed) Stryer L., Berg J. M. & Tymoczko J. L., Editorial Reverte, Barcelona.

Bioquímica curso básico (2014) Tymoczko J. L. , Berg J. M., Stryer L., Editorial Reverte, Barcelona

BIOQUÍMICA Las bases moleculares de la vida (2009) 4 Ed., McKee T. & McKee. J.R., McGraw Hill Interamericana Editores, México.

Detailed bibliography

In-depth bibliography

Molecular Biology of the Cell (2008) (5th ed) Alberts A., Johnson A., Lewis J., Raff M., Roberts K. & Walter P., Garland Science, New York.

Fundamentals of Biochemistry (2006) 2nd ed., Voet D., Voet J.G. & Pratt CW., John Wiley & Sons, New York.

Bioquímica (2002) 3ª edición, Mathews, C.K. & van Holde, K.E., McGraw Hill Interamericana, Madrid.

Journals

Journals

· Nature

· Science

· Investigación y Ciencia

Web sites of interest

http://www.biology.arizona.edu/default.html
http://wwwbioq.unizar.es/
http://www.zientzia.net
http://www.ehu.es/biomoleculas
http://www1.euskadi.net/euskalterm/indice

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOTE30 - Bachelor`s Degree in Biotechnology	**Year**	Second year

COURSE

26714 - Genetics	**Credits, ECTS:**	6

COURSE DESCRIPTION

The subject of Genetics is the first one related to the study of the transmission of biological characteristics in the Degrees of Biology, Biochemistry and Molecular Biology, and Biotechnology. For this reason, in this subject the basic contents of genetic inheritance are presented: the types of hereditary transmission, as well as the analysis of methodologies that are applied in the different types of organisms.
The course focuses mainly on the genetic analysis of eukaryotic organisms, where the fundamentals of Mendelian inheritance and other more complex situations that alter the genotype/phenotype relationship are analyzed. The effects caused by changes in the gene sequence and in the structure and number of chromosomes, the bases of genetic improvement in animals and plants, and general aspects of Population Genetics are also considered. Less exhaustively, the mechanisms of transfer of genetic information in bacteria and viruses, and their evolutionary and health effects, are evaluated. Procedures for the resolution of practical cases are also worked on, using examples of heritable characters, real or fictitious, in different species of eukaryotes, including the human species. The subject uses various training resources worked in teams, which facilitate autonomous learning, stimulate interest in the subject, promote individual responsibility in cooperative work, develop verbal and written communication skills, and encourage critical thinking and reasoning.
Previous knowledge in Genetics is not required, but it is advisable to have studied Biology in High School and have a basic knowledge of some subjects of the 1st year of the degrees in Biosciences (subjects such as Cellular Biology and Biochemistry), and the calculation of probabilities worked in Biostatistics, as well as in High School Mathematics. Given its basic nature, the contents of this subject are essential to advance in the compulsory and/or optional subjects in the Genetics area and in subjects from other related areas that participate in the Biosciences Degrees, such as Molecular Biology, Cellular Biology, Anthropology or Microbiology.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

When students finish this subject:
1. They understand the basic principles of inheritance and apply them for the correct resolution of simple cases of transmission of characters.
2. They know the influence that the existence of physically linked genes has on heredity, the effect of multiple genes involved in the same character and the environment on phenotypic expression, and are able to recognize and reasonably interpret biological characters that show forms of complex transmission.
3. They understand the molecular mechanisms involved in genetic and epigenetic changes and recognize their effects on phenotypic expression.
4. They identify factors that influence the inheritance of quantitative traits and the evolution of populations, and are able to predict in a basic way what will happen to traits subjected to selective forces or other evolutionary factors.
5. They cooperatively solve simple cases of genetic counseling using specialized databases.
6. They plan, design, and carry out simple research projects as a team, which they later present in the form of a scientific article.
7. They develop skills for safe work in the laboratory and for the correct handling of chemical compounds and biological agents, and of the chemical and biological residues that are generated.
8. They critically develop valid conclusions (reasoned and justified) through efficient and comprehensive management of the information acquired.

Theoretical and Practical Contents

THEORIA
INTRODUCTION
1.- History of Genetics. Definition of Genetics. Parts of Genetics. Basic concepts.
CELL DIVISION, MENDELISM AND THE CHROMOSOME THEORY OF INHERITANCE
2.- Topography of chromosomes and Cell Division. Mitosis and cell cycle. Meiosis and sexual reproduction.
3.- Basic principles of the inheritance of a single gene. Mendelian inheritance. Mendel's experimental method. Monohybrid cross: principle of equivalent allelic segregation. Dominance and recessiveness. The test cross and its importance. Probability and genetic events. Pedigree analysis.
4.- Basic principles of the inheritance of several independent genes. Principle of independent segregation. Dihybrid and polyhybrid cross. The test cross with several genes. Evaluation of genetic data: Chi-square analysis. Chromosomal theory of heredity.
MODIFICATIONS TO MENDELISM: EFFECT OF THE LOCATION OF THE GENE IN THE CHROMOSOME
5.- Genes located in sexual chromosomes: Linkage to sex. Pedigree analysis. Gene determination and sexual

differentiation. Other situations: genes located in mitochondria and chloroplasts.
6.- The inheritance of linked genes. Complete or partial linkage of genes located on the same chromosome. Meiotic recombination and genetic mapping. Three point mapping. Interference and coincidence coefficient.
MODIFICATIONS TO MENDELISM: INTERACTION AND VARIATION IN PHENOTYPIC EXPRESSION 7.- Allelic and gene interaction. Allelic interaction: complete dominance, partial dominance and codominance. Multiple alleles and lethal alleles. Pleiotropy. Gene interaction: epistasis, new phenotypes, other modifications. Complementation analysis.
8.- Variation of the phenotypic expression. Penetrance and expressiveness. Influence of the genetic background and influence of the environment. Epigenetics: Imprinting, X chromosome inactivation. Influenced and sex-limited inheritance.
9.- Quantitative Genetics. Polygenic inheritance. Statistical methods for the analysis of quantitative characteristics. Heritability and estimation methods.
CHROMOSOMAL ALTERATIONS IN EUKARYOTES
10.- Changes in the structure of chromosomes. Mechanisms and types. (a) Deletions (b) Duplications (c) Pericentric and paracentric inversions (d) Translocations
11.- Changes in the number of chromosomes. (a) Euploidy: monoploid, diploid, polyploid. Autopolyploidy and allopolyploidy. (b) Aneuploidy: nullisomies, monosomies and trisomies. (c) Somatic aneuploidies: mosaicism vs. chimerism.
POPULATION GENETICS
12.- Population Genetics. Allelic and genotypic frequencies. Hardy - Weinberg equilibrium. Balance test. Non-random crosses: consanguinity. Processes that change gene frequencies. Mutation. Migration. Genetic drift: founder effect and bottlenecks. Natural selection, fitness and alteration of allelic frequencies.
GENETIC ANALYSIS IN BACTERIA
13.-Recombination in Bacteria. Gene transfer mechanisms: (a) Conjugation: F+ and Hfr strains. F' factors and sexduction. (b) Transformation: phases. (c) Generalized and specialized transduction. Genetic maps in bacteria. Recombination in bacteriophages and genetic maps in viruses.
PROGRAMMING OF LABORATORY PRACTICES (P) AND SEMINARS (S)
P1- Observation and analysis of the human karyotype
S1- A practical case of genetic counseling
P2- Identification of mutants in Drosophila
S2- Experimental design in Drosophila to determine the inheritance of two phenotypic characters
P3- Directed crosses in Drosophila and phenotypic analysis of the offspring

TEACHING METHODS

The subject uses four face-to-face teaching modalities (master classes, classroom practices, laboratory practices and seminars) in which various activities are performed.
- In the master classes, fundamental theoretical concepts of Genetics are worked on and their application to the resolution of practical cases of transmission of characters with qualitative and quantitative variation, and their application to problem solving.
- In seminar classes, laboratory practices and classroom practices, the student is introduced to the bases of genetic counseling and the principles of experimentation (hypothesis development, experimental design, execution of the experiment, analysis of results, discussion and conclusions and preparation of scientific articles). These activities are carried out in groups of four people whose composition is maintained for the entire course.
The teaching team is fully coordinated in terms of the types of activities that are performed and the schedules of the different activities, both between groups of the same subject and between subjects of the same course.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	35	5	5	15					
Horas de Actividad No Presencial del Alumno/a	55	15	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 methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 20%
- Multiple choice test 20%
- Exercises, cases or problem sets 20%
- Teamwork assignments (problem solving, Project design) 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The continuous evaluation system includes the evaluation of training activities carried out in teams and a final individual test in the form of an exam.
1) The written tests worked in teams include the resolution of theoretical and practical problems and the preparation of reports related to the laboratory and seminar sessions (40% of the overall grade). The evaluation of each member of the team will be individualized based on the level of commitment and personal involvement. To pass the subject, a minimum participation in team activities of 80% and a minimum mark of 5 are required.
2) The final written test, whose evaluation constitutes 60% of the overall mark for the subject, consists of test questions, short questions and two problems. To pass the subject, a minimum of 4 (out of 10) is required in each of the sections.
Students under continuous evaluation can refuse exam call at any time until a month before the ending of the classes. However, it is recommended to declare the intention to renounce continuous evaluation before the end of the third week of teaching period.
During the development of the final test, the use of books, notes, as well as telephone, electronic, computer or other devices, by students will be prohibited. Only calculator is allowed. In case of dishonest or fraudulent practice, the protocol of UPV/EHU with regard to academic ethics and prevention of dishonest or fraudulent practices will be applied.
For all students (regardless of whether they take a continuous or final assessment), it will be enough not to attend the final test to be <<Not Presented>>.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary call, the evaluation system will be similar to that followed in the ordinary call. The positive results of the continuous assessment obtained by the students during the course are saved. In case of negative results in the continuous evaluation, the final evaluation test will constitute 100% of the mark for the subject. During the development of the final test, the use of books, notes, as well as telephone, electronic, computer or other devices by students will be prohibited. Only calculator is allowed. Only calculator is allowed. In case of dishonest or fraudulent practice, the protocol of UPV/EHU with regard to academic ethics and prevention of dishonest or fraudulent practices will be applied.
For all students (regardless of whether they take a continuous or final assessment), it will be enough not to attend the final test to be <<Not Presented>>.

MANDATORY MATERIALS

Teachers will provide students with the following material:
THEORY SCHEMES AND FIGURES COLLECTION to facilitate the monitoring of classes on theoretical content.
COLLECTION OF PROBLEMS: this collection will be the basic material for learning how to solve cases. It will be used during master classes and must be used by the student as material for personal work.
LABORATORY PRACTICE PROTOCOL: including the objectives of each activity, its technical development and some questions that each student must answer during or after completion of the corresponding practice. It is mandatory to read the protocol before carrying out the corresponding practice.
PROTOCOL FOR THE SEMINARS: the objectives of each activity and the necessary documentation are included.
All this documentation will be available to the students in the virtual classroom of the subject, sufficiently in advance.

BIBLIOGRAPHY

Basic bibliography

.- BROOKER RJ (2017) Genetics. Analysis & Principles. 6/e. McGraw Hill (978-1259921650)
.- GRIFFITHS AJF, WESSLER SR, CARROLL SB, DOEBLEY J (2015) An introduction to genetic analysis. 11/e. FREEMAN AND CO (978-1429229432)
.- HARTL DL, JONES EW (2017) Genetics. Analysis of Genes and Genomes. Jones and Bartlett Publishers 9/e. (978-1449635962)
.- HARTWELL L, GOLDBERG L, FISCHER JA, HOOD L, AQUADRO CF (2017) Genetics. From Genes to Genomes. 6nd edition. McGraw-Hill (978-0073525310)
.- KLUG WS, CUMMNINGS MR, SPENCER CA, PALLADINO MA. KILLIAN D (2019) Concepts of Genetics (978-1292265322)
.- PIERCE BA (2020) Genetics: A Conceptual Approach. Freeman & Company. 7/e
.- PIERCE BA (2021) Genetics Essentials. Concept and Connections. 5/e. MacMillan 9781319383367

Detailed bibliography

.- CONKITE, D. (2008) A problem-based guide to Basic Genetics. Ed. Thomson.

Journals

Nature Review Genetics
Nature
Science

Web sites of interest

https://ocw.ehu.eus/course/view.php?id=397
https://www.ucm.es/genetica1/apuntes-de-genetica
www.segenetica.es/docencia.php
www.ncbi.nlm.nih.gov/sites/entrez?db=omim
www.biologia.arizona.edu/mendel/mendel.html
www.genome.gov/sglossary.cfm
teknopolis.elhuyar.org/
www.zientzia.eus/

OBSERVATIONS

https://ocw.ehu.eus/course/view.php?id=397
https://www.ucm.es/genetica1/apuntes-de-genetica
www.segenetica.es/docencia.php
www.ncbi.nlm.nih.gov/sites/entrez?db=omim
www.biologia.arizona.edu/mendel/mendel.html
www.genome.gov/sglossary.cfm
teknopolis.elhuyar.org/
www.zientzia.eus/

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GBIOTE30 - Bachelor`s Degree in Biotechnology	Year	First year

COURSE		
26721 - Basic Biochemical Methodology	Credits, ECTS:	9

COURSE DESCRIPTION

The subject "Basic Biochemical Methodology" is mainly a practical subject. In Basic Biochemical Methodology, students will acquire basic knowledge about the techniques commonly used in biochemistry laboratories. The knowledge acquired in this subject is of vital importance for the subsequent academic and professional development.
The use of scientific literature, experimental design, laboratory safety, and ethics will be covered during the first semester. During the second semester, the teaching activities are focused on acquiring sufficient knowledge and skills for the proper performance of the laboratory practices that will take place throughout the degree program. The various teaching activities in this semester of "Basic Biochemical Methodology" are closely aligned with the subject "Instrumental Techniques" offered in the second year. In "Instrumental Techniques," students will delve deeper into the concepts previously learned in "Basic Biochemical Methodology," specifically regarding chromatography, electrophoresis, and protein purification.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The general objective of this subject is to provide training that will enable students to work in the future in research centres, biotechnological industries, or educational institutions. To this end, the specific (M) and transversal (G) competencies and their learning outcomes (LO) detailed below will be addressed:

Specific Competencies

M04.1 - Understand the principles, instrumentation, and applications of the main techniques of Biochemistry and Molecular Biology and their usefulness in Biotechnology.

RA1 - The student will be able to explain the knowledge related to the separation and analysis of biomolecules.
RA2 - The student will be able to design and interpret experimental protocols to solve specific biochemical problems.

M04.2 – Execute properly laboratory protocols in Biotechnology and in Biochemistry and Molecular Biology.

RA3 - The student will be able to use skillfully basic instrumentation and the most commonly used experimental methods in biochemistry.
RA4 - The student will be able to explain and implement good laboratory practices.
RA5 - The student will be able to solve theoretical-practical exercises to obtain precise quantitative data.

M04.7 – Extract and analyse information from bibliographic sources, biological databases, and other bioinformatics tools.

RA6 - The student will be able to manage the scientific-technical literature in their field and apply it to the acquired knowledge.

Transversal Competencies

G001 - Acquire adequate capacity for analysis, synthesis, and critical reasoning in the application of the scientific method.

RA7 - The student will be able to describe, quantify, analyze, and critically evaluate the experimental results obtained and draw conclusions from them.

G002 - Develop continuous autonomous learning, fostering initiative and adaptation to new situations.

RA8 - The student will be able to manage the decisions they make, the knowledge they apply, the difficulties they encounter in learning, and how to overcome them.

G003 - Acquire the ability to convey ideas and communicate them to both professional and non-professional audiences, promoting the use of foreign languages, especially English.

RA9 - The student will be able to use structures and norms in specialized written communication for the preparation of academic and/or scientific documents.

RA10 - The student will be able to communicate orally their ideas and arguments in a comprehensible manner and in accordance with established formal criteria.

Theoretical and Practical Contents

Syllabus:

BLOCK 1: Introduction to Experimentation and Information and Communication Technologies

Topic 1: Scientific Articles and Journals. Bibliographic Searches. Data Repositories for Scientific Articles. PubMed. Science Citation Index.

Topic 2: The Scientific Method in Biochemical Research and Ethical Considerations. The Scientific Method in Biochemical Research. Formulating a Hypothesis. Experimental Design. Data Treatment and Evaluation. Drawing Conclusions. Ethical Considerations.

Classroom Practices: How many types of scientific articles can we find? Reading opinion articles about the editorial system and predatory journals. Reviewing basic laboratory calculations (concentrations, dilutions, etc.). Analysing the results of a Bradford experiment (using Excel: inserting a chart, linear regression, etc.). Guidelines and recommendations on writing a scientific paper (bias in writing lab reports, etc.).

Computer Practices: Bibliographic search and bibliometrics.

BLOCK 2: Experimentation in Biochemistry. Cellular Systems and Subcellular Fragmentation

Topic 3: Good Practices in a Biochemistry Laboratory: Identification of Hazards (physical, chemical, biological, and radiological). General and Personal Safety Measures. Safety Regulations. Behaviour in Emergency Situations.

Topic 4: Levels of Experimentation in Biochemistry: Studies with Intact Animals, Isolated Organs, Tissues, or Cells. Molecular Studies (Structural or Functional). Cellular Systems. Techniques for Separating Different Cell Types. Cell Cultures. Cell Quantification and Viability. The Hemocytometer.

Topic 5: Subcellular Fractionation: Methods for Homogenization and Obtaining raw Extract. Preparative Centrifugation (Differential and Density Gradient). Marker Enzymes to Identify Various Cellular Organelles. Organelle Viability. Analytical Centrifugation.

Classroom Practices: Solving exercises and problems related to centrifugation. Designing workflows for conducting experimental sessions.

Laboratory Practices:

Cell Fragmentation and Protein Quantification.
Isolation of Chloroplasts by Sucrose Gradient Centrifugation.
Mitochondria Purification. Determination of Mitochondrial Viability.

BLOCK 3: Basic Techniques Used in the Biochemistry Laboratory

Topic 6: Preparation and Separation Techniques. Chromatography. Electrophoresis Techniques. Agarose Gels, Native Gels, SDS-PAGE. Isoelectric Focusing. Two-Dimensional Electrophoresis. Capillary Electrophoresis. Chromatography. Types of Chromatography. Electrophoretic Techniques: Electrophoresis in Agarose Gels, Gradient Gels, SDS-PAGE, Isoelectric Focusing, Two-Dimensional Electrophoresis, Capillary Electrophoresis.

Topic 7: Analytical Techniques. Spectrophotometry Techniques. Equipment: Visible and Ultraviolet Spectroscopy. Design of Enzymatic Assays. DNA Denaturation and Renaturation. Polymerase Chain Reaction (PCR). RT-PCR. DNA Chips.

Topic 8: General Techniques for Macromolecule Labelling and Their Applications. Radiochemical Techniques. Immunochemical Techniques. Immunoprecipitation. Immunoassays (ELISA, RIA). Identification Techniques. Western Blot, Dot Blot.

Classroom Practices: Simple practical problems on chromatography. Electrophoresis Experiment Simulator: SDS-PAGE. Enzyme Reaction Calculation Problems. Simple practical problems on PCR and qPCR. Simple practical problems on Immunotechniques. Radioactivity Calculation Exercises and Problems. Complex Theoretical-Practical Experimental Exercises. How to Give a Good Oral Presentation Using ICT Resources.

Laboratory Practices:

Gel Filtration Chromatography. Determination of the Molecular Mass of a Protein.
Purification of Lysozyme from Egg White by Ion Exchange Chromatography.

Protein Electrophoresis in Polyacrylamide-SDS Gel.
Nucleic Acid Electrophoresis in Agarose Gel. Characterization of Plasmid DNA.
Seminars:

Seminars. Communication (written and oral) of a Current Scientific Topic Related to the SDGs (Sustainable Development Goals)

TEACHING METHODS

The teaching methodology includes lectures, classroom practices, seminars, computer practices, and laboratory practices:

Lectures: The instructor will present the course content using a digital presentation and links to audiovisual content (available on Egela). Students will be encouraged to ask questions, and the instructor will also pose questions to prompt student reflection and communication. This approach allows for necessary feedback during each lecture.

Classroom Practices: Students will solve scheduled problems and questions. These practices are typically used as supplementary material to the theoretical lectures or laboratory practices.

Computer Practices: Students will apply their knowledge related to bibliographic searches and bibliometric analyses (quality indicators). Additionally, they will attend a seminar on databases and complete practical exercises using information from the lectures.

Laboratory Practices: This methodology is designed for students to acquire the appropriate skills for working in a laboratory. Students will develop manual skills to observe and obtain results, analyze and reflect on them, and communicate their findings through practice reports. Laboratory practices are closely related to the theoretical content of the course, allowing students to apply the knowledge gained in lectures to real experimental work situations.

Seminar Sessions: Students will develop a topic related to Biotechnology or Biochemistry and the Sustainable Development Goals (SDGs) outlined in the EHUagenda. They will communicate their findings both in writing and orally in the format of scientific dissemination.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	40	5	10	30	5				
Horas de Actividad No Presencial del Alumno/a	60	7,5	15	45	7,5				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Oral presentation of assigned tasks, Reading¿ 10%
- In this section, the sum of the percentages corresponding to theory (45%), laboratory practices (30%), computer exercises (5%), and problem-solving exercises (10%) is included. 90%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The assessment of the "Basic Biochemical Methodology" course is divided into five sections:

-Written Exam 45%: Correct answers, expression, argumentation, and use of scientific terminology will be taken into consideration. A minimum of 50% correct answers is required.
-Laboratory Practical Session 30%: Attendance, attitude, and cleanliness; accuracy and clarity of the report/exam will be taken into account, with a requirement to pass at least 50% of the questions.
-Computer Practical Session 5%: Attendance, attitude, and completion of exercises.
-Seminar 10%: Attendance, attitude, organization of information, analytical and synthesis skills, clarity of presentation, and participation in the debate.
-Problem-solving 10%: Attendance, correct resolution of problems posed during classroom exercises; exam, requiring a minimum of 50% correct answers.
In the case of taking partial exams, it will be necessary to obtain a minimum of 50% correct answers to pass the subject.
Attendance to the different teaching modalities throughout the course will be mandatory to be eligible to take the exams in

the regular session. A minimum of 50% correct answers will be required to pass the exam.
Waiving: Failing to take the final exam is sufficient to waive the final grade.
Not taking the final exam is enough to receive a grade of "not presented" for the course.
The use of books, notes, phones, electronic devices, computers, or other equipment is not allowed during assessment tests (except for a calculator*). If any academic dishonesty or fraudulent practices are detected, the protocol on academic ethics and prevention of such practices at UPV/EHU will be enforced.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The final grade will be calculated by adding the grades obtained in the following sections:
-Written Exam 45%
-Laboratory Practical Session 30%.
-Computer Practical Session 5%.
-Seminar 10%.
-Problem-solving 10%.
Participation in the different teaching modalities throughout the course will be mandatory to be eligible to take the exams in the extraordinary session. A minimum of 50% correct answers will be required to pass the exam.
The grades of the sections passed will be kept for the extraordinary assessment session of that school year if the subject is failed in the ordinary call.
Not taking the written test will be qualified as "not presented" in the final grade for the course.

MANDATORY MATERIALS

The eGela webpage (http://egela.ehu.eus) will be used to publish the course guide and information about the activities performed in the laboratory, computer room and classroom.
Before entering the laboratory, students must carefully read the protocol for the corresponding session. This protocol will be uploaded to eGela.

BIBLIOGRAPHY

Basic bibliography

- Wilson, K. and Walker, J. (eds.)(2018). Principles and Techniques of Biochemistry and Molecular Biology. 8th edn. Cambridge University Press.
- Lesk, A."Introduction to Protein Science: Architecture, Function, and Genomics". Oxford University Press, 2017.
- Roca, P. y cols. (2003). Bioquímica. Técnicas y Métodos. Editorial Hélice
- Freifelder, D. (2003). Técnicas de Bioquímica y Biología Molecular. Editorial Reverté.
- García-Segura, J.M. y cols. (2002). Técnicas instrumentales de análisis en Bioquímica. Editorial Síntesis

Detailed bibliography

- Boyer, R. F. (2009). Biochemistry laboratory: modern theories and techniques. Pearson Education.
- Serdyuk, I.N., Zaccai, N. Zaccai, J. Methods in molecular biophysics Ed. Cambridge University Press, 2007.

Journals

The journal of biological chemistry, Crc critical reviews in biochemistry, European journal of biochemistry/febs, Journal of biochemical and biophysical methods, Bioscience, biotechnology, and biochemistry, Progress in biochemical pharmacology, Archives of biochemistry and biophysics, European journal of medicinal chemistry, Clinical physiology and biochemistry, J capillary electrophor, , Appl theor electrophor, J. of chromatography, Analytica chimica acta.

Web sites of interest

http://ocw.mit.edu/OcwWeb/web/home/home/index.htm
http://www.sciencedirect.com/science/journal/00219673
http://workbench.concord.org/database/
http://www.springerprotocols.com/Abstract/doi/10.1007/978-1-59745-376-9_6
http://www.ncbi.nlm.nih.gov/pubmed
https://apps.webofknowledge.com/

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOTE30 - Bachelor`s Degree in Biotechnology	**Year**	Fourth year

COURSE

26731 - Nanobiotechnology	**Credits, ECTS:**	4,5

COURSE DESCRIPTION

DESCRIPTION AND CONTEXTUALIZATION OF THE SUBJECT

As it is a new area of a multidisciplinary nature, this subject is related to other general (and prior) subject of the Undergraduate Degree Course in Chemistry and Physics and some from Biology (Genetics, Cellular Biology). Knowledge will be acquired on an area that is considered a priority and with great future potential, both in terms of development and for its economic potential. This knowledge can be applied to, among others, the academic, hospital, pharmaceutical and food sectors.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIES / LEARNING OUTCOMES OF THE SUBJECT

General and cross-cutting skills:
Learn the basis of the experimental strategies used in biochemical research.
List the molecular knowledge acquired with possible biomedical applications.
Interpret and evaluate the scientific literature on the area.
Transmit ideas and communicate them to a professional and non-professional audience, fostering the use of foreign languages, particularly English.

Specific competencies/Learning outcomes
The ability to recognize technological advances and current problems in the mastery of nanotechnology as a multidisciplinary science.
The ability to apply microscope techniques to characterization on a nanoscale.
The ability to handle the basic tools of nanomanufacturing and nanomanipulation.
Obtain a general vision of the applications of nanotechnology in the fields of cellular and molecular biology and biomedicine and understand the exceptional advantages that this science offers in comparison with conventional biological study techniques.
Develop basic experimental skills related to the application of nanometric techniques in biotechnology and biomedicine.

Theoretical and Practical Contents

THEORETICAL-PRACTICAL CONTENT

Introduction to nanotechnology. The interface between nanotechnology and biotechnology.
Properties on the nano scale. Need for the nano scale and its characteristics: Nanoelectronics, nanomagnetism and nanophotonics.

Nanotools I: Instrumental techniques for characterization. Microscopes: AFM, electronic, NSOM. Other techniques (SPR....).

Nanotools II: Nanomanufacturing strategies and techniques. Types of nanolithography and Nano modeling. Nanomanipulation.

Nanomaterials and nanoparticles: Based on carbon, of natural original, metallic.
Principles of self-organization of biological macromolecules and their use in nanoengineering. Uses.

Microfluids: Behavior of fluids on the microscale and subjected to fields. Applications. Lab on chip. Nano biosensors.

Applications in Biology: Microstamping of molecules and cells. Artificial intelligence (Deep learning). DNA origami. Sequencing of DNA with nanopores. Use of nanopores for analytical purposes. Cell cultures: Nano matrixes in 2 and 3 dimensions. (Nanofibers).

Applications to Biomedicine Nano systems for diagnosis and treatment. Controlled release of medical drugs. Regenerative nanomedicine. Other medical applications: Implants and surgery.

Economic and social impact. Current legislation. Future prospects and risk assessment.

TEACHING METHODS

METHODOLOGY

In lectures, the contents will be explained, and exercises and problems related to the concepts explained with the worked on. Practical computer classes will consist of sessions in which simulations of the use of complex techniques will be carried out, such as Atomic Force Microscopy (AFM). In the seminars the students will present, individually or in groups, current issues, and in the field visits a nanoscience research center will be visited.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	25	4		6	4				6
Horas de Actividad No Presencial del Alumno/a	35,5	12		12	8				

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Exercises, cases or problem sets 22%
- Individual assignments 12%
- Report about the visit to Nanotechnology centers 6%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

ORDINARY CALL: GUIDANCE AND WITHDRAWAL

The subject will be assessed taking the following factors into account:
1) Taking an exam that may include short, multiple-choice-type questions and problem solving. This part will represent 60% of the final grade.
2) Assessment of classwork and an individual or seminar project. The level of active participation in class discussions will also be taken into account (12%)
3) Assessment of the field visit to research centers in NanoSciences, and report on the visit (6%)
4) Assessment of the work associated with practical computer tasks (10%)
5) Assessment of laboratory practical work (12%).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Extraordinary call: GUIDANCE

If the subject is not approved in the ordinary call, the partial grades of the approved sections will be saved for the extraordinary call of the current year (July). The assessment criteria are the same as in the ordinary call.

MANDATORY MATERIALS

MANDATORY USE MATERIALS

- Egela course available at the beginning of the term
- Additional material (articles, reviews etc) provided on the lectures

BIBLIOGRAPHY

Basic bibliography

- Bionanotechnology.Concepts and Applications. Ljiljana Fruk & Antonina Kerbs.Cambridge University Press, 2021.
- Nanotechnology: An Introduction (2nd edition).Jeremy J. Ramsden.Elsevier, 2016.
- Introduction to BioMEMS. Albert Folch, CRC Press, 2012.
- NANOTECHNOLOG IN BIOLOGY AND MEDICINE: Methods, Devices, and Applications. Tuan Vo-Dinh (ed) CRC 2007
- Biomedical Nanotechnology. N.H.Malsch. Taylor & Francis, 2005.
- Structural DNA Nanotechnology. Nadrian C. Seeman. Cambridge University Press 2016

- Plenty of room for Biology at the bottom: An introduction to Bionanotechnology. E. Gazit. Imperial College Press 2007
- The Science of Nanotechnology: An Introductory Text . L Tilstra y cols. Nova Science Publishers, Inc. New York 2008
- BioNanotechnology. Elisabeth S. Papazoglou, Aravind Parthasarathy. Morgan y Claypol, 2007

Detailed bibliography

- Nanobiotechnology. Concepts, Applications and Perspectives. C.M.Niemeyer y C.A. Mirkin(eds.). Wiley & sons 2004.
- Nanobiotechnology II: More concepts and applications. Chad A. Mirkin and Christof M. Niemeyer eds) Wiley 2007- Nanobiotechnology. Bioinspired devices and materials of the future. O. Shoseyov y I Levy. Humana Press, 2008.
- Nanobiotechnology Protocols. S.J.Rosenthal y D.W.Wright. Humana Press 2005.

Journals

Science, Nature, Nature Nanotechnology, Angew.Chem., Langmuir, Nano Lett., Biophysical Journal, Nanotechnology, ACS Nano, Small...

Web sites of interest

USA National Nanotechnology Initiative. http://www.nano.gov/
European Commision. Nanomedicine Technology Platform. https://etp-nanomedicine.eu/
National Cancer Institute Alliance for Nanotechnolgy in cancer. http://nano.cancer.gov/
blog~nano
Nanoscale Materials and Nanotechnology http://nanoscale-materials-and-nanotechnolog.blogspot.com/search/label/nanomedicine
Nanotechnology Now: http://www.nanotech-now.com/
Responsible Nanotechnology: http://crnano.typepad.com/
Wikipedia -- http://en.wikipedia.org/wiki/Nanotechnology

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOTE30 - Bachelor`s Degree in Biotechnology	**Year**	Fourth year

COURSE

26738 - Risk & Safety Analysis in Industrial Plants	**Credits, ECTS:**	4,5

COURSE DESCRIPTION

All around the world, the chemical industries have to implement Safety Management Systems in order to evaluate the risks of the process and equipment. The students receive training in the methodology of identification, evaluation and minimization of safety risk at work. The students also receive training on chemicals safety, basic biological safety, and management of accident and chemical emergencies.
The subject is structured in three segments:
i)risk evaluation methods,
ii)specific risks of fires and explosions, and spillage of chemical agents and biological agents.
iii)preparation of emergency plans and implementation of Sfaety Management Systems.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCES:

Basic knowledge of the safety aspects of chemical process industries and risk analysis. Both design step and operational step are covered. Detailed competences are as follows:

1. Deployment of Safety Management Systems as per world standard ISO-45001 (supersedes OHSAS-18001).

2. Development the risk evaluation and analysis of chemical processes. Planning and implementation of audits to carry out the risk assessment of the industrial sites and to establish preventive actions as necessary to eliminate or minimize the risk of having an accident.

3. Selection of Personal Protective Equipment (PPE) and collective protection equipment (CPE).

Theoretical and Practical Contents

LESSON-1. INDUSTRIAL SAFETY TECHNIQUES. Concept and definition of industrial safety. Safety techniques. Health conditions at work. Signalling.
LESSON-2. ACCIDENTS IN INDUSTRIAL PLANTS. REAL CASES. Methodology of accident investigation. Statistical indicators of accidents. Notification and file of accidents. Analysis of effects and causes of mayor accidents.
LESSON-3. RISK ANALYSIS OF PROCESSES. Professional risks. Techniques for risk identification. Comparative methods, risk indexes and HAZOP method. Risk of chemical substances.
LESSON-4. INDUSTRIAL SAFETY AT PLANTS: FIRES AND EXPLOSIONS. Flammability. Confined explosions. Unconfined explosions. Storage tanks. Fires in liquids. Fire in dards. BLEVE processes and fire spheres.
LESSON-5. INDUSTRIAL SAFETY AT PLANTS: SPILLAGE OF DANGEROUS SUBSTANCES. Flow of spillage. Evaporation. Dispersion of gases and vapours. Risk in charging / discharging operations.
LESSON-6. HEALTH AT WORK: CHEMICAL, BIOLOGICAL AND PHYSICAL RISKS. Identification of contaminants. Measurement of exposition and assessment. Active and pasive systems. Individual and collective protection systems.
LESSON-7. EMERGENCY PLANS. Selfprotection Handbook. Preparation of emergency plans. Safety inspections. Safety Management Systems under ISO-45001.

TEACHING METHODS

The subject is structured in three segments with three topics in each segment. The whole content covers the risk evaluation and minimization together with the safety measures to avoid risk of fire, explosion and spillage of chemicals. Finally, the content explains the development of emergency plans and the deployment of Safety Management Systems.

The overall goal of the subject include the following objectives:

1. Basic training in the methodology of risk evaluation in industrial sites of chemcial sector.
2. Basic knowledge of the risks coming from fire, explosion and spillage of chemicals, in order to set up the safety measures for different kind of industrial sites.
3. Basic training in the management tools for safety planning, emergency measures and implementation of safety management systems.

In the seminar classes, the student will simulate safety inspections to audit the risk evaluation in industrial sites (chemical sectors and other related industries). The students work in teams to reach the following goals:

- Assesment and scope of the risk evaluation.
- Non-conformities and deviations as per safety concepts.

- Eficacy of training plan, maintenance plan and other issues found as root-causes of the accidents.

TYPES OF TEACHING

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

Legend:

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 50%
- Teamwork assignments (problem solving, Project design) 50%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the ordinary call, the continuous assessment system is done as follows:

- Written exam: 80% (this examination must be done in the place and time as scheduled by the ZTF/FCT. This information is available on the Web).

- Team work and practical cases: 20% (to be done during the seminar classes). The main topics are the risk analysis of cases of accidents in industrial plants, together with related topics on safety issues. The root-causes, the risk factors, the chain of events, the preventive actions and the corrective actions in order to avoid the repetition of the accident.

The resignation of this continuous evaluation system must be submitted in writing to the teacher before the end of the 9th week of the course. The final evaluation system means that the exam has the total percentage (100%) of the mark (qualification).

The student who resigns from the call will have the mark (qualification) of "Not presented". This sentence is applicable to students in both continuous or final evaluation systems.

Given the circumstances that sanitary conditions would prevent from face-to-face evaluation, if any student cannot carry out the assessment in the terms described above due to sanitary conditions, they will have to follow the assessment guidelines issued by the Rectorate at the time of sitting the exam.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary call the mark (qualification) is determined by a single written exam that includes issues to develop and practical cases. The exam must be done in the place and time as scheduled by the ZTF/FCT. This information is available on the Web.
The percentage of the written exam is 100% as per the current Regulation on Evaluation of the Students (Normativa de Evaluación del Alumnado).

It is considered that the student waives the call if not attending the final exam.

Given the circumstances that sanitary conditions would prevent from face-to-face evaluation, if any student cannot carry out the assessment in the terms described above due to sanitary conditions, they will have to follow the assessment guidelines issued by the Rectorate at the time of sitting the exam.

MANDATORY MATERIALS

Slides provided by the teacher during the course.
The files are availbale in the on-line system (E-GELA) of the course.

BIBLIOGRAPHY

Basic bibliography

1. Standard ISO-45001:2018 (Occupational health and safety management systems. Requirements with guidance for use).

2. Bond, J., The Hazards of Life and All That, IOP Publishing (1996).

3. Dirección General de Protección Civil, Guía técnica: Metodología para el análisis de riesgos. I. Visión general. Madrid (1994).

4. Guidelines for Chemical Process Quantitative Risk Analysis, AIChE, New York (1989).

5. Kent, J.A. "Riegel´s Handbook of Industrial Chemistry". Chapman & Hall, New York (1992).

6. Lees, F.P., Loss Prevention in the Process Industries. Butterworth-Heinemann. Londres (1980).

7. Santamaría, J.M., Braña, P.A., Análisis y reducción de riesgos en la industria química, Mapfre, D.L, Madrid (1994).

8. TNO Environment, Energy and Process Innovation, The Yellow Book 2 vol., 820 pag., 3rd edition, Holland (1997).

9. Gómez, G.; Manual para la formación en prevención de riesgos laborales: especialidad de seguridad en el trabajo; Editorial CISS (2003).

10. Haddow, G. D.; Introduction to emergency management; Butterworth Heinemann Ed. (2006).

Detailed bibliography

Legislation (applicable in Spain)
1. REAL DECRETO 948/2005, de 29 de julio, por el que se modifica el Real Decreto 1254/1999, de 16 de julio, por el que se aprueban medidas de control de los riesgos inherentes a los accidentes graves en los que intervengan sustancias peligrosas. BOE núm. 181, de 30 de julio de 2005
2. REAL DECRETO 1254/1999, de 16 de julio, por el que se aprueban las medidas de control de los riesgos inherentes a los accidentes graves en los que intervengan sustancias peligrosas. BOE de 20 de julio de 1999.
3. REAL DECRETO 1196/2003, 19 de septiembre, Directriz Básica de protección civil para el control y planificación ante el riesgo de accidentes graves en los que intervienen sustancias peligrosas. BOE núm. 242 DE 9 DE OCTUBRE.
4. DIRECTIVA CE DEL CONSEJO, 96/82 de 24 de junio de 1982, relativa a los riesgos de accidentes graves en determinadas actividades industriales.
5. DIRECTRIZ BÁSICA para la elaboración y homologación de los planes especiales del sector químico. BOE 06/02/1991.
6. LEY 31/1995, de 8 de noviembre de Prevención de Riesgos Laborales. BOE 269, de 10 de noviembre.

Libros
1. "Perry´s chemical engineer´s handbook", Perry, R.H., y Green, D. W., McGraw-Hill, New York, 1997.
2. "Procedimiento para el Análisis de Riesgos de Operación.- Método HAZOP". Arístides Ramos Antón, COASHIQ,(APA.- revista Prevención, Julio-Septiembre 1987)
3. "Manual de seguridad industrial en plantas químicas y petroleras", Storch de Gracia, J.M., McGraw-Hill., Madrid, 1998.
4. "Análisis de Riesgos en Instalaciones Industriales", Edición UPC.- J. Casal, E. Montiel, E. Planas, J.A. Vilchez.- Septiembre 1999.

Journals

Acción Preventiva
Revista de prevención de riesgos laborales de la CEOE

PREVENCION
Revista técnica de seguridad y salud laboral, ISSN: 0034-8732

Web sites of interest

http://osha.europa.eu
http://www.cdc.gov/niosh
http://www.osalan.net
http://www.insht.es

OBSERVATIONS

This subject covers horizontal training topics that are applicable in early every industrial sector. In particular, is applicable to industries of chemical and biotechnology sector where legal requirements are mandatory concerning risk evaluation and emergency plans.

Academic ethic. During the examinations in classroom (ordinary and/or extraordinary calls) the use of any book, paper, slide or text is strictly forbidden for the students. The use of electronic equipment and/or transmission equipment of any type is also strictly forbidden. In the event of dishonest or fraudulent action done by any student, the protocol of UPV/EHU on academic ethic during exams will be applied.

Universidad del País Vasco Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOTE30 - Bachelor`s Degree in Biotechnology	**Year**	Fourth year

COURSE

26740 - Microbial Biotechnology	**Credits, ECTS:**	4,5

COURSE DESCRIPTION

Description:
The general objective of this subject is to show students the potential of microorganisms as biotechnological tools in the production of food and alcoholic beverages, enzymes, biofuels, antibiotics and other products of interest. The first part of the course aims to enable students to design and plan an industrial-scale production process involving microorganisms. In the second part, the production strategies of specific processes are analysed and the basic knowledge acquired is applied.

In order to satisfactorily take this subject, it is necessary that students have basic knowledge of microbiology that has been acquired in the subject of Microbiology in the first semester of the second year of Biotechnology degree. In addition, it is also advisable to have satisfactorily completed the subject Microbiology and Industrial Production taught in the second semester of the second year of the degree.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

BASIC AND GENERAL COMPETENCES

GENERAL:
G007 – To develop ethical commitment, motivation for quality and the ability to participate in social debate, showing sensitivity towards environmental and social issues.

BASIC:
CB2 - Students know how to apply their knowledge to their work or vocation in a professional manner and possess the competences that are usually demonstrated through the elaboration and defence of arguments and the resolution of problems within their area of study.
CB4 - Students are able to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.
CB5 - Students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

SPECIFIC COMPETENCES
1- To know how to carry out the necessary steps to conduct a production process mediated by microorganisms at different scales of production, from laboratory to industrial scale.
2- To know the biotechnological processes carried out by microorganisms in the different thematic fields, food, health, environment, and their relationship with industry and society.
3- To apply the knowledge to practical production of different biotechnological products.

LEARNING OUTCOMES
1- Students understand the role of the different compounds of growth and production media.
2- Students are able to design a process for the production and recovery of a biotechnological product.
3- Students know the main microorganisms involved in biotechnological processes.
4- Students understand the main biotechnological processes and their possibilities of improvement.

Theoretical and Practical Contents

THEORETICAL PROGRAMME
1. Development of a microbial biotechnology process. Stages of a production process.
2. Design of culture media in industry.
3. Development of inoculum in industrial processes.
4. Sterilisation.
5. Installations and equipment. Types of bioreactors and their operation.
6. Product recovery.
7. Microbial biotechnological processes in the food industry. Products of lactic fermentation, alcoholic fermentation, acetogenesis, food additives, and single cell protein.
8. Organic solvents. Biofuels.

PRACTICAL PROGRAMME
1. Winemaking
2. Antibiotic production.

3. Antibiotic sensitivity testing. Antibiogram.

9. Microbial biotechnological processes for obtaining primary metabolites.
10. Microbial biotechnological processes in the pharmaceutical industry. Production of antibiotics, steroids, therapeutic proteins, vaccines and hormones.
11. Other microbial biotechnological processes. Biomining, Biotransformations, Bioremediation.

TEACHING METHODS

Theoretical lectures will be combined with laboratory practice.
Seminars will be held in which an industrial process will be studied and improvements will be proposed in group work.
Visits will be made to companies of the sector.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	25	5		10					5
Horas de Actividad No Presencial del Alumno/a	35	10		15					7,5

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 50%
- Exercises, cases or problem sets 30%
- Teamwork assignments (problem solving, Project design) 10%
- Oral presentation of assigned tasks, Reading¿ 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS ASSESSMENT
1) Written exam with essay questions. The correctness and elaboration of the answers will be assessed. 50% of the final grade.
2) Laboratory and field practice. Compulsory attendance and written exam. Continuous and exam evaluation. 30% of the final grade.
3) Seminars. Active participation and the performance and presentation of team work will be assessed. 20% of the final grade.

It will be necessary to pass each of the sections separately (with a 5 out of 10) in order to pass the course. The completion of laboratory and field practice will be compulsory.

FINAL ASSESSMENT
Students will have the right to be assessed by means of the final assessment system. To do so, they must submit a written waiver of continuous assessment to the lecturer responsible for the subject within a maximum period of 9 weeks from the beginning of the semester, in accordance with the academic calendar of the centre. In this case, the student will prove the attainment of knowledge and competences inherent to the subject through a single final test (written exam) which will comprise 100% of the final grade of the subject.

During the written exams, the use by students of books or notes, as well as telephone, electronic, computer or any other type of apparatus or device, is forbidden. [Only the use of a calculator* is permitted.] In the event of any case of dishonest or fraudulent practice, the provisions of the protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and academic work at the UPV/EHU will be applied.

WITHDRAWAL FROM THE EXAM
Failure to assist to the exams on the official exam date will mean the automatical withdrawal of the student from the exam. In this case, the final grade will be no-presented.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary call, the same assessment criteria will be maintained as in the ordinary call. In this case, the marks of the sections that have been passed will be maintained and it will only be necessary to repeat the tests that have been failed (less than 5 out of 10).

During the written exams, the use by students of books or notes, as well as telephone, electronic, computer or any other type of apparatus or device, is forbidden. [Only the use of a calculator* is permitted.] In the event of any case of dishonest or fraudulent practice, the provisions of the protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and academic work at the UPV/EHU will be applied.

WITHDRAWAL FROM THE EXAM
Failure to assist to the exams on the official exam date will mean the automatical withdrawal of the student from the exam. In this case, the final grade will be no-presented.

MANDATORY MATERIALS

Lab coat, practice protocol, and permanent marker pen.

BIBLIOGRAPHY

Basic bibliography

- Okafor N., Okeke BC (2018) Modern industrial microbiology and biotechnology. 2nd edition. Science Publishers.
- Waites MJ, NL Morgan, JS Rockey, G Hington. (2001) Industrial Microbiology. An Introduction. Blackwell Science, Oxford.
- Thieman J, Palladino MA, (2010). Introducción a la Biotecnología. 2º edición. Pearson.
- Madigan MT (2015). Brock, Biología de los microorganismos. 14a edición. Pearson Educación.
- Baltz RH ,Demain AL, Davies JE. (2010). Manual of industrial Microbiology and Biotechnology. 3rd edition. ASM Press.
- Lee Y (2013) Microbial biotechnology: principles and applications. 3rd edition. Word Scientific Pub.
- Leveau JY, M Bouix. (2000) Microbiología industrial: Los microorganismos de interés industrial. Acribia. Zaragoza.
- Ratledge C, Kristiansen B. (2006) Basic Biotechnology. 3rd edition. Cambridge Univ. Press.
- Renneberg R (2019). Biotecnología para principiantes (electrónico). Editorial Reverte.
- Satyanarayana T, Kunze G. (2009). Yeast Biotechnology: diversity and applications. Springer.

Detailed bibliography

- Baglio E. (2014) Chemistry and Technology of Yoghurt Fermentation. Springer.
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- Briggs DE, Boulton CA, Brookes PA, Stevens R. (2004) Brewing: Science and Practice. Woodhead Publishing
- Eibl D, Eibl E(2014) Disposable Bioreactors II. Springer.
- El-Mansi EMT, Mielsen J, Mousdale D, Allman T, Carlson R. (2019) Fermentation microbiology and biotechnology. 4th edition. Taylor and Francis.
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- Hui YH, Goddik LM, Hansen AS, Josephsen J, Nip WK.(2004) Handbook of food and beverage fermentation technology. Marcel Dekker.
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- Scragg A (2005) Environmental Microbiology (2nd ed.) Oxford University Press.
- Singh Jr. VP, Stapleton RD.(2002). Biotransformations: Bioremediation Technology for Health and Environmental Protection. Elsevier Science Ltd.
- Spencer JFT, Ragout de Spencer AL. (2001). Food Microbiology Protocols. Humana Press.
- Tkacz JS, Lange L (2004) Advances in Fungal Biotechnology for Industry, Agriculture, and Medicine. Springer.

Journals

Biotechnology Advances
Biotechnology Annual Review
Critical Reviews in Biotechnology
Current Opinion in Biotechnology
Journal of Biotechnology
Microbial Biotechnology
Microbiology today
Nature Biotechnology
The scientist
Trends in Biotechnology

Web sites of interest

http://www.ncbi.nlm.nih.gov/

http://www.bio.org/
https://www.bioindustry.org
http://www.asebio.com
https://www.naturesfynd.com/fy-protein
https://www.quorn.com/

OBSERVATIONS

En el curso 2024/2025, esta asignatura solo se ofertará en castellano.

Universidad del País Vasco Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GBIOTE30 - Bachelor`s Degree in Biotechnology	Year	Fourth year

COURSE

26746 - Genomics	Credits, ECTS:	4,5

COURSE DESCRIPTION

This course brings together students from the Biotechnology and Biochemistry and Molecular Biology degrees. Genomics is aimed at those students interested in delving into the area of Genetics.
In this subject the general principles of genomics in eukaryotes, bacteria and viruses are worked on. The foundations of the study of complete genomes are established. Methods for the analysis of eukaryotic genomes and critical analysis of scientific articles are worked on.
The contents that are worked on are integrated and related to various subjects in the areas of Cellular and Molecular Biology, Microbiology, Genetics, etc. The subject is basic for the professional practice of any graduate in Biosciences.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The knowledge and skills acquired by the students after successfully completing the subject are detailed below:
1. Know the fundamentals of Genomics and master the procedure to follow for annotating a genome (T8).
2. Know the most appropriate methodological approach to each biological question and be able to apply appropriate genomic analyzes to the specific requirements of the genomic study of animals, plants, viruses, as well as the microbiome. (T2; T6).
3. Understand the complexity of the annotation process and its limitations and know different strategies to overcome them (T6).
4. Know how to use the bioinformatics tools developed for genome annotation (T2; T20).
5. Know how to read scientific articles on Genomics research. Knowing how to critically read and interpret articles on different methodologies, being able to understand the reasons for the differences in workflows in each case. Ability to perform a critical reading of articles and papers (T4; T20; T24).
6. Know different graphs to represent results and know how to make presentations through a web page (T22).
The competences/learning results are related to the following competences of the Biochemistry and Molecular Biology and Biotechnology degree:
T2. Develop the capacity for autonomous learning and adaptation to new situations.
T6. Develop the ability to create and undertake: formulate projects, design and manage, search for and integrate new knowledge and behaviors.
T8. Know the scientific foundations to understand the behavior, properties and interactions of Biological Molecules.
T20. Analyze and interpret appropriately data and experimental results specific to the area.
T22. Know the procedures commonly used by the scientific community to create, transmit and disseminate scientific information.
T24. Evaluate and interpret the scientific literature of the area.
Likewise, the competencies worked on in this subject are related to the transversal competencies of the faculty, especially "teamwork", "the capacity for creation and entrepreneurship" and "autonomy and responsibility". (https://www.ehu.eus/eu/web/ztf-fct/transversal-competences)

Theoretical and Practical Contents

GENOMES PROJECT ORGANIZATION AND OBJECTIVES
UNIT 1.-Basic objectives of genomics. Mapping genomes. Genetic maps. Physical maps
UNIT 2.-Human genome project: Objectives. History. Perspectives the human genome project. Internet resources.
UNIT 3. ENCODE project: Historical context. Objectives. Experiments. Phases. Cell lines. Conclusions. Criticisms.
UNIT 4.- Animal genome projects. Rodentia. Other vertebrates. Invertebrate genome projects
UNIT 5.- Plant genomes project: Arabidopsis thaliana. Legumes. other plants
UNIT 6.- Microbial genome projects. Sequencing microbial genomes. Yeast genomes. Parasite genome. Minimal Genome concept. Metagenomics and environmental genomics
GENOME SEQUENCING AND ANNOTATION
UNIT 7.- Automatic sequencing. Sanger's method. NGS. Masive sequencing by Next Generation Sequiencing (NGS) and Third Generation Sequencing (TGS). Sequence assembly.
UNIT 8.- Genome sequencing. Hierarchical Sequencing, Shotgun, Sequence Check
UNIT 9.- Structural annotation. Location of genes in the sequence of a genome. Gene search: extrinsic, intrinsic and integrated methods. Localization of genes in prokaryotic organisms. ORF search. Search for genes in eukaryotic organisms. Location of functional RNA genes.
UNIT 10.- Comparative genomics. Clustering of sequences by homology. Orthologous genes. phylogenies.
UNIT 11.- Determination of the function of the genes. Computerized analysis of gene function. Gene Ontology. Assignment of functions by experimental analysis. Annotation. Genome comparison

UNIT 12.-Functional annotation. Identification of regulatory sequences, other non-protein-coding genes.
ANALYSIS OF GENOMIC VARIATION
UNIT 13.- Genetic variation. Types of markers: SNPs and copy number changes (CNV). Nature of the variations. Classification and distribution. Linkage disequilibrium and haplotypic maps
UNIT 14.-Technology. Discovering new SNPs. SNP genotyping. Genome-Wide Association Studies (GWAS). SNPs and complex diseases.
UNIT 15.- Pharmacogenomics. Other SNP genotyping applications in Forensics, Nutrigenetics. Sport Genetics and Genetic Doping.
ANALYSIS OF GENOMIC EXPRESSION. TRANSCRIPTOMIC
UNIT 16.- Analysis of expression microarrays. Types and methods. Experimental design. Statistical analysis. Data mining. RNA Sequencing (RNA-Seq) and single cell RNA-Seq (scRNA-Seq). eQTL analysis.
UNIT 17.- Validation of array and RNA-Seq results. Single gene analysis (qRT-PCR, etc). Expression databases
UNIT 18.- Epigenomics. Epigenetic marks: histone modifications and DNA methylation. DNA methylation analysis: methylation arrays and Whole Genome Bisulphite Sequencing (WGBS). mQTL analysis.
PRACTICAL PROGRAM
1. Sequence alignment
2. ORF search, gene search (homology analysis), analysis of repetitive sequences
3. Transcrptomics.
4. Search and analysis of SNPs
5. Global genome analysis, bioinformatic tools.

TEACHING METHODS

The teaching methodology is based on student participation in the development of the subject. We encourage the interaction with the student by asking questions about specific aspects both addressed to the class in general and to part of the student body in particular.
In the theoretical classes, in addition to the teacher's explanations, analysis of scientific articles on various topics will be interspersed. The student must analyze a minimum of 5 articles during the course. Students must comment and discuss various readings that are proposed during the course. This analysis of scientific articles will be carried out both individually and in groups.
Genomics Project: Students will have to assemble and annotate a problem genome.
The research project will be guided, but since each group can follow different strategies in the analysis of the genome, the path and rhythms of each group will be respected. Each group has a different genome, with its own specifications, therefore, there is no single workflow, so that each group can follow its own strategy, following a methodology and using specific software, etc. There are different ways to approach the same problem.
The teacher makes a guide but does not provide protocols. For each session, a common objective is established for the groups and each one must find a way to overcome it. So it is the responsibility of each group to find the right tools and workflow, explaining the processes and software followed, as well as the reason for their strategy.
The teacher will make sure that each group manages to overcome the challenge, providing in each case the help that is necessary for it.
The way to prove that the challenge is met is to provide the teacher with a small report (200 words maximum) with the results of each session. The teacher will give them feedback so that each group knows if they have passed the challenge or not, pointing out their strengths and weaknesses.
By the tenth week of class, they will have the results of all the challenges, and from that moment until the end of the course, they will have 5 weeks to work on their presentation. In that time interval, each group will have two tutorials to explain her work in detail to the teacher.
Reading articles
The articles have to be read individually, underlining the 10 main ideas and agreeing on these ideas as a group. Subsequently, the selection of these ideas is defended against the rest of the class. So each group presents their ideas and the article is underlined among all. The reason for each idea is analyzed in class. The teacher helps to carry out a critical reading of the article, validating or rejecting the underlined ideas.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	5			10				
Horas de Actividad No Presencial del Alumno/a	45	7,5			15				

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 50%
- Teamwork assignments (problem solving, Project design) 50%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The written exam is 50% of the qualification and the other 50% is the group work "genomics project". It is necessary to obtain a grade of 4 or higher to pass the course in both sections (exam and group work).
For the students, subject to both continuous and final evaluation, it will be enough to not take the final test for the final grade of the subject to be "not presented".
During the development of the evaluation tests, the use of books, notes or notes, as well as telephone, electronic, computer or other devices or devices, by the students will be prohibited. In any case of dishonest or fraudulent practice, the provisions of the protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and academic work at the UPV/EHU will be applied.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation criteria will be the same as in the ordinary exam. In exceptional situations the criteria will be established with the student.
For the students, subject to both continuous and final evaluation, it will be enough to not take the final test for the final grade of the subject to be not presented or not presented.
During the development of the evaluation tests, the use of books, notes or notes, as well as telephone, electronic, computer or other devices or devices, by the students will be prohibited. In any case of dishonest or fraudulent practice, the provisions of the protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and academic work at the UPV/EHU will be applied.

MANDATORY MATERIALS

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BIBLIOGRAPHY

Basic bibliography

Greg Gibson, Spencer V. Muse (2004) A primer genome science 2nd edition. Editorial Sinauer

Detailed bibliography

Terry A. Brown, Ed Panamericana (2008) Genomas. 3º Edición
Malcolm Campbell, Laurie J. Heyer (2006) Discovering Genomics, Proteomics, and Bioinformatics. Editorial Cold Spring Harbor Laboratory Press, 2ª edición
Reece R.J. (2004) Analysis of Genes and Genomes Ed. Wiley

Journals

Nature
Science
Nature Review Genetics
Genomics

Web sites of interest

http://www.biomedcentral.com/bmcgenomics/
http://www.biomedcentral.com/bmcmedgenomics/
http://genomebiology.com/
http://www.ebi.ac.uk/microarray-as/ae/
http://www.hapmap.org/
http://www.ncbi.nlm.nih.gov/sites/entrez?db=pubmed
http://www.ncbi.nlm.nih.gov/sites/entrez?db=Genome&itool=toolbar
http://www.ensembl.org/index.html

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOTE30 - Bachelor`s Degree in Biotechnology	**Year**	Second year

COURSE

27804 - Cell & Tissue Cultures — **Credits, ECTS:** 6

COURSE DESCRIPTION

In this course, students will learn the main techniques for cell and tissue study, including preparation, staining and microscopic observation of biological samples, as well as basic culture techniques and in vitro tests with animal cells and their specific applications.
The acquired knowledge will be the basis to understand the organization and functioning of any organism. This knowledge will help the student to deal with other related subjects such as Physiology, Immunology, Human Genetics, Clinical Biochemistry, Molecular Pathology or Tissue Engineering.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

- Apply the main techniques of preparation, staining and observation of biological samples
- Understand organisms at the cellular and molecular level.
- Know the histological structure of the different organs of the animal and plant organism, and understand their participation in physiology and structure-function relationships.
- Identify and describe the different animal tissues in histological preparations using microscopic techniques, and interpret the results.
- Make cell cultures and use them for cell function studies.
- Apply their knowledge to their work or vocation in a professional manner and possess the skills that are usually demonstrated through the discussion and the resolution of problems within their area of study.
- Properly handle basic knowledge of instrumental techniques to obtain information, design experiments and interpret results.
- Develop the capacity for analysis, synthesis and critical reasoning in the application of the scientific method.
- Develop autonomous learning and adaptation to new situations.

Theoretical and Practical Contents

THEORETICAL SYLLABUS

Topic 1. PREPARATION OF BIOLOGICAL MATERIALS FOR MICROSCOPIC OBSERVATION.
Topic 2. BASES AND INSTRUMENTATION IN MICROSCOPY.
Topic 3. CONCEPT OF HISTOLOGY.
Topic 4. HISTOLOGY.
Topic 5.- EPITHELIAL TISSUE.
Topic 6. CONNECTIVE TISSUE.
Topic 7. MUSCULAR TISSUE.
Topic 8. NERVOUS TISSUE.
Topic 9. INTRODUCTION TO ANIMAL CELL CULTURES.
Topic 10. The CELL CULTURE ENVIRONMENT.
Topic 11. THE CELL CULTURE LABORATORY.
Topic 12. PRIMARY CULTURES.
Topic 13. CELL LINES.
Topic 14. BIOLOGY OF IN VITRO CELLS.
Topic 15. TYPICAL PARAMETERS IN CELL CULTURES.
Topic 16. CHARACTERIZATION AND CONSERVATION OF CELLS.
Topic 17. SPECIFIC CELL CULTURES

LABORATORY PRACTICE SYLLABUS
Practice 1. Preparation of samples for optical microscopy.
Practice 2. Histological stains
Practice 3. Observation and interpretation of histological sections
Practice 4. Study of the lining epithelial tissue
Practice 5. Study of glandular epithelial tissue
Practice 6. Study of connective tissue, I.
Practice 7. Study of connective tissue, II.
Practice 8. Study of the muscular and nervous tissue.
Practice 9 Cell cultures.
CLASSROOM PRACTICE

Practice 1. Resolution of practical cases on histological processing.
Practice 2. Tissue observation: ultrastructure vs optical microscopy.
SEMINARS
Seminar 1. Applications of histological techniques and cell cultures I.
Seminar 2. Applications of histological techniques and cell cultures II.

TEACHING METHODS

The subject is taught through lectures, laboratory practice, seminars and classroom practices.
The lectures aim to introduce the concepts and theoretical foundations necessary to carry out the rest of the activities. In these sessions, the explanation by the teaching staff also promotes the active participation of the student.
The laboratory practice consists of 9 sessions, dedicated to the 3 fundamental aspects of the subject: histological preparation, tissue biology and cell cultures. Given the eminently practical nature of the subject, a methodology that seeks involvement will be used. As support for the preparation of the practices, the groups of students will be tutored.
The practical sessions are complemented by classroom practice and seminars whose objective is to apply the knowledge acquired in the laboratory practice and relate it to the theoretical foundations.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	2	4	24					
Horas de Actividad No Presencial del Alumno/a	62	8	8	12					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 45%
- Multiple choice test 10%
- Exercises, cases or problem sets 35%
- Oral presentation of assigned tasks, Reading¿ 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

ORDINARY SITTING
A) CONTINUOUS EVALUATION SYSTEM:
- There will be questionnaires in e-Gela for the different sections of the content of the subject.
Percentages and evaluation criteria:
- Written exam (45%): this exam will be on the subject taught in the lectures and practice (theoretical-practical program).
Questionnaire activities will have a value of 10% of the final grade.
- Classroom Practice and Seminars (10%).
- Laboratory practices (35%): Includes the relevance of the work carried out in practice, presentation of reports and the achievement of objectives.
Attendance at seminars, classroom and laboratory practice will be mandatory.
A minimum of 5 points will be required in each section to obtain "pass" grade.

.- OPTING OUT OF CONTINUOUS ASSESSMENT: According to current regulations, students who wish to opt out of the continuous assessment system and want to do a final assessment must formally notify the faculty responsible for the subject within a period of 9 weeks after the beginning of the course.
B) FINAL EVALUATION SYSTEM
Students who have opted out of the continuous evaluation will have a final evaluation exam. It will consist of a theoretical-practical final exam.
- Written exam (50%): on the subject taught in the lectures (theoretical program).
- Practical exam (50%): on the subject taught in the practice (laboratory and classroom)

Opting out of the evaluation sitting: In this subject the percentage of the final test is greater than 40% of the total grade; thus, any student not present on the official test date will obtain a the final grade for the subject of "not sat".
During evaluation, the use of books, notes or electronic devices will be prohibited. The protocol on "academic ethics and prevention of dishonest or fraudulent practices in assessment tests and in academic work" of the UPV/EHU will be activated in the event of dishonest or fraudulent practices.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY SITTING:
This will consist of a theoretical-practical exam.
- Written exam (50%): on the subject taught in the lectures (theoretical program).
- Practical exam (50%): on the subject taught in the practice (laboratory and classroom).

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

- David JM (2002) Basic Cell Culture: A Practical Approach Oxford University Press
- Fawcett DW. 1999. Compendio de Histología. Interamericana McGraw Hill. Madrid.
- Fresney, R.I. (2005) Culture of animal cells: a manual of basic technique (5ª ed). Wiley-Liss.
- Gartner LP, Hiatt JL. 2003. Atlas Color de Histología. 3ª Edición. Ed. Médica Panamericana. Buenos Aires.
- Kühnel W. 2005. Atlas Color de Citología e Histología. 11ª Edición. Ed. Médica Panamericana.
- Junqueira LC, Carneiro J. 2005. Histología Básica. 6ª Edición, Masson SA, Barcelona.
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- Mather JP, Barness D (1998) Animal Cell Culture Methods. Academic Press
- Paniagua P, Nistal M. 1983. Introducción a la histología animal comparada. Labor. Barcelona.
- Paniagua R, Nistal M, Sesma P, Álvarez-Uría M, Fraile B, Anadón R, Sáez FJ. 2007. Citología e Histología Vegetal y Animal. Volumen 2. 4ª Edición. McGraw-Hill-Interamericana, Madrid.
- Ross MH, Kaye GI, Pawlina W. 2005. Histología. Texto y Atlas Color con Biología Celular y Molecular. 4ª Edición. Ed. Médica Panamericana. Buenos Aires.
- Young B, Heath JW. 2000. Wheater¿s Histología funcional. Texto y atlas en color. 4ª Edición. Harcourt, Churchill Livingstone, Madrid.

Detailed bibliography

- Butler M (2004) Animal Cell Culture & Technology. BIOS Scientific Publishers
- Catell, J.V. & Gómez-Lechón, M.J. (eds.) (1992) In vitro alternatives to animal pharmoco-toxicologyFarmaindustria, Madrid.
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- Doyle, A. Wiley (1998) Cell and tissue culture. Laboratory procedures.
- Griffihs, B. (1997) Cell culture essential techniques. Essential Techniques series. Wiley.
- Harris, J.R, Graham, J & Rickwood, D (eds) (2006) Cell Biology protocols.. John Wiley & Sons, Ltd.
- Harrison MA, Rae IF, Harris A (1997) General Techniques of Cell Culture. Cambridge University Press.
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- Jeanne F. Loring, Robin L. Wesselschmidt and Philip H. Schwartz (eds) 2007. Human Stem Cell Manual A Laboratory Guide. Elsevier Ltd.
- Jolles, G. & Cordier, A. (eds.) (1992) In vitro methods in Toxicology. Academic Press, London.
- Lanza R, Gearhart J, Hogan B, Melton D, Pedersen R, ThomsonJ, West M. 2004. Handbook of Stem Cells. Elsevier Inc.
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- Mitsuhashi, J (2002) Invertebrate tissue culture methods. Springer Lab Manual.
- Mothersill, C & Austin, B. (2001) Acuatic invertebrate cell culture. Springer.

Journals

Web sites of interest

Microscopy and Histology Atlas:
http://www.uni-mainz.de/FB/Medizin/Anatomie/workshop/EM/EMAtlas.html
https://campus.usal.es/~histologia/histologia.htm
https://histology.medicine.umich.edu/
https://histologyguide.com//index.html
http://wzar.unizar.es/acad/histologia/paginas/Atlas_inicio.htm
https://www.uv.es/histomed/odontologia/index.htm
https://mmegias.webs.uvigo.es/
https://www.kenhub.com/en/library/anatomy/introduction-to-histology
https://vmicro.iusm.iu.edu/

General:
http://www.ncbi.nlm.nih.gov/books/
https://archive.org/details/HistologyATextAndAtlasRoss/page/n649/mode/2up

OBSERVATIONS

Coordinator: Oihane Diaz de Cerio (oihane.diazdecerio@ehu.eus)

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GBIOTE30 - Bachelor`s Degree in Biotechnology	Year	First year

COURSE

27806 - Physics	Credits, ECTS:	9

COURSE DESCRIPTION

Any Science focused on the understanding and description of Nature needs a solid foundation on Physics. Physics studies Nature at its most fundamental level.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

In general:

-Explain and analyze the essential phenomena, concepts, principles and theories related to Biology, Geology and Biochemistry.
-Know, describe, analyze and evaluate the physical environment.
-Know and apply the physical and chemical principles of Biology, Geology and Biochemistry.

Transversal competences:
G001 - Ability to analyze and synthesize and reason critically in the application of the scientific method.
G002 - Ability to solve problems.
G005 - Learning and continuous autonomous work, promoting initiative and adaptation to new situations.
M01C18 - Process and interpret data from observations and measurements according to explanatory models.

Specific competences:
Degree in Biology:
M04C03 - Know and apply the physical and chemical principles of Biology.
M04C05 - Demonstrate a basic knowledge of mathematics and statistics applied to Biology.
Degree in Geology:
M01GM1.3 - Development of spatial vision and the capacity of abstraction.
Degree in Biochemistry and Molecular Biology:
MO1.1 - Understand and apply the basic knowledge of Physics, Mathematics and Chemistry to biological systems
MO1.7 - Master the basic terminology of the different physical quantities, and correctly use the systems of international units and their equivalences
Degre in Biotechnology:
M01CM1.1 - Understand and apply the basic knowledge of Physics, Mathematics and Chemistry to the biological and engineering systems.

Theoretical and Practical Contents

1. GENERAL CONCEPTS
Unit systems. Dimensional analysis. Laws of scale.

2. INTRODUCTION TO MECHANICS
Uniform movement. Movement uniformly accelerated. Linear momentum. Force. Static Biomechanics. Newton's laws. Work, Energy and Power. Elastic properties of materials.

3. FLUIDS
A) Hydrostatics. Density. Pressure. Atmospheric pressure. Floatation.
B) Hydrodynamics. Flow in ideal fluids. Bernoulli equation. Venturi effect.
C) Flow in viscous fluids. Law of Poiseuille. Reynolds number. Law of Stokes. Blood circulation.
D) Surface tension. Law of Laplace. Capillarity.

4. THERMODYNAMICS
Temperature scales. Heat. Heat capacity. Calorimetry. First Law of thermodynamics. Entropy. Second principle of thermodynamics. Phase transitions and phase diagrams. Heat transmission: Conduction, convection, radiation.

5. DISSEMINATION PROCESSES
Collisions and average free travel. Law of Fick. Stationary diffusion. Thermal diffusion: Fourier's Law. The diffusion with drag. Diffusion in solutions. Law of Nerst. Osmosis.

6. ELECTRICITY AND MAGNETISM
Electric charge Coulomb law. Electric field and potential. Gauss's theorem. Electric capacity and capacitors. Electric dipoles. Electric current. Ohm's law. Resistance. Sources of electric power. Power in electrical circuits. Circuits Nervous driving Magnetic field. Force on a moving load.
Mass spectrometer.

7. WAVES AND OPTICS
Wave motion. Types of waves. Wave pulses and periodic waves. Interference of waves and standing waves. Doppler effect. Sound and ultrasound. Electromagnetic waves. Electromagnetic spectrum. Refractive index. Reflection and refraction of light. Diffraction. Polarization. Mirrors and lenses. The optical microscope. The human eye

8. RADIACTIVITY

The atomic nucleus Mass number and atomic number. Isotopes. Law of disintegration. Radioactive activity Radioactive dating Interaction of radiation with matter. Biological effects

TEACHING METHODS

Master lessons and practical problem-solving classes.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	54	5	31						
Horas de Actividad No Presencial del Alumno/a	81	7,5	46,5						

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Both in the partial (that will take place at the end of the first quarter) and in the final exams, there will be theoretical questions as well as problems to be solved. Students that pass the partial exam can choose not to answer the questions corresponding to the material of the first quarter in the final exam. In that case, the mark of the partial exam will count 1/3 over the final mark, whereas the other 2/3 will be taken from the mark of the final exam. Students that do not pass the partial exam will have to perform the complete final exam. The mark for the students that perform the complete final exam will be given by the mark obtained in this exam. Failing to take the final call exam (ordinary call) is equivalent to waiving the call.

During the evaluation tests it is not allowed to use books, notes or notebooks, as well as any kind of mobile phone, computer or electronic devices. Only didactic material, devices or computer authorized by the teaching team may be used. If unethical or dishonest behaviour is detected the protocol dealing with academic ethics and prevention of fraudulent and dishonest behaviour in evaluation test and academic assessments in the UPV/EHU will be applied.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

All students that take the resit exam will have to perform the complete exam, even if they had passed the partial exam. The extraordinary call exam counts 100% of the grade. Failure to take the exam (extraordinary call) is equivalent to waiving the call.

During the evaluation tests it is not allowed to use books, notes or notebooks, as well as any kind of mobile phone, computer or electronic devices. Only didactic material, devices or computer authorized by the teaching team may be used. If unethical or dishonest behaviour is detected the protocol dealing with academic ethics and prevention of fraudulent and dishonest behaviour in evaluation test and academic assessments in the UPV/EHU will be applied.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Physics for Scientists and Engineers. P. M. Fishbane, S. Gasiorowicz, and S. T. Thornton. (Prentice Hall, 1996)
Física para ciencias de la vida. Jou i Mirabent, David. McGraw-Hill (2009).
Física. W. Kane y M.M. Sternheim. Reverté (2ª edición 1996)
Física para las Ciencias de la Vida. A. Cromer. Reverté (2ª edición 1996)

Detailed bibliography

Physics. 8th Edition, Cutnell & Johnson. (John Wiley & Sons, INC, 2009)
Física para Ciencias e Ingeniería. (2 volúmenes) R. A. Serway y J. W. Jewett. Thomson-Paraninfo (2005)
Física biológica: energía, información, vida. P. Nelson. Reverté (2005).
Física. (2 volúmenes) P. A. Tipler Reverté (4ª edición 2000).
Física de los procesos biológicos. F. Cussó, C. López y R. Villar. Ariel. (1ª edición 2004).
Introducción a la Física y a la Biofísica. J. González Ibeas. Alhambra (1974).
Física. D. Tilley y W. Thumm. Fondo Educativo Interamericano (1976).

Journals

Web sites of interest

http://www.sc.ehu.es/sbweb/fisica/
http://www.colos.org/
http://webphysics.davidson.edu/Applets/TaiwanUniv/index.html

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GFISIC30 - Bachelor`s Degree in Physics	Year	Fourth year

COURSE

25992 - Analog Electronics	Credits, ECTS:	6

COURSE DESCRIPTION

Analog Electronics is a compulsory subject in the 3rd year of the Degree in Electronic Engineering (DEE), in the 4th year of the Double Degree in Physics and in Electronic Engineering (DDPEE) and an optional subject in the 4th year of the Degree in Physics (DP). In the DEE it is part of the module "Design Techniques in Electronic Engineering" and in the DP part of the module "Instrumentation and Measurement".

The course is focused on the analysis and design of basic and advanced analog circuits and functions. The design of general amplifiers in their most common configurations is addressed, using different device technologies. Likewise, an introduction to the design of analog integrated circuits is included, covering topics such as output stages, current sources, active loads, and other basic functions.

This subject is based on the learning outcomes obtained in the subjects "Electronics" and "Experimental Techniques II" of the 2nd year of the DEE, the DP and the DDPEE. It also requires knowledge of semiconductor physics, especially in relation to the study of second-order effects that limit the behavior of integrated circuits. For this, the subject makes use of knowledge acquired either in the subject "Electronic and Optoelectronic Devices" in the 3rd year of the DEE and in the 4th year of the DDPEE, or in the subject "Physics of the State Solid I" of the 4th year of the DP. Finally, it is highly advisable to have the ability to solve simple electronic circuits by combining circuit theory and the simplified operation of electronic devices.

In relation to the professional field, the subject provides knowledge and skills that contribute to the development of the exit profile of the students and their insertion in various sectors: Components, Consumer Electronics and Professional Electronics (Industrial, Electromedicine, Defense, Instrumentation, among others).

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

At the end of the course, students are expected to be able to:

1. Analyze and interpret the functionality of analog circuits, discrete and integrated, based on their circuit diagram at different levels of abstraction.
2. Solve analog circuits and systems using the appropriate methodology.
3. Properly design, through discrete and integrated techniques, the different modules that make up the amplifier circuits as well as their interconnection to achieve the required specifications.
4. Manage analog simulators as tools to help the design of analog electronic circuits.
5. Correctly use measurement equipment and electronic instrumentation to carry out measurements in analog circuits, promoting teamwork.
6. Approach autonomously and efficiently the search and treatment of information in the context of electronic design as a means to promote the updating of knowledge.
7. Communicate in writing knowledge, results and ideas related to analog electronics.

These competencies are a concretion of the competencies defined at module and/or subject level in the study plans of the Degree in Electronic Engineering and the Degree in Physics.

Theoretical and Practical Contents

1- Introduction to analog circuits
Analog circuits versus digital circuits. Discrete circuits and integrated circuits. Fundamentals of amplification.
2- Basic amplifier stages
Bipolar transistor bias in discrete circuits. Amplifier stages: common emitter, common base and common collector. Field effect transistor biasing in discrete circuits. Amplifier stages: common source, common gate and common drain. Frequency response.
3- Amplifying stages with several transistors
Cascode Amplifier. The Darlington pair. Multistage amplifiers with RC coupling. Feedback circuits (Miller's Theorem).
4- Output stages
Classification of the output stages. Class A output stage. Class B output stage. Class AB output stages.
5- The differential amplifier
Differential amplification: concepts and definitions. Large signal analysis. Operation of differential pair in small signal: differential mode analysis, common mode analysis, superposition of common and differential modes, Common Mode Rejection Ratio (CMRR).

6- Current sources (bipolar and CMOS)
Basic CMOS current mirror. Control of currents and multiple outputs. Bipolar mirrors. High output impedance mirrors: Cascode mirror, Wilson mirror. Widlar source.
7- Amplifying stages and active loads.
Basic CMOS amplifier stages with active loads. Basic differential amplifier with active loads. Cascode differential amplifier.
8- Linear analog integrated circuits
CMOS operational amplifier. Study of an analog integrated circuit (bipolar technology, CMOS, ...).

TEACHING METHODS

The subject is developed in lectures, classroom practices and seminars. In addition, the subject also has laboratory practices and computer practices.

In the lectures, the theoretical concepts related to the subject will be explained, illustrating them with simple examples and problems to be solved by the students will be proposed. In the classroom practices, practical examples will be developed and the proposed problems will be corrected and discussed, promoting the active participation of the students. Finally, in order to promote collaborative learning, theoretical/practical seminars will also be held to deepen some of the topics covered.

In the computer practices, simulation practices will be carried out to fix the theoretical concepts, understand the limitations of real circuits and to work on the analog simulations themselves, which constitute an essential tool for the analysis and design of electronic circuits.

The learning is complemented with the design, assembly and verification in the electronic instrumentation laboratory of a set of circuits of practical interest.

In addition, the eGela tool will be used as a means of communication with the student and as a platform for disseminating learning material and teaching resources. Tasks will also be proposed through eGela and this tool will be used to provide the necessary feedback to improve learning.

Finally, the importance of tutorials is to be highlighted. Teachers' tutorial schedules are accessible from GAUR.

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	45	7,5	15	15	7,5				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Exercises, cases or problem sets 20%
- Individual assignments 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS ASSESSMENT SYSTEM:

-Throughout the school period, students will carry out various tests and activities to assess their progress. These tests and activities will have the following weighting in the assessment of the subject:

20 %: Practices and reports.
The completion of laboratory practices is mandatory to pass the course through the continuous assessment system. Minimum grade required: 5 out of 10.

10 %: Deliverable assignments and exercises.
Failure to complete these activities implies the loss of the corresponding grade.

Throughout the course, guidelines will be given to improve the work delivered to guide the student in improving subsequent deliveries.

-On the official date established in the exam period, a written test will be taken with the following weighting in the assessment of the subject:

70 %: Individual written test.
The written test will consist of problems to solve, theory questions applied to the proposed problems and questions related to the instrumentation and simulation practices carried out in the corresponding laboratories.
Minimum grade required: 4.5 out of 10.

The final grade will be obtained from the weighted average of the previous grades. If the minimum grade required in the practices and/or in the individual written test is not reached, the final grade for the subject will be a maximum of 4.5 out of 10.

RESIGNATION TO CONTINUOUS ASSESSMENT:

Students who do not want to participate in the continuous assessment must request in writing to the coordinator of the subject to resign to the continuous assessment within a period of 9 weeks from the beginning of the semester. In this case, the evaluation will be carried out through the final evaluation system.

FINAL EVALUATION SYSTEM:

The final evaluation system will consist of an individual written test and a practice exam with the following weighting:

80 %: Individual written test.
The written test will consist of problems to solve, theory questions applied to the proposed problems and questions related to the instrumentation and simulation practices carried out in the corresponding laboratories.
Minimum grade required: 4.5 out of 10.

20 %: Laboratory practice exam.
The laboratory practice exam will be taken after passing the written exam with a minimum grade of 4.5 out of 10 and will include writing reports.
Minimum grade required: 5 out of 10.

The final grade will be obtained from the weighted average of the previous grades. If the minimum grade required in the individual written test is not obtained, the final grade for the subject will be that of the written test. If the minimum grade required in the laboratory practice exam is not obtained, the final grade for the subject will be a maximum of 4.5 out of 10.

RESIGNATION TO ORDINARY CALL:

Not attending the individual test set on the official exam date will mean automatic resignation from the ordinary call.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation will be carried out through the final evaluation system (see previous section).

However, students who have been evaluated through continuous evaluation in the ordinary call will keep the positive results obtained in the continuous evaluation (20 % related to practices and reports and, if it is for their benefit, also 10 % related to the deliverable assignments and exercises). If the minimum grade required in the individual written test is not obtained, the final grade for the subject will be a maximum of 4.5 out of 10.

Not attending the individual test set on the official exam date will mean automatic resignation from the ordinary call.

MANDATORY MATERIALS

- PSPICE analog simulator (student version)
- WEB page of the subject in eGela

BIBLIOGRAPHY

Basic bibliography

- A.S. Sedra, K.C. Smith, Microelectronic Circuits, Oxford University Press, New York, 2010.

Detailed bibliography

- P.R. Gray, R.G. Meyer, Analysis and design of analog integrated circuits, John Wiley & Sons, New York, 1993.
- D.A. Johns, K. Martin, Analog integrated circuit design, John Wiley & Sons, New York, 1997.

Journals

Web sites of interest

- PSpice (student version): Electronics Lab: http://www.electronics-lab.com
- Analog Devices: http://www.analog.com
- Texas Instruments: http://www.ti.com

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GELECT30 - Bachelor`s Degree in Electronic Engeineering	**Year**	Third year

COURSE		
26630 - Signals & Systems	**Credits, ECTS:**	6

COURSE DESCRIPTION

- This course covers the fundamentals of signal and system analysis in both the continuous and discrete domains, for applications in signal filtering and processing, communications, and automatic control. Contents include convolution, Fourier series and transforms, sampling and discrete-time processing of continuous signals, Laplace and Z transforms, frequency domain analysis, and systems analysis using the transfer function.

- To enroll in the subject it is advisable to have basic knowledge of mathematics and physics. Basic Mathematics includes solving linear differential equations with constant parameters, matrix calculus, and analysis of functions of complex variables. As for Physics, basic knowledge of mechanics and electricity is required (Newton's and Kirchhoff's laws among others).

- This course is basic to adequately study the Automatic Control subject, which is taught later and is also compulsory to obtain the Double Degree in Physics and Electronic Engineering and the Degree in Electronic Engineering. In addition, this subject is basic for students of the Physics Degree who are going to study the Instrumentation and Measurement specialty, this being one of the options that the student can choose to obtain said degree.

- The techniques developed for the analysis of signals and systems that are learned in this course are applicable to a wide spectrum of physical processes (electrical, mechanical, chemical, thermodynamic, hydraulic, etc). Likewise, these techniques can also be applied to processes of another nature such as economic processes, population dynamics, image processing, etc. Consequently, this course is essential for any engineering student, since the skills and knowledge acquired during the course will be very useful in their future professional career. Likewise, said knowledge is basic for Physics students whose professional career is oriented towards experimental Physics where it is a fundamental requirement to possess knowledge and skills in Instrumentation and Measurement.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The purpose of the course is for the student to acquire the following skills:

- Know and manage the fundamental concepts related to signals and systems.

- Know and apply methods of modeling and analysis of signals and systems in the temporal and frequency domain, both in continuous time and in discrete time.

- Know and handle continuous signal sampling techniques and signal reconstruction from their samples.

- Solve basic problems about signals and systems using the appropriate techniques.

- Being able to communicate knowledge, results and ideas related to the subject in writing through practice reports and solving problems proposed in class.

Theoretical and Practical Contents

The theoretical contents of the subject are included in the following program:

1. Introduction to signals and systems:

Basic concepts.
Models in the temporal domain of systems.
Signals and systems in continuous time and in discrete time.

2. Signal transformation:

Fourier series and Fourier transforms.
The Laplace transform.
The Z-transform.
The transfer function.

3. Signal and system analysis:

Amplitude and phase spectra.
Energy and power signals.
Spectral density of energy and power.
Power calculation for periodic signals.
Integral of convolution.
Discrete convolution.
Time systems analysis continuous and discrete using the transfer function.
BIBO stability.

4.Sampling and Reconstruction:

Fourier transform of a sampled signal.
Reconstruction of signals from their samples.
Overlap and the Nyquist sampling theorem.
Ideal filter and ZOH.

5. Analysis of signals and systems in the frequency domain:

Frequency response using Fourier, Laplace and Z transforms.
Graphical interpretations of the frequency response function (Polar Representation and Bode Place).
Graphic construction of Bode diagrams (constants, poles and real zeros, and two poles and two complex zeros).

The practical contents consist of:

- Use of Scilab mathematical software for scientific calculation.

- Representation of continuous and discrete signals in both the time and frequency domains using Scilab.

- Analysis of signals in the frequency domain: representation of amplitude, phase, energy and power spectra of signals using Scilab.

- Analysis of systems in the frequency domain: representation of the Bode plot using Scilab.

TEACHING METHODS

- The master classes consist of the presentation by the teacher of the main contents of the course through the use of the blackboard, the projection of slides, the simulation of systems with the computer using Scilab, etc.

- Classroom practices consist of solving problems proposed in class in advance. Student participation is required to solve part of these problems either in person or virtually using the eGela platform. In this way it is intended to encourage communication between students and the teacher.

- The aim of the laboratory practices is for students to assimilate and apply the concepts presented in the lectures. These are simulation practices using Scilab, directed by the teacher and, mainly, are face-to-face for the student. In special cases, and with the consent of the teacher, the practices could be remote.

- The student must make use of the notes of the subject, the books proposed in the bibliography, as well as the problems and laboratory practices raised during the course to acquire the basic knowledge and skills for the subject.

- Information about the subject (notes, problems, presentations, practice scripts, etc.) will be available on the eGela server of the university.

- In classroom and laboratory practices, active methodologies are used for the training of students. Specifically, these classes are characterized by learning based on problems and cooperative projects, which entails a significant level of involvement and responsibility on the part of the students.

- It is interesting to take part in the activities organized by the Systems Engineering and Automation area. Among them, attend the presentations of work during the Days on Electronic Engineering that are held annually at the Faculty of Science and Technology.

TYPES OF TEACHING

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

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

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

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

- To pass the subject, the minimum mark in the written final exam must be 3.5 points out of 10.

- Carrying out practices and submitting reports is mandatory, so failure to carry them out means not passing the course.

- The practices are carried out in groups and each group has to deliver a practice report. In this way, group work is encouraged.

- Within the 30% of the qualification corresponding to the realization of practices, the collaboration of the student in solving problems in class is included.

- Students who for justified reasons provided for in the regulations must be examined by means of a final test will have a written final exam (70% of the grade) and a practical exam (the remaining 30%). To pass the subject, the minimum mark in the written final exam must be 3.5 points out of 10.

- Students can consult the notes of the subject (the theoretical part without including solved problems) during the written final exam. Likewise, the use of the calculator during said test is allowed.

- Evaluation criteria: Both in the theoretical exam and in the practical reports, the analysis of the results obtained will be especially valued.

- If the student does not attend to carry out the written final exam, it will be understood that he or she waives the call and will be graded with a "Not presented".

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

- To pass the subject, the minimum mark in the written final exam must be 3.5 points out of 10.

- Carrying out practices and submitting reports is mandatory, so failure to carry them out means not passing the course. The student who wishes can submit a new practice report. Otherwise, the practical qualification corresponding to the ordinary call will be maintained.

- Students who for justified reasons provided for in the regulations must be examined by means of a final test will have a written final exam (70% of the grade) and a practical exam (the remaining 30%). To pass the subject, the minimum mark in the written final exam must be 3.5 points out of 10.

- Students can consult the notes of the subject (the theoretical part without including solved problems) during the written final exam. Likewise, the use of the calculator during said test is allowed.

- Evaluation criteria: Both in the theoretical exam and in the practical reports, the analysis of the results obtained will be especially valued.

- If the student does not attend to carry out the written final exam, it will be understood that he or she waives the call and will be graded with a "Not presented".

MANDATORY MATERIALS

The material provided by the teacher at the beginning and during the course, both in the classroom and through the eGela platform.

BIBLIOGRAPHY

Basic bibliography

* Introduction to signals and systems. Lindner, Douglas K. McGraw-Hill. 2002
* Signals and systems. Oppenheim, Alan V, Nawab, S. Hamid, Willsky, Alan S. Prentice-Hall Hispanoamericana. 1998.

Detailed bibliography

* Fundamentals of signals and systems: using the Web and MATLAB. Kamen, Edward W., Heck, Bonnie S. Pearson. 2007
* Signals and Systems: Analysis Using Transform Methods and MATLAB. Roberts, Michael J. McGraw-Hill. 2017
* Signals and Systems. Haykin, Simon and Veen, Barry Van. John Wiley & Sons, 2003.
* Continuous and discrete signals and systems. Soliman, Samir S, Srinath, M. D. Prentice Hall. 1998.

Journals

Web sites of interest

* MIT OpenCourseWare, Massachussets Institute of Technology: http://ocw.mit.edu/OcwWeb/web/home/home/index.htm
* Scilab: http://www.scilab.org
* Matlab: http://www.mathworks.com/academia/index.html
* EHU OpenCourseWare, Automatica: http://http://ocw.ehu.es/ensenanzas-tecnicas/automatica/Course_listing

OBSERVATIONS

- No observations

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GFISIC30 - Bachelor`s Degree in Physics	Year	.

COURSE

26631 - Instrumentation I	Credits, ECTS:	6

COURSE DESCRIPTION

The object of the subject is to introduce general concepts about electronic instrumentation systems, regardless of their field of application. The principles of the experimental characterization of physical quantities are covered, including an introduction to sensors, noise and electromagnetic interference, and basic signal acquisition and conditioning techniques. Likewise, the issues of signal generation and modulation and an introduction to acquisition systems are addressed.

Instrumentation I is a compulsory subject in the third year of both the Degree in Electronic Engineering and the double Degree in Physics and Electronic Engineering. The students who take it have a basic knowledge of electronic circuits acquired in the subjects of Electronics and Experimental Techniques II (both in the second year). Likewise, the students of the aforementioned grades have the optional subject Instrumentation II (fourth year) which delves into virtual instrumentation from a basic introduction acquired in this subject. On the other hand, Instrumentation I is also an optional subject in the Physics Degree (third or fourth years). It is especially indicated for the experimental areas of Physics, since it provides the bases for the analog processing of the physical signals coming from sensors and transducers.
The skills acquired in the Instrumentation I course are applicable to any professional activity that includes the use of electronic equipment. For example, in measurement or control applications in industrial environments, or in scientific/technological research environments that include experimentation and measurements.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The skills expected to be developed in this subject are:

- Describe the basic principles of measurement systems, including calibration and error.
- Know the principles of operation of sensors of different nature for the measurement of various physical magnitudes as well as the main practical problems associated to them.
- Identify the effect of noise and electromagnetic interference on the operation of systems for electronic instrumentation, know the associated limitations and be able to apply strategies to minimize them.
- Analyze and design basic electronic circuits and systems for signal synthesis, data acquisition and signal conditioning.
- Skillfully use computer tools for the analysis and design of circuits and electronic instrumentation systems, as well as for the virtual instrumentation and control of measuring instruments.
- Communicate, both orally and in writing, knowledge, results and ideas related to basic electronic instrumentation.

These skills are a concretion of the competencies defined at module and/or subject level in the study plans of the Degree in Electronic Engineering and the Degree in Physics.

Theoretical and Practical Contents

1. Introduction
  1.1 Introduction to electronic instrumentation
    Definitions and basic concepts. Fundamental functions and blocks of an electronic measurement system. Variables and signals
  1.2 Characteristics of a measurement system
    Static characteristics: Calibration curve. Dynamic characteristics. Errors and Calibration
  1.3 Fundamental concepts
   Amplification. Power transfer. Operational amplifier. Diodes

2.Sensors
  2.1 Introduction
    Transducers and sensors. Basic transduction processes. Smart sensors and MEMS
  2.2 Classification of sensors
    Classification criteria. Sensors for typical magnitudes.
  2.3 Examples of basic sensors
    Resistive sensors: Potentiometers, RTDs, strain gauges, thermistors. Capacitive and inductive sensors. Thermocouples. Optoelectronic sensors: Photodiodes and phototransistors.
  2.4 Sensors for measuring electrical magnitudes.
    Diode power detector

3.Signal conditioning
3.1 Introduction
3.2 Amplification
Differential amplifier. Transimpedance amplifier. Logarithmic amplifier. Instrumentation amplifier. Transducer bridge amplifier
3.3 Filtering
Passive RC filters. Active filters
3.4 Practical limitations in the use of the operational amplifier
Static limitations (impedances, saturation, input offset, bias currents, common mode rejection...). Dynamic limitations (bandwidth, slew rate)

4. Noise and electromagnetic interference
4.1 Introduction
4.2 Noise
Mathematical aspects. Thermal noise. 1/f Noise. Noise in the OPAMP. Effect of noise on circuits and systems. Noise figure. Phase noise.
4.3 Electromagnetic interference
Context and definitions. Conductive coupling. Capacitive and inductive coupling. Radiative coupling
4.4 Measurements in the presence of noise
Lock-in amplifier.

5.Generation and signal synthesis
5.1 Multivibrator circuits
Astable and monostable multivibrators. Integrated 555 timer. Astable with 555 IC. Monostable with 555 IC.
5.2 Harmonic oscillators
Oscillation conditions. Oscillators with RC network and Operational Amplifier. LC tuned oscillators. Voltage Controlled Oscillators (VCOs). Characteristic parameters of an oscillator. Crystal oscillators.

6. Data acquisition and instrument control
6.1 Data acquisition systems
6.2 Software for instrumentation

TEACHING METHODS

The subject is developed in lectures, classroom practices and seminars. In addition, the subject also has laboratory practices and computer practices.
In the lectures, the theoretical concepts related to the subject will be explained, illustrating them with simple examples and problems to be solved by the students will be proposed. In the classroom practices, practical examples will be developed and the proposed problems will be corrected and discussed, promoting the active participation of the students. Finally, in order to promote collaborative learning, theoretical/practical seminars will also be held to deepen some of the topics covered.

In the computer practices and especially in the laboratory ones, the practical part of the subject will be worked on. These practices complement the theoretical concepts and are focused on practical cases of interest, to which the students must respond through the design, assembly and verification of the appropriate measurement systems.

In addition, the eGela tool will be used as a means of communication with the student and as a platform for disseminating learning material and teaching resources. Tasks will also be proposed through eGela and this tool will be used to provide the necessary feedback to improve learning.

Finally, the importance of tutorials is to be highlighted. Teachers' tutorial schedules are accessible from GAUR.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	5	5	10	10				
Horas de Actividad No Presencial del Alumno/a	45	7,5	7,5	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 methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 80%
- Exercises, cases or problem sets 10%
- Oral presentation of assigned tasks, Reading¿ 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS ASSESSMENT SYSTEM:

Throughout the school period, students will carry out various tests and activities as part of the assessment, with the following weighting:

- Class test (15% of the final mark)*
- Deliverable assignments and exercises (10% of the final mark)*
- Practices and reports (10% of the final mark)**

On the official date established in the examination period, the following will be carried out:
- Final written exam (65% of the final mark)***

* Failure to complete these activities implies the loss of the corresponding grade.
** Practices are mandatory in the continuous assessment system.
*** To pass the subject it is necessary to obtain at least a mark of 4 out of 10 in the written exam.

If these 4 points are not reached, the grade for the subject will be that of the written exam.

Throughout the course, guidelines will be given to guide the student in improving their work.

RESIGNATION TO CONTINUOUS ASSESSMENT:

The student can resign to continuous assessment within the period indicated in the assessment regulations: 9 weeks from the beginning of the semester in accordance with the academic calendar of the center. The resignation will be made in writing, through a resignation document that must be delivered to the professor duly completed and signed.

In this case, the student will be evaluated through the FINAL EVALUATION SYSTEM, which will be graded as follows:

- Written exam (90% of the final grade) on the official date established in the exam period. This test will not necessarily be the same as the test that students evaluated through the continuous assessment system will take during the official exam period.
- Specific practice test (10% of the final mark). If at least a 4.5 out of 10 has been obtained in the written exam, a specific practice test must be satisfactorily completed and passed.

RESIGNATION TO ORDINARY CALL:

Not attending the individual test set on the official exam date will mean automatic resignation from the ordinary call, regardless of the evaluation system.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The extraordinary call will be evaluated through the FINAL EVALUATION SYSTEM, as follows:

-Written exam (90% of the final grade) on the official date established for this purpose. Students who have been evaluated through continuous evaluation in the ordinary call may keep the positive results of the class test (%15 of the final grade) and/or of the work and deliverable exercises (10% of the final grade), subtracting the percentage corresponding to the written exam, if this results in your benefit.

To pass the subject it is necessary to obtain at least a mark of 4 out of 10 in the written exam. If these 4 points are not reached, the grade for the subject will be that of the written exam.

- Specific practice test (10% of the final mark). If at least 4.5 out of 10 has been obtained in the written exam, a specific practice test must be satisfactorily completed and passed. The practice test is mandatory for those students who have not satisfactorily passed this part in the ordinary call. Students who have been evaluated through continuous evaluation in the ordinary call, or failing to it, have passed the specific practice test in the ordinary call, will keep the positive results of it for this final evaluation.

RESIGNATION TO EXTRAORDINARY CALL:

Not attending the individual test set on the official exam date will mean automatic resignation from the ordinary call, regardless of the evaluation system.

MANDATORY MATERIALS

WEB page of the subject in eGela

BIBLIOGRAPHY

Basic bibliography

- S. Franco, Design with operational amplifiers and analog integrated circuits,
McGraw-Hill, 2005.
- A.S. Sedra, K.C. Smith, Microelectronic Circuits, Oxford University Press, New York, 2010.

Detailed bibliography

- D. Christiansen, Electronics Engineers¿ Handbook, McGraw-Hill, 1989.
- G. Meijer, Smart Sensor Systems, John Wiley & Sons, 2008.
- C. R. Paul, Introduction to Electromagnetic Compatibility, John Wiley & Sons, 1992.
- W.F. Egan, Phase-Lock Basics, John Wiley & Sons, 1998.
- G. Nash, Phase Locked Loops Design Fundamentals, AN 535, Motorola Semiconductor Application Note, 1994.

Journals

Web sites of interest

- http://www.egr.msu.edu/em/research/goali/notes/
- http://www.design-reuse.com/
- http://www.national.com/analog
- http://www.educypedia.be/electronics/
- http://www.ni.com/labview/

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GELECT30 - Bachelor`s Degree in Electronic Engeineering	Year	Fourth year

COURSE

26632 - Sensors and Drive Systems	Credits, ECTS:	6

COURSE DESCRIPTION

This course describes the operation and use of the most common sensors and actuators, both classic and modern, with special emphasis on the underlying principles, but without overlooking practical aspects. The general characteristics of sensors that define their performance are reviewed. Sensors are studied, mainly regarding physical magnitudes, classified by the magnitude or property that are used for transduction: resistive, capacitive, digital, etc. Their description is accompanied with examples and their signal conditioning circuits. In the case of reversible principles, the relevant actuators are studied in conjunction with the sensors. The course is completed with a brief description of electromechanical actuators.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Course competences
1) An ability to manage methods of designing electronic systems for data acquisition and signal conditioning, including sensors of a different nature
2) Being able to use instrumentation laboratories in different applications, including the use of automated measurement instruments and automatic control applications.
3) An ability to design closed-loop controllers for real applications, including the use of actuators, and considering problems such as noise processing and disturbance effect.
4) An ability to understand the implementation of computer systems in real time for use in an instrumentation and control laboratory.
5) Being able to communicate knowledge, results and ideas in writing, and write and document reports on work carried out.

Learning outcomes
1) An ability to understand the principle of operation of the main types of sensors and actuators, taking into account the magnitudes used in transduction and configurations that leverage these principles to implement useful, top-performing useful devices.
2) An ability to assimilate the fundamentals of basic electronic signal conditioning circuits.
3) An ability to acquire selection criteria of the elements that make up the measuring and control systems before the requirements of an application.
4) An ability to practice in the laboratory with sensors and actuators, and the functions of these devices in the automation of industrial processes and in measuring and control systems.

Theoretical and Practical Contents

Course Program

1. Introduction.
The sensors and actuators in measurement and control systems. Classification of sensors and actuators. Static and dynamic characteristics.
2. Resistive sensors of mechanical magnitudes.
Potentiometers and strain gauges.
3. Electromagnetic sensors and actuators
Magnetic circuits. Three-phase circuits. Electric motors. Tachogenerators. Synchros and resolvers .
4. Inductive and capacitive sensors.
Proximity and presence detectors. LVDT.
5. Temperature and humidity sensors.
RTDs, NTC, thermocouples, optical pyrometers. Humidity sensors.
6. Piezoelectric sensors and actuators.
The piezoelectric effect. Piezoelectric sensors. Piezoelectric actuators. Ultrasonic sensors and actuators.
7. Position encoders and other digital sensors.
Incremental and absolute encoders. Self-resonating sensors. Other digital sensors
8. Optical sensors.
Photodiodes, photoresistors, photomultipliers, image sensors. Optical fibers.
9. Magnetic sensors and actuators.
Magnetic field sensors. Magnetoelastic sensors. Magnetostrictive actuators. Other magnetic actuators.

Practical sessions:

1. Linearity of a capacitive level sensor.
2. Strain gauges.
3. Analysis of the operation of a load cell.
4. Temperature sensors.
5. Magnetic circuits. Electric motors.
6. Incremental position encoder.
7. Magnetoelastic labels.

TEACHING METHODS

Theory hours (M) will be used to present the contents of the subject, encouraging the discussion with the students around said contents.
Hours of classroom practicals (GA) are used for problem solving.
Laboratory classes (GL + GO) are used for carrying out practical and experimental work.
Seminars (S) are used for presenting and discussing topics related to the subject.
Students have an official tutoring schedule available in GAUR.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	35	5	5	10	5				
Horas de Actividad No Presencial del Alumno/a	52,5	7,5	7,5	15	7,5				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 35%
- Multiple choice test 10%
- Exercises, cases or problem sets 20%
- Individual assignments 30%
- Participación activa en el desarrollo de las clases 5%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Students have the right to decide whether they will take part in the continuous assessment system or the final evaluation system.
In continuous evaluation, the mark will be based on:
1. Attendance, attitude and participation in class.
2. Delivery of selected problems.
3. Practicals and reports.
4. Preparation and participation in the seminars
5. Final exam on course content

To pass the course, a 50% mark will be sufficient.

For the final evaluation and the extraordinary evaluation, students must take an exam which will include questions and problems related to the course practicals (15% of the mark) and seminars (15% of the mark).

Evaluation waiver: students may waive the evaluation up to 10 days before the beginning of the exam period. Should they fail to waive but not attend the exam and the rest of the marks earned not reach the minimum pass mark, the student will fail the course.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

For the final evaluation and the extraordinary evaluation, students must take an exam which will include questions and problems related to the course practicals (15% of the mark) and seminars (15% of the mark).

MANDATORY MATERIALS

Texts described in the basic bibliography. There are copies available in the University Library of the Campus of Leioa (and in others of the University).

BIBLIOGRAPHY

Basic bibliography

* Instrumentación Electrónica. Miguel A. Pérez García y otros. Editorial Thomson, Madrid 2004
* Sensores y acondicionadores de señal. Ramón Pallás Areny. 4ª Ed. Editorial Marcombo, Barcelona. 2005
* Instrumentación aplicada a la Ingeniería. J. Fraile-Mora y otros. 3a ed. Editorial Garceta, Madrid 2013.

Detailed bibliography

* Sensors and actuators. Control system instrumentation. Clarence W. De Silva. Editorial CRC Press. 2007
* Máquinas Eléctricas. S. J. Chapman. 4ª Ed. Editorial Mc. Graw Hill. 2005

Journals

* Sensors and Actuators A: Physical (ISSN: 0924-4247). Elsevier. www.journals.elsevier.com/sensors-and-actuators-a-physical
* Sensors (ISSN 1424-8220). MDPI. www.mdpi.com/journal/sensors
* IEEE Sensors Journal (ISSN: 1530-437X). IEEEE. www.ieee-sensors.org/journals

Web sites of interest

* http://www.sensorsportal.com/
* http://spectrum.ieee.org/

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GELECT30 - Bachelor`s Degree in Electronic Engeineering	**Year**	Fourth year

COURSE

26634 - Optics — **Credits, ECTS:** 6

COURSE DESCRIPTION

Optics is a discipline of Physics that deals with the phenomena associated with Light. These phenomena are related to the interaction of light with optical substances: the modifications they produce to on light, their ability to adapt the light trajectory for the formation of images, and other processes. Given the wave and electromagnetic nature of light, optics must be developed after the topic of wave-mechanics and electromagnetism. In these topics, the basic concepts of electromagnetic radiation are discussed.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

At the end of the course, the student should have acquired knowledge, skills and abilities in:
- Geometric Optics and optical instruments.
- Wave optics: Diffraction and Interference, interference devices.
- Electromagnetic and Applied Optics: polarizers, phase retarders, sheets, anisotropic materials, lasers and optical fibers.

Theoretical and Practical Contents

Optics (60 hours)

1- Introduction: Historical introduction and current perspective of the Optics.
2- Geometrical Optics: Foundations of Geometrical Optics. Fermat principle. Image formation; Gaussian or paraxial optics. Centered systems. Centered systems with focal points. Systems coupling. Beam limitation: stops and pupils. The eye. Optical instruments (photographic systems, telescope and microscope). Chromatic and geometrical aberrations (conceptual study). Optical fibers.
3- Wave optics; Classic model: Introduction. Scalar waves. Interference and Coherence. Scalar theory of diffraction. Fresnel diffraction (Huygens-Fresnel principle). Fraunhofer diffraction through different openings. Diffraction gratings. Resolution of optical instruments. Fourier Optics Methods. Diffractional theory of image formation. Applications.
4- Wave optics; Electromagnetic model: Introduction. Electromagnetic waves. Propagation in dispersive media. Phase and group speed. Polarization I. Jones vectors. Stokes parameters. Polarizers and phase retarders. Polarization II. Natural and partially polarized light. Refraction and reflection in homogeneous and isotropic dielectrics. Reflection at a metal surface. Films. Propagation in anisotropic media. Uniaxial and biaxial crystals. Methods and devices for obtaining and analyzing polarized light (birefringent polarizers and phase retarders).

TEACHING METHODS

1. Theoretical development of the chapters corresponding to the course contents.
2. Development and resolution of practical exercises after each theoretical topic
3. Complementary seminars

TYPES OF TEACHING
Classroom hours 36
Seminars 3
Practical class work 21

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	3	21						
Horas de Actividad No Presencial del Alumno/a	54	4,5	31,5						

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

ASSESSMENT SYSTEMS

- Final assessment exam

TOOLS USED & GRADING PERCENTAGES

- Written exam 100%

ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

- Exam at the end of the term: 100% of the final mark.

In the event that the health situation forces to take measures that prevent the realization of a face-to-face evaluation, a non-face-to-face evaluation will be activated, which the students will be informed promptly.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

- June resits written exam 100%

In the event that the health situation forces to take measures that prevent the realization of a face-to-face evaluation, a non-face-to-face evaluation will be activated, which the students will be informed promptly.

MANDATORY MATERIALS

In addition to the basic bibliography outlined, the student will have a copy of the contents of the subject; slides or other digital formats. These will be distributed in class, or will be made available in the corresponding virtual classroom. Their contents, will match to the subject needed for each of the chapters, and will contain both; the theoretical and the practical parts.

BIBLIOGRAPHY

Basic bibliography

Basic bibliography
J. Casas, Óptica, Librería Pons, Zaragoza 1994.
Hecht-Zajac, Óptica, Addison-Wesley 1986

Detailed bibliography

In-depth bibliography
M. Born and E. Wolf, Principles of Optics, 7th Ed. Pergamon Press 1999.

Journals

Web sites of interest

Useful websites
https://egela.ehu.es/login/index.php
http://www.ub.edu/javaoptics/index-en.html

OBSERVATIONS

According to general UPV/EHU policy, a level of B2 or higher is recommended for attending courses taught in English

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GELECT30 - Bachelor`s Degree in Electronic Engeineering	**Year**	Fourth year

COURSE

26636 - Statistical Physics & Thermodynamics	**Credits, ECTS:**	12

COURSE DESCRIPTION

The subject Thermodynamics and Statistical Physics (TFE) is a full course subject, corresponding to 12 ECTS credits. It is compulsory for the Degree in Physics and the double Degree in Physics and Electronic Engineering, while in the Degree in Electronic Engineering it is offered as an optional subject.

Thermodynamics and Statistical Physics is part of the "Basic Concepts" module, which constitutes the fundamental core of physics knowledge that you will need to access any of the possible professions related to physics. The objective of this module is therefore to guarantee that you acquire an adequate understanding of the most fundamental physics, and a solid base so that you can tackle the most advanced subjects of the Degree.

What are you going to see in Thermodynamics and Statistical Physics?

The subject of Thermodynamics and Statistical Physics is divided into two parts: Thermodynamics is developed in the first quarter and Statistical Physics in the second. The two parts are two sides of the same coin, and have the same objective: to predict the equilibrium states of physical systems, making use of their characteristics (through state equations, experimental coefficients, the fundamental equations, etc) and making use of the experimental conditions. The difference is how each of the parts of the course addresses this objective:

• Thermodynamics uses the macroscopic criterion. To predict the equilibrium state of a physical system, it is enough to know the values of a number of macroscopic parameters called thermodynamic quantities, such as pressure, volume, temperature, number of moles, etc. Using theoretical relationships between various magnitudes, such as state equations or fundamental equations) the equilibrium state of the system can be calculated, which defines the rest of the magnitudes.
• Statistical Physics uses the microscopic criterion. To predict the equilibrium state of a system, it is necessary to know the behavior of the fundamental particles that make up the system (usually we talk about atoms). The number of particles is so extraordinarily large that each particle cannot be treated independently and it is necessary to study collective behavior. From this collective or statistical behavior, the macroscopic thermodynamic magnitudes of the system can be calculated.

Within the degree you are studying, Thermodynamics and Statistical Physics is related to one level or another with all the subjects, since it tries to predict properties of any physical system, from a mechanical system such as an engine to an astronomical system such as a white dwarf , going through gases or solids in general. That is why it is a subject in the "Basic Concepts" module.

What do you need to study Thermodynamics and Statistical Physics?

Thermodynamic processes are described by means of differential equations, and therefore a good domain of "Differential and Integral Calculus" of 1º is necessary. The state equations, for example, are the first derivatives of the fundamental equations of the systems, and the experimental coefficients, the second derivatives. In the case of Statistical Physics, mathematical competence is something more special. Apart from what was mentioned above, it is necessary to have notions of probability, distributions and integrals of special functions, how they are calculated and what values they have. Therefore, the subject "Mathematical Methods" of the 2nd year is essential.

What will Thermodynamics and Statistical Physics be used for?

Firstly, there is a direct relationship with the subject of "Experimental Techniques III" of his same course. In Experimental Techniques III you will carry out experiments on thermodynamic magnitudes of various systems, and to understand the physical processes that are taking place, as well as their theoretical justification, you need to take Thermodynamics and Statistical Physics.

From here, the knowledge will be useful to address any advanced course in the 4th year or electives, take Master's degrees, or do PhDs, as well as carry out work outside the academic world. Thermodynamics and Statistical Physics will be especially relevant in fields such as Physics of Materials, various Engineering (Mechanics, Aerospace, Fluids, etc.), Econophysics and Finance, Biophysics, Big Data and Machine Learning, etc.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Statistical Physics. You can see those skills that you will acquire in the following table:

General and Transversal Competences of the Degree
G001 - Learn to pose and correctly solve problems
G003 - Understand physical phenomena theoretically
G005 - Being able to organize, plan and learn independently
G006 - Being able to analyze, synthesize and reason critically
Specific Competences of Module 2
CM01 - Acquire the necessary knowledge to clearly understand the basic principles of Thermodynamics and Statistical Physics and their applications
CM02 - Correctly pose and solve problems involving the main concepts of Thermodynamics and Statistical Physics
CM03 - Document yourself correctly and present work related to Thermodynamics and Statistical Physics in an organized way to consolidate or expand knowledge and to discern between what is important and what is accessory
CM04 - Present in writing and orally problems and questions about Thermodynamics and Statistical Physics, to develop skills in scientific communication

It will be considered that you have acquired these skills as long as at the end of the course you are able to:

Learning outcomes
LO1 - Explain in writing in an orderly and rigorous way the concepts of Thermodynamics and Statistical Physics included in the syllabus (G003, G006, CM01, CM04)
RA2 - Solve basic problems of Thermodynamics and Statistical Physics in a mathematically ordered way (G001, CM02, CM04)
LO3 - Present orally with ease and rigor the theoretical concepts and mathematical developments of Thermodynamics and Statistical Physics included in the agenda (G006, CM04)
LO4 - Reasonably justify physical processes of Thermodynamics and Statistical Physics from the purely numerical results that describe them (G003, G006, CM01)
LO5 - Prepare texts and simple theoretical models on topics of Thermodynamics and Statistical Physics from information collected independently (G005, CM03)

Theoretical and Practical Contents

1. Introduction
Concepts and definitions: thermodynamic systems, thermodynamic variables, interactions, processes, equilibrium.

2. Zero Principle (Temperature) Thermal equilibrium.
Zero principle of thermodynamics. temperature concept. Temperature scale, measurement of temperature. (Temperature microscopically).

3. Simple system Simple system.
thermodynamic equilibrium. State equation.

4. First Principle (Internal Energy)
Work: concept of work, mechanical work, compound systems. Heat: system/environment, calorimetric definition of heat, adiabatic work, internal energy. First Law of thermodynamics. Specific heats. heat sources. (I work microscopically).

5. ideal gas
Development of the Virial: equation of state. free expansion. ideal gas. adiabatic processes. Polytropic processes. (Ideal gas microscopically).

6. Second Law (Entropy) Natural asymmetry.
Statements of the second principle. Reversibility/irreversibility. Consequences of the second principle. Clausius's theorem. Principle of increase of entropy. Maximum/minimum work. Usable energy. (entropy microscopically)

7. Special systems
Electric system. magnetic system. elastic system. General system: X, Y. Equations of state, work, calculation of entropy variations

8. Third Principle (Cooling processes)
cooling processes. Statements of the third principle. Physicochemical consequences of the third principle. magnetic system. negative temperatures.

9. Fundamental Equation (Thermodynamic Potentials)
Postulates of thermodynamics. Fundamental equation, equations of state, extremal principles, alternative formulations: thermodynamic potentials, Maxwell relations.

10. Application of the theory (Phase transitions) Stability conditions.
Le'Chatelier principle, Le'Chatelier/Braun principle. First order transitions: van der Waals fluid. Clausius/Clapeyron equation.

STATISTICAL PHYSICS

11. Previous concepts
Introduction. Microstates and macrostates. Connection between Statistical Mechanics and Thermodynamics. Odds. Examples of physical systems: monatomic ideal gas, perfect paramagnetic substance, two-level system. Phase space. Liouville's theorem.

12. Gibbs collectivities. microcanonical set
Introduction. Microcanonical set. Calculations in the microcanonical ensemble. Equipartition and virial theorems. Examples of application of the microcanonical set.

13. Gibbs collectivities. canonical set
Introduction. partition function. Connection with thermodynamics. fluctuations. Examples: classical ideal gas, classical and quantum oscillator systems, perfect paramagnetism. Quantum formulation of the canonical ensemble: density matrix.

14. Gibbs collectivities. macrocanonical set
Introduction. partition function. Connection with thermodynamics. fluctuations. Examples: classical ideal gas, molecules adsorbed on a surface.

15. Quantum Statistics of Ideal Gases
Introduction. partition function. Boson gas: radiation, Bose condensation, superfluids. Fermi gas: metals, white dwarfs.

16. Interacting systems
real gases. Viral development. Approximation of the mean field. Ferromagnetism. Distribution functions in liquids.

17. Phase transitions
Fundamental concepts: order parameter, susceptibility and fluctuations. Ising's model. The Monte Carlo method.

18. Transport phenomena
elementary theory. Boltzmann equation. Approximation of relaxation time.

TEACHING METHODS

In the first part Thermodynamics is studied, the first part of the subject and in the second part Statistical Physics is studied, the second part of the subject. Each partial will be evaluated independently, with 2 types of evaluation:

Continuous assessment
The continuous evaluation may consist of intermediate controls and activities to be carried out such as problems or works. The % of each activity will be agreed by the teacher of each partial with the students at the beginning of the partial

Final evaluation
Written test to develop (%): 100

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	72	6	42						
Horas de Actividad No Presencial del Alumno/a	108	9	63						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 100%
- With regard to Continuous Assessment, this will be proposed by the teacher at the beginning of each semester. 0%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the ORDINARY call

• Both parts of the course must be passed with a grade ≥ 5.0

• The course can be passed by partials. In case of failing a single partial, the student may only attend that partial in the ORDINARY exam. The mark of the partial approved will be kept.

• The final grade will be the average of both partials

Resignations

• It will be considered that the student waives the continuous evaluation if he does not show up for any control or does not carry out the agreed activities.

• In any case, students will have the right to be evaluated through the final evaluation system, regardless of whether the continuous evaluation system has started, submitting in writing to the teaching staff responsible for the subject the waiver of continuous evaluation with at least 3 weeks notice. prior to the exam session.

• In the event that the student chooses the final evaluation method, the waiver of the ordinary call will be automatic just by not showing up for the test set on the official date.

In the event that sanitary conditions prevent carrying out a face-to-face evaluation, a non-face-to-face evaluation will be activated, of which the students will be informed promptly.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

D.A. McQuarrie, Statistical Mechanics, Harper and Row, 1976
R.K. Pathria, Statistical Mechanics, Pergamon Press, 1996
F. Reif, Física Estadística y Térmica, Ediciones del Castillo, 1968
F. Reif, Física Estadística, Reverte, 1996

Detailed bibliography

D.A. McQuarrie, Statistical Mechanics, Harper and Row, 1976
F. Reif, Física Estadística y Térmica, Ediciones del Castillo, 1968
F. Reif, Física Estadística, Reverte, 1996

Journals

Web sites of interest

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GFISIC30 - Bachelor`s Degree in Physics	**Year**	Second year

COURSE

26640 - Electromagnetism I	**Credits, ECTS:** 6

COURSE DESCRIPTION

Fundamental aspects of electromagnetic fields

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Degree competences (all transversal):
G001. Learn to pose and solve problems correctly.
G005. Be able to organize, plan and learn autonomously.
G006. Be able to analyze, synthesize and reason critically.
G008. Be able to present ideas, problems and scientific results orally and in writing.

Competences of the Basic Concepts module (all generic):
CM01. Acquire the necessary knowledge to clearly understand the basic principles of Classical Physics, Chemistry and Electronics and their applications.
CM02. Approach correctly and solve problems involving the main concepts of Classical Physics, Chemistry and Electronics and their applications.
CM03. Document and raise in an organized manner subjects related to the subjects of the Module to strengthen or expand knowledge and to discern between the important and the accessory.
CM04. Present written and oral problems and questions about Classical Physics, Chemistry and Electronics, to develop skills in scientific communication.

Theoretical and Practical Contents

1. Introduction to Electromagnetism
   Electromagnetic interaction, E and B fields. Maxwell´s equations in differential form. Review of vector analysis.

2. Vacuum electrostatics
   Electrostatic field and potential. Gauss' theorem. Poisson's and Laplace equations.

3. Dielectric electrostatics.
   Dipolar moments of atoms and molecules, polarization. Gauss' law in a dielectric medium. Displacement vector field. Electric susceptibility and permittivity. Energy density of the electrostatic field.

4. Electric current.
   Continuity equation. Ohm's law. Electromotive force. Electrostatic equilibration in conductors.

5. Magnetic field of stationary currents.
   The magnetic field, B. The Biot-Savart law, Ampère's circuit law. Vector potential. Magnetic moment.

6. Magnetic field in matter.
   Magnetization, magnetization current. Ampère's law in matter. The H vector field. Boundary conditions for magnetic vectors.

7. Electromagnetic induction and magnetic energy.
   Electromagnetic induction. Faraday's law. Energy density of the magnetic field.

8. Maxwell's equations and electromagnetic waves.
   Generalising Ampère's law: displacement current. Maxwell's equations and electromagnetic wave equation. Energy of the electromagnetic field. Poynting's vector.

TEACHING METHODS

Lectures on theoretical aspects, and example sessions.

Universidad del País Vasco / Euskal Herriko Unibertsitatea

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	3	21						
Horas de Actividad No Presencial del Alumno/a	54	4,5	31,5						

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Not taking the ordinary call (convocatoria ordinaria) exam equals giving up the call (renuncia a la convocatoria).
If the public health situation warrants it, the paper will be given telematically. In that case an oral exposition/defence might be part of the exam.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Not taking the extrordinary call exam equals giving up the call.

If the public health situation warrants it, the paper will be given telematically. In that case an oral exposition/defence might be part of the exam.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

- Foundations of Electromagnetic Theory, John R. Reitz, Frederick J. Milford, Robert W. Christy, Addison-Wesley, 2008.
- Introduction to Electrodynamics, David J. Griffiths, Cambridge University Press, 2017.

Detailed bibliography

1) R. Feynman, D.R. Leighton y M. Sands. FISICA (vol II), Fondo Educativo Interamericano, Bogotá (1972)
2) E.M. Purcell. BERKELEY PHYSICS COURSE (Vol 2: Electricidad y Magnetismo) , Reverté, Barcelona (1994)

Journals

Web sites of interest

http://www.sc.ehu.es/sbweb/ocw-fisica/elecmagnet/elecmagnet.xhtml
http://academicearth.org/courses/physics-ii-electricity-and-magnetism
http://ocw.mit.edu/OcwWeb/Physics/8-02Electricity-and-MagnetismSpring2002/CourseHome/

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GFISIC30 - Bachelor`s Degree in Physics	Year	Third year

COURSE

26643 - Electromagnetism II	**Credits, ECTS:**	6

COURSE DESCRIPTION

The aim is to familiarize the student with the most common applications of Maxwell's equations in the following fields: problems in static fields, propagation of electromagnetic waves, generation of electromagnetic radiation, microscopic theory of electromagnetic effects on material, and transformation of the electromagnetic field between inertial frames (special relativity). This subject is compulsory in the 3rd year both for students of the Degree in Physics, Degree in Electronic Engineering and double degree in Physics and Electronic Engineering.

To follow this course, it is necessary to have the following prior knowledge: knowledge of electromagnetic phenomena that are included in Maxwell's equations, differential equations, resolution of boundary problems, propagation of mechanical waves and knowledge of the atomic structure of matter. This knowledge has been acquired during the second year of the degrees in Physics, Electronic Engineering and double Degree in Physics and Electronic Engineering in the subjects of Electromagnetism I, Mechanics I and Structure of Matter.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The COMPETENCIES that will be worked on this course are:
- Getting to know the necessary knowledge to clearly understand the basic principles of Electromagnetism and its applications.
- Correctly proposing and applying the appropriate techniques to solve problems that involve the main concepts of Electromagnetism and its applications.
-Communicating, both orally and in writing, knowledge, problems and questions about Electromagnetism to develop skills in scientific communication.

The learning RESULTS for this subject, that is, the specific knowledge and skills that students must acquire throughout the course are the following:
- Solving electrostatic and magnetostatic problems in two dimensions by separating variables and the image method.
- Knowledge of the propagation laws of the electromagnetic field in dielectrics and conductors and in the separation surface between them.
- Solving EM field propagation problems in simple rectangular wave guides. Knowledge of the properties of rectangular resonant cavities and obtaining the resonance conditions.
- Knowledge of the fundamentals of EM wave radiation by moving charges, and in particular the dipole radiation. Application to radiation by antennas and by atoms.
- Knowledge of the microscopic mechanisms of polarization, electrical conduction and magnetization in matter, and the macroscopic equations that describe it. Solving simple problems of electrical and magnetic properties of matter.
- Knowledge of the transformation properties of charges and currents, potentials and fields in a change of reference system (relativistic formulation of EM) and resolution of simple field and potential transformation problems.

Theoretical and Practical Contents

Electromagnetism II (6 ECTS, mandatory, 3rd Course of the Degrees in Physics, Electronic Engineering and Double Degree F-IE))

Program:

1.- Problems of boundary conditions for static fields: Maxwell's equations in a vacuum and in continuous media. The Poisson and Laplace equations. Solutions of Laplace's equation in two dimensions. The method of images. Boundary conditions problems in magnetostatics. Introduction to numerical methods.

2.- Electromagnetic waves in unlimited media: Monochromatic plane waves in dielectrics. Polarization. Energy and momentum of EM waves. Waves in conductors: complex refractive index, skin effect.

3.- Electromagnetic waves in limited media: Reflection and refraction of EM waves. Fresnel formulas. Guided wave propagation: rectangular waveguides, cut-off frequency. resonant cavities.

4.- Radiation of electromagnetic waves: Delayed potentials: quasi-stationary and radiation regimes. Electric dipole radiation. Magnetic dipole radiation. antennae.

5.- Electromagnetic Theory of matter: Microscopic theory of dielectrics. Dependence of the permittivity with the frequency, dispersion. Microscopic theory of Magnetism. Conduction in solids, superconductors.

6.- Relativity and Electromagnetism: Lorentz transformation, quadri-vectors and tensors. The electromagnetic field tensor and Maxwell's equations in covariant form. Transformation of the electromagnetic field.

TEACHING METHODS

ECTS credits: 6 (150 hours: 60 face-to-face teaching hours and 90 student working hours)

A combination of teaching methods is used including:

- For the development of theoretical content, master classes that are complemented by classrooms exclusively dedicated to problem solving.

- For the development of continuous assessment, self-assessment tests will be proposed throughout the course.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	3	21						
Horas de Actividad No Presencial del Alumno/a	54	4,5	31,5						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS EVALUATION

There will be 2 partial exams (3 topics in each one):
- They will be done during teaching hours.
- The student must pass the first written test exam with a grade >=4 to be able to participate at the second partial exam.
NOTE: to pass the course, an average grade >=5 is mandatory.

Self-assessment tests will be carried out throughout the course.

Final mark of the course EM-II:
Grade = Average grade from partial exams + 0.15 x Grade for tests
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FINAL EVALUATION

If the student does not pass or failure to take the partial exams, the course will be graded through the Final Exam.

Final mark of the course EM-II: Final Exam mark (ordinary examination period)

OPTING OUT

Failure to take the test set on the official exam date will automatically waive the corresponding call.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The same criterion of the FINAL EVALUATION in ordinary examination period is maintained, that is, the grade for the subject will be the mark of the exam carried out in the extraordinary call.

OPTING OUT

Failure to take the test set on the official exam date will automatically waive the corresponding call.

MANDATORY MATERIALS

Notes and problems of the subject (eGela webpage of the course: https://egela.ehu.es)

BIBLIOGRAPHY

Basic bibliography

1) J.R. Reitz y, F.J. Milford y R.W. Christy, FUNDAMENTOS DE LA TEORIA ELECTROMAGNETICA, Addison-Wesley Iberoamericana, Delaware (1996).

2) P. Lorrain y D.R. Corson, CAMPOS Y ONDAS ELECTROMAGNETICOS, Selecciones Científicas, Madrid (1979).

3) D.J. Griffiths, INTRODUCTION TO ELECTRODYNAMICS, Prentice-Hall Inc. USA-1999.

4) R.K. Wagness, CAMPOS ELECTROMAGNETICOS, Limusa, México DF (1983).

5) M.A. Plonus, ELECTROMAGNETISMO APLICADO, Reverté, Barcelona (1982).

Detailed bibliography

6) J.D. Jackson. CLASSICAL ELECTRODYNAMICS. 3ª ed., Wiley, 1999

Other helpful bibliography:

7) MANUAL DE MATEMATICAS, I. Bronshtein y K. Semendiaev, Ed. Rubiños, Madrid (1993).

Journals

Revista Española de Física

Web sites of interest

http://www.sc.ehu.es/sbweb/ocw-fisica/elecmagnet/elecmagnet.xhtml
http://academicearth.org/courses/physics-ii-electricity-and-magnetism
http://ocw.mit.edu/OcwWeb/Physics/8-02Electricity-and-MagnetismSpring2002/CourseHome/

OBSERVATIONS

Universidad del País Vasco · Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25

Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GFISIC30 - Bachelor`s Degree in Physics	**Year**	First year

COURSE

26645 - Linear Algebra and Geometry I	**Credits, ECTS:**	12

COURSE DESCRIPTION

In this course, students will become familiar with basic concepts of Linear Algebra and some of their applications. Student will also be introduced to the management of mathematical language and the most common demonstration techniques.

In Degree in Mathematics, this subject shares a module with Linear Algebra and Geometry II, which is studied in the second year of the Degree. Both subjects have as common goal the understanding of the main concepts of Linear Algebra and Affine and Euclidean Geometries and their use to solve linear problems through matrices and geometric problems on planes and spaces. Likewise, both courses intend for the student to acquire basic and horizontal training in these subjects to allow them to understand and apply such knowledge and skills in multiple interrelated directions. Also, the contents studied in both will be used in both mandatory and optional higher-level courses.

In Degree in Physics, Degree in Electronic Engineering and Double Degree in Physics and Electronic Engineering, Linear Algebra and Geometry I, Differential and Integral Calculus I, Vector and Complex Analysis and Mathematical Methods comprise the Mathematics module. The central goal of this module is the acquisition of mathematical tools to allow students to focus on the physical aspects in other modules in the respective curricula. Likewise, students will learn to appreciate mathematical abstraction and conceptual rigour.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SPECIFIC COMPETENCIES
Know how to solve linear equation systems.
Understand the concept of vector space and the basic concepts related to vector spaces (subspaces and quotient spaces, basis and spanning set, linear transformations).
Know how to diagonalize matrices and compute the Jordan form of a matrix.
Know how to orthogonalize a vector system in an euclidean space.
Know how to diagonalize a quadratic form.
Work with points, vectors, distances and angles in affine and euclidean spaces.
Use references systems, subspaces and affine transformations.
Solve geometric problems of the plane and the spaces.
Classify isometries in the plane and the space, giving its type and characteristic elements.

LEARNING OUTCOMES
Solve linear equation systems.
Compute the Jordan form of a matrix.
Compute an orthogonalization of a vector system in an euclidean space.
Diagonalizing a quadratic form.
Work with points, vectors, distances and angles in affine and euclidean spaces.
Use references systems, subspaces and affine transformations.

Theoretical and Practical Contents

UNIT 1. VECTOR SPACES.
Vector space. Vector subspaces. Basis and dimension of a vector space. Change of basis.
UNIT 2. LINEAR TRANSFORMATIONS.
Linear transformations. Kernel and Range of a linear transformation. Isomophisms of Vector spaces. Matrix of a linear transformation.
UNIT 3. SYSTEMS OF LINEAR EQUATIONS AND DETERMINANTS.
Rank of a matrix. Elementary transformations and the computation of the rank of a matrix. System of linear equations. Rouché-Frobenius Theorem. The symmetric group. Determinant of a matrix. Cramer's Rule.
UNIT 4. DIAGONALIZATION OF ENDOMORPHISMS FROM V INTO V.
f-invariant subspaces. Eigenvalues and eigenvectors. Characteristic polynomial. Diagonalization. Introduction to Jordan canonical form.
UNIT 5. BILINEAR AND QUADRATIC FORMS.
Bilinear forms. Associated matrix of a bilinear form. Orthogonality. Non-degenerated forms. Orthogonal basis. Sylvester's law of inertia. Quadratic forms.
UNIT 6. EUCLIDEAN SPACES.
Inner product and norm. Orthonormality. Orthogonal subspaces. Some special endomorphisms. Isometries.
UNIT 7. AFFINE GEOMETRY
Affine structure of R^n. Affine subspaces. Intersection and parallelism. Affine reference system.
UNIT 8. EUCLIDEAN GEOMETRY

Euclidean affine structure of R^n. Perpendicularity. Distances and angles. Euclidean affine geometry of the plane and the space.
UNIT 9. GEOMETRIC TRANSFORMATIONS.
Affine transformations. Translations. Homotecies. Symmetries. Proyections. Rotations. Movements and similarities. Movements in the plane and the space.
UNIT 10. INTRODUCTION TO CONICS AND QUADRATICS.
Geometric elements of the conics. Reduction equations of the conics. Reduction equations of the quadratics.

TEACHING METHODS

Using the lecture methodology, the theoretical sessions will be presented in the master sessions, following the basic references contained in the Bibliography and the mandatory material. These lectures will be complemented with problem-solving classes in the practical classroom. These will be proposed to the students to solve questions in which the knowledge acquired in the theoretical classes is applied. Finally, in the seminar sessions, students will take a more active role and develop issues and representative examples of the content of the subject.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	72	12	36						
Horas de Actividad No Presencial del Alumno/a	108	18	54						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- See Guidelines and resignation 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

A final written examination will be taken on the subject taught in class on the date set in the official examination calendar of the Faculty corresponding to the regular May-June evaluation. This exam will be on the second of the dates assigned in the May-June calendar for the course. This examination will evaluate the level of acquisition of all the skills associated with the subject.

In addition, in order for students to be able to measure their progress in learning the subject, two partial exams are scheduled to take place in the official exam period in January and May-June, respectively. Both partial exams will be written. The first of the partial exams will cover the content explained in the first term of the course (weeks 1-15). The second partial exam will evaluate the acquisition of the competences associated to the content explained during the second term (weeks 16-30) and will take place on the first of the dates assigned to the course in the official May-June exam calendar. Students who pass one of the two partial exams or both partial exams will not have to take the exam on the content they have passed in the final exam of the ordinary evaluation.

CONTINUOUS EVALUATION:

PERCENTAGES OF THE MARKS
Written exam: 80%-100%
Oral exhibitions: 0%-5%
Submitted exercises and problems: 0%-15%

To apply the mentioned percentages the minimum mark in the written exam would be 4 over 10.

NON-CONTINUOUS EVALUATION: Final written exam 100%

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

A final written examination will be taken on the subject taught in class (weeks 1-30) on the date set in the official examination calendar of the Faculty corresponding to the extraordinary evaluation.

Final written exam: 100%

MANDATORY MATERIALS

Classroom notes. Exercise and problem sheets.

BIBLIOGRAPHY

Basic bibliography

M. CASTELLET e I. LLERENA, Álgebra Lineal y Geometría, Reverté, 2000.
M. EIE, S. CHANG, A first course in linear algebra, World Scientific, 2016.
E. HERNÁNDEZ, M.J. VÁZQUEZ y M.A. ZURRO, Álgebra Lineal y Geometría, Pearson, 2012.
P. PETERSEN, Linear algebra, Springer-Verlag, 2012.
A. SHELDON, Aljebra Lineala ondo egina, Euskal Herriko Unibertsitateko Argitalpen Zerbitzua, UPV/EHU, 2017.
A. SHELDON, Linear Algebra Done Right, Springer International Publishing, 2015.
G. STRANG, Introduction to Linear Algebra, 5th ed. Wellesley-Cambridge Press, 2016.
A. VERA y P. ALEGRIA, Problemas de Geometría Analítica y Formas Bilineales. Murcia,1993.
A. VERA y J.M. ARREGI, Aljebra Lineala eta Geometria I, Ed. AVL, Bilbao 1998.
A. VERA, J.L. HERNANDO y F.J. VERA, Problemas de Algebra I, Ed. Ellacuria, Bilbao 1986.
A. VERA y F.J. VERA, Introducción al Álgebra. Ed. Ellacuria, Bilbao 1984.

Detailed bibliography

R. BENAVENT, Cuestiones sobre Álgebra Lineal, Paraninfo, 2011.
J. DE BURGOS, Álgebra lineal y Geometría cartesiana, MacGraw-Hill, 2006.
J. DE BURGOS, Test y Problemas Álgebra, García-Maroto Editores, 2011.
W. H. GREUB, Linear Algebra, Springer-Verlag, 1981.
I.M. GUELFAND, Lecciones de Álgebra Lineal, Servicio Editorial de la Universidad del País Vasco, 1986.
E. HERNÁNDEZ, Álgebra y Geometría, Addison Wesley, 1999.
J. IKRAMOV, Problemas de Álgebra Lineal, Mir, 1990.
I.V. PROSKURIAKOV, Problemas de Álgebra Lineal, Mir, 1986.

Journals

Web sites of interest

https://ocw.ehu.eus/file.php/133/algebra/Course_listing.html
http://ocw.ehu.es/course/view.php?id=212
http://ocw.ehu.es/course/view.php?id=43
https://ocw.ehu.eus/course/view.php?id=343
http://ocw.ehu.es/ciencias-experimentales/introduccion-al-algebra-lineal/Course_listing
http://math.about.com/od/linearalgebra/Linear_Algebra_Help_and_Tutorials.htm

OBSERVATIONS

COURSE GUIDE 2024/25

Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GFISIC30 - Bachelor`s Degree in Physics	**Year**	Third year

COURSE

26646 - Experimental Techniques III — **Credits, ECTS:** 9

COURSE DESCRIPTION

Experimental techniques provide a complementary perspective to the phenomena described in the subjects Optics and Thermodynamics. Measurement techniques, proprietary technologies and data processing related to these disciplines will be worked out. Due to the characteristics of the practices, it is fundamental that the concepts from the subjects "Optics" and "Thermodynamics and Statistical Physics" have been correctly assimilated. The knowledge of these subjects will also be evaluated in Experimental Techniques III.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

-M03CM01: Carry out physical experiments independently.
-M03CM02: Critically analyze the results and draw conclusions. Assess the uncertainty of the results and compare them to what is theoretically expected.
-M03CM03: Deal with the numerical processing and graphic presentation of data, and be able to express the acquired knowledge, results and ideas in writing and orally.
-M03CM04: Use the bibliography for research and project design.
-M03CM05: Know the basic experimental techniques.

Theoretical and Practical Contents

1. Introduction to the thermodynamics laboratory

2. Thermodynamics laboratory. The following experiments will be carried out:
1 Measurement of the adiabatic coefficient of ideal gases.
2 Thermal expansion of solids.
3 Specific heat capacity of solids.
4 Thermodynamic analysis of real gases.
5 Vapor pressure and heat of vaporization of water.
6 Stirling engine.

3. Introduction to optical equipment

4. Optics laboratory. Every year, 4 of the following experiments will be carried out:
1. Examination of lenses
2. Characteristics of optical glasses (prism spectrometer).
3. Interferometry through front splitting (Fresnel's biprism).
4. Wavefront-splitting interferometry (Michelson interferometer)
5. Measurement of the Rydberg constant (diffraction grating).
6. Interferences in thin sheets.
7. Analysis of the polarization of light.
8. Fraunhofer diffraction.

5. Project
Desing and presentation of the development of a laboratory experiment related to the topics of the subject.

TEACHING METHODS

1. Theoretical introduction and explanation of experiments
2. Experimental work in the lab.
3. Design and presentation of an experiment

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching		6		84					
Horas de Actividad No Presencial del Alumno/a		9		126					

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

Evaluation methods

- Continuous evaluation

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Exercises, cases or problem sets 65%
- Oral presentation of assigned tasks, Reading¿ 35%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The default system of evaluation in the ordinary call will be continuous evaluation, with the following rating percentages:
Experiments + lab reports: 60-70%
Project design + presentation: 30-40%

According to the university regulations, students can request to be evaluated through a final evaluation system, with the following criteria and percentages:
Carry out or present a laboratory experiment: 50%
Multiple choice exam: 50%
Students will be able to waive the continuous evaluation system by writing to the professors
within 18 weeks after the start of the course.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Carry out or present a laboratory experiment: 50%
Multiple choice exam: 50%

MANDATORY MATERIALS

The material available in the laboratories of Thermodynamics and Optics.

BIBLIOGRAPHY

Basic bibliography

- Santiago Velasco, José Manuel Faro (Editores), Manual de Técnicas Experimentales en Termodinámica, Ediciones Universidad de Salamanca

- Zemansky-Dittman, Heat and Thermodinamics.

- H.B. Callen, Thermmodynamics and an Introduction to Thermostatistics

- Stephen G. Lipson, Optics Experiments and Demonstrations for Student Laboratories, Institute of Physics Publishing, 2020

- J. Casas, Optica, Librería Pons, Zaragoza 1994.

- Hecht-Zajac, Optics.

Detailed bibliography

Journals

Web sites of interest

http://egela.ehu.es/
http://www.ub.edu/javaoptics/

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GDFIIE30 - Double Degree in Physics and Electronic Engineering	**Year**	Fourth year

COURSE

26648 - Solid State Physics I	**Credits, ECTS:**	6

COURSE DESCRIPTION

Esta asignatura tiene por objetivo familiarizar al alumno con los fenómenos físicos relacionados con la dinámica de los electrones y de la red en un sólido, y le proporciona la preparación teórica básica para comprender la Física de la Materia Condensada y sus múltiples aplicaciones prácticas.
Presupone un buen conocimiento de la Física Cuántica y extiende su dominio de aplicación de los átomos y moléculas a los sólidos cristalinos.
Aquellos alumnos interesados en profundizar sus conocimientos en este campo pueden cursar además la asignatura optativa "Física del Estado Sólodo II".

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Se trabajarán especialmente las siguientes competencias (se indica entre paréntesis las correspondientes competencias específicas de la titulación y las del Módulo M07: Física de Estado Sólido):
-Ser capaz de organizar, planificar y aprender autónomamente los conceptos fundamentales de la Física del Estado Sólido, basándose en el estudio independiente de la bibliografía obligatoria y en la resolución de ejercicios asignados regularmente (G001, G005, G006, M07CM02 y M07CM03)
-Comprender teóricamente los fenómenos físicos relacionados con la dinámica electrónica y de red en el sólido y conocer los modelos teóricos más relevantes: Modelo de Drude, teorema de Bloch y teoría de bandas electrónicas, aproximación tight-binding, aproximación armónica a las vibraciones de red y teoría de los semiconductores. (G002 y M07CM01)
-Interpretar y correlacionar los datos experimentales más importantes con los distintos modelos de dinámica electrónica y de la red en el sólido. (G004 y M07CM01)

Theoretical and Practical Contents

1- Introducción
Aproximación de Born-Oppenheimer. Electrones en sólidos. Partículas independientes. Bandas de energía. Metales, aislantes y semiconductores.
2- El modelo de Drude
Introducción. Conductividad dc. Efecto Hall y magnetorresistencia. Conductividad ac. Conductividad térmica y efectos termoeléctricos. Ley de Wiedemann-Franz
3- El modelo de Sommerfeld
Modelo de electrones libres. El estado base del gas de electrones. Estadística de Fermi-Dirac. Propiedades térmicas del gas de electrones. Conducción eléctrica y térmica. Emisión termoiónica
4- Redes cristalinas
Redes de Bravais. Ejemplos. Celdas primitiva, convencional y de Wigner-Seitz. Estructuras cristalinas. Ejemplos. Red recíproca: definiciones y ejemplos. Zona de Brillouin.
5- Electrones en cristales
Potencial periódico. Teorema de Bloch. Condiciones de Born-von Karman. Superficie de Fermi. Densidad de estados. Electrones casi libres: Teoría de perturbaciones. Aparición de gaps de energía. Bandas en 1D y 3D. Electrones fuertemente ligados: método LCAO. Formulación en 1D y 3D.
6- Dinámica vibracional
Aproximación armónica. Vibraciones de red. Ejemplos: Red monoatómica unidimensional. Condiciones de contorno. Red unidimensional con una base. Modos acústicos y ópticos. Red tridimensional monoatómica. Matriz dinámica. Relaciones de dispersión. Conexión con la teoría de la elasticidad. Condicionamientos de la simetría. Modos transversales y longitudinales. Ley de Dulong-Petit.
7- Teoría cuántica del cristal armónico
Cuantización. Relaciones generales. Operadores de creación y aniquilación. Energía vibracional. Distribución térmica de fonones. Calor especifico. Expresiones generales discreta y continua. Densidad de modos. Modelos de Einstein y de Debye. Temperatura de Debye.
8- Semiconductores
Propiedades generales. Estructura de bandas. Portadores en equilibrio térmico. Semiconductores intrínsecos y extrínsecos. Semiconductores inhomogéneos. La unión p-n.

TEACHING METHODS

El libro de texto indicado en la bibliografía (Ashcroft y N. D. Mermin) se utilizará desde el primer día de clase y es imprescindible para poder seguir la asignatura, por lo que es muy recomendable que se disponga de él antes de empezar el curso.
Cada día se asignarán unas páginas del libro de texto para estudiar fuera del aula. Al comienzo de cada clase los alumnos podrán intervenir para exponer sus dudas y comentarios, y el profesor orientará la clase en función de estas intervenciones, aclarando los puntos difíciles y ampliando el material presentado en el libro.

Una parte de las prácticas de aula (GA) serán evaluadas como examenes parciales escritos (véase aclaraciones sobre la evaluación)

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	3	21						
Horas de Actividad No Presencial del Alumno/a	54	4,5	31,5						

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 90%
- Exercises, cases or problem sets 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Método de evaluación:
P= Participación alumno en prácticas de aula
E= Examen final escrito
Nota asignatura = P + E

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

En la convocatoria extraordinaria (junio) el examen final constituye siempre el 100% de la nota de la asignatura.

MANDATORY MATERIALS

* N. W. Ashcroft y N. D. Mermin, "Solid State Physics", Saunders College Publishing 1976.

BIBLIOGRAPHY

Basic bibliography

* N. W. Ashcroft y N. D. Mermin, Solid State Physics, Saunders College Publishing 1976.
* C. Kittel, Introducción a la Física del Estado Sólido, Springer 1995.

Detailed bibliography

Journals

Web sites of interest

OBSERVATIONS

Universidad del País Vasco Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GFISIC30 - Bachelor`s Degree in Physics	**Year**	Fourth year

COURSE

26649 - Solid State Physics II	**Credits, ECTS:**	6

COURSE DESCRIPTION

This course aims to delve into the basic phenomena related to the physical properties of crystalline solids. It provides a basic theoretical preparation for understanding the Physics of Condensed Matter and its many practical applications.

It presupposes a good knowledge of Quantum Physics, Statistical Physics, practical notions of computation and having successfully completed the mandatory course Solid State Physics I.

Although it is not necessary to have taken the optional Quantum Mechanics and Structural Properties of Solids, they help in understanding some concepts taught in this course.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The following competences will be especially dealt with

- Being able to organise, plan and learn autonomously the fundamental concepts of Solid State Physics, based on the independent study of bibliography and the resolution of regularly assigned exercises.

- An ability to theoretically understand physical phenomena related to the fundamental properties of solids.

- An ability to interpret and correlate experimental data with basic theoretical models.

- Being able to carry out simple computational calculations on the phenomena and models studied, developing small computer programs in the MATHEMATICA language.

- An ability to understand and critically interpret the content of simple research articles related to the subject matter of the course.

Theoretical and Practical Contents

0- Electronic bands in real crystals
Free electron bands and Fermi surfaces in two and three dimensions. Nearly-free electrons and pseudopotentials. Hybridation of orbitals and tight-binding method. Independent electrons and DFT.

1- Electron dynamics in crystals
Electron wave-packets.Semiclassical model and equations of motion. Motion under electrostaic fields. Effective mass. Holes. Motion in a static magnetic field. Measuring the Fermi surface. The Haas-van Alphen effect. Introduction to the quantum Hall effect.

2- Scattering
Introduction. Crystal momentum conservation. Neutron scattering: general aspects. Cross section. Elastic scattering (Bragg's law) and inelastic (one phonon processes). Optical probes: Brillouin and Raman scattering.

3- Anharmonic effects
Limitations of the harmonic approximation. Nearly-harmonic approximation and thermal expansion. The Gruneisen parameter. Thermal conductivity.

4- Magnetic properties
Interactions of solids with magnetic fields. Magnetic susceptibility. Larmor diamagnetism. Curie's law. Pauli paramagnetism. Electonic interactions and magnetic structure. Magnetic properties of two-electrons systems.Exchange interaction. Spin hamiltonian. Ferromagnetism and antiferromagnetism.

5.Defects and optical properties
Point defects. Color centers. Polarons and excitons. Optical spectroscopies. The Franck-Condon effect.

TEACHING METHODS

The textbook indicated in the bibliography (Ashcroft and Mermin) will be used from the first day of class and it is essential to be able to follow the course, so it is highly recommended that you have it before starting the course. Apart from that book, additional Moodle material will be distributed on each topic.

Textbook pages and additional material will be regularly assigned for study outside the classroom. At the beginning of each class, students will be able to speak up to express their doubts and comments, and the teacher will focus the class according to this, clarifying any difficult points and elaborating upon the material distributed in writing.

Examples of small codes written in MATHEMATICA will also be distributed to allow students to perform calculations and show results for various examples related to the course. Based on those codes, students may be assigned tasks relating to their modification or the design of new ones to allow results to be obtained for other examples.

Depending on the progress of the course, some classroom practice may also be evaluated, the result of which would be included in the ordinary evaluation.

VERY IMPORTANT: It is a course in which regular attendance to class is fundamental. In any case, only students who regularly attend classes will be able to submit papers throughout the course and attend evaluated classroom practicals.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	3	21						
Horas de Actividad No Presencial del Alumno/a	54	4,5	31,5						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

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

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

P = Average mark of the papers delivered through eGela and, if applicable, the written partial tests carried out during the term ("evaluated classroom practicals"). Papers not delivered within deadlines and classroom practicals which have not been undertaken will get a 0 mark.

WAIVERS: Failure to attend the final exam will result in a "deferral" (NO PRESENTADO) mark.

- Pursuant to the new UPV/EHU regulations, during the first nine weeks of the term, students can waive their class mark by notifying their teacher in writing. In that case, their mark will be solely based on the final exam, without taking into account any assignments delivered or classroom practicals evaluated. Students without a class mark may have to take additional tests during the final exam to demonstrate their competence in those aspects of the course evaluated in the class mark.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The mark will be solely based on the final exam.

MANDATORY MATERIALS

-Textbook by Ashcroft y Mermin.

-The program "Mathematica". Students of the University of the Basque Country can download the program for free, following the directions in eGela.

BIBLIOGRAPHY

Basic bibliography

* Ashcroft, N.W., Mermin, N.D. "Solid State Physics", Holt, Rhinehart & Winston 1976.
* Hook, J.R., Hall, H.E. "Solid State Physics", John Wiley 1991.
* Kittel, C., "Introducción a la Física del Estado Sólido", Reverté 1993.

Detailed bibliography

Please check eGela.

Journals

Research papers on related topics may be assigned for reading along the course. Students of the University of the Basque Country may download a VPN that gives electronic access to many scientific journals.

Web sites of interest

Please check eGela.

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

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

Degree GFISIC30 - Bachelor`s Degree in Physics **Year** Fourth year

COURSE

26652 - Quantum Mechanics **Credits, ECTS:** 6

COURSE DESCRIPTION

Pure states and mixtures. Symmetry. Approximation methods. Theory of collisions.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Degree competences (all transversal):
G001. Learn to pose and solve problems correctly.
G005. Be able to organize, plan and learn autonomously.
G006. Be able to analyze, synthesize and reason critically.
G008. Be able to present ideas, problems and scientific results orally and in writing.

Competences of the Solid State Physics module:
CM01. Acquire the necessary knowledge to reach a global understanding of the basic theoretical principles of the Physics of Condensed Matter.
CM02. Correctly propose and solve problems involving the main concepts of Solid State Physics in order to acquire the basic knowledge of this branch of Physics.
CM03. To document and pose in an organized manner subjects related to the Physics of Condensed Matter to strengthen or expand knowledge and to discern between the important and the accessory.
CM04. Orally expose problems and questions about Condensed Matter Physics to learn to develop skills in scientific oral communication.

Theoretical and Practical Contents

Programme
* Pure states and mixtures: density matrix. Images of Schrödinger, Heisenberg and interaction.
* Symmetry: angular momentum, tensor operators and Wigner-Eckart theorem. Discrete symmetries.
* Approximation methods: WKBJ. Time-dependent perturbations: Fermi-Dirac's golden rule. Electromagnetic interaction
* Theory of collisions. Approximation of Born. Development in partial waves. Resonances. Inelastic collisions.

TEACHING METHODS

Master lessons and practical problem-solving classes.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	3	21						
Horas de Actividad No Presencial del Alumno/a	54	4,5	31,5						

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

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

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The resolution and written delivery of at least three sets of proposed problems that constitute 30 percent of the final grade is mandatory.

Not taking the ordinary call (convocatoria ordinaria) exam equals giving up the call (renuncia a la convocatoria)

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Not taking the extraordinary call (convocatoria extraordinaria) exam equals giving up the call (renuncia a la convocatoria).

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Bibliografía
* J. J. Sakurai, with San Fu Tuan, Ed., Modern Quantum Mechanics, revised ed., Addison-Wesley, Reading, Mass., 1994.
* R. Shankar, Principles of Quantum Mechanics, 2nd edition, Plenum Press, New York, 1994.
* K. Gottfried and T.-Mow Yan, Quantum Mechanics: Fundamentals, Second Edition, Springer 2003.

Detailed bibliography

Journals

Web sites of interest

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

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

Degree GFISIC30 - Bachelor`s Degree in Physics **Year** Fourth year

COURSE

26653 - Electrodynamics **Credits, ECTS:** 6

COURSE DESCRIPTION

Relativistic description of the electromagnetic field, radiation and Lagrangian formalism.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Degree competences (all transversal):
G001. Learn to pose and solve problems correctly.
G005. Be able to organize, plan and learn autonomously.
G006. Be able to analyze, synthesize and reason critically.
G008. Be able to present ideas, problems and scientific results orally and in writing.

Competences of the Fundamental Physics module (all generic):
CM01. Be able to describe the branches of current Physics.
CM02. Be able to raise and solve basic problems of these branches.
CM03. Be able to transmit basic ideas from fundamental physics to non-specialized public.
CM04. Be able to use several textbooks per subject.
CM05. Be able to lead and participate in group work.

Theoretical and Practical Contents

1- Maxwell equations
2- Electromagnetic radiation
3- Special relativity
4- Covariant formalism of Electrodynamics
5- Dynamics of charged relativistic particles
6- Lagrangian formulation of the electromagnetic field

TEACHING METHODS

Lectures on theoretical aspects and practical problem-solving classes.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	3	21						
Horas de Actividad No Presencial del Alumno/a	54	4,5	31,5						

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Not taking the ordinary call (convocatoria ordinaria) exam equals giving up the call (renuncia a la convocatoria).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Not taking the extraordinary call (convocatoria extraordinaria) exam equals giving up the call (renuncia a la convocatoria).

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

- J. D. Jackson, Classical Electrodynamics, 3rd ed., Wiley & Sons (1999).
- L. D. Landau, E. M. Lifshitz, Teorı́a clásica de campos, Reverté (1986).
- Andrew Zangwill, Modern Electrodynamics, Cambridge Univ. Press (2012).

Detailed bibliography

- F. Rohrlich, Classical Charged Particles, Addison-Wesley (1990).
- A. O. Barut, Electrodynamics and Classical Theory of Fields and Particles, Dover (1980).
- B. Thidé, Electromagnetic field theory, Dover (2009).
- D. J. Griffiths, Introduction to Electrodynamics, Prentice-Hall, New Jersey (1999).
- W. K. H. Panofsky, M. Phyllips, Classical Electricity and Magnetism, 2nd. edition, Addison-Wesley, (1972).
- A. P. French, Relatividad Especial, Reverté (1996).
- J. Costa Quintana, F. López Aguilar, Interacción Electromagnética. Teoría Clásica, Editorial Reverté (2007).
- J. Vanderlinde, Classical Electromagnetic Theory, 2nd edition, John Wiley & Sons (1993).
- W. Greiner, Classical Electrodynamics, Springer-Verlag (1998).
- V. V. Batyguin y I. N. Toptygin, Problems in Electrodynamics, Academic Press (1978).

Journals

Web sites of interest

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25

Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GFISIC30 - Bachelor`s Degree in Physics	**Year**	.

COURSE

26654 - Gravity and Cosmology	**Credits, ECTS:**	6

COURSE DESCRIPTION

Main Objectives of the Course
• That the student is comfortable with the fundamental concepts of Einstein's theory of gravitation and is able to apply these concepts for the study of both compact systems and the evolution of the universe on a large scale.
• Acquire basic knowledge in calculus and differential geometry, exact solutions of Einstein's equations, interpretation of certain solutions and temporal evolution of the universe from the first moments until today.
• Learn to calculate the geodetic trajectories, the curvature tensors in an arbitrary space-time (in particular, in spaces with a high degree of symmetry).
• Get the feeling that Einstein's gravitation is probably the most beautiful theory in modern physics.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Degree competences (all transversal):
G001. Learn to pose and solve problems correctly.
G005. Be able to organize, plan and learn autonomously.
G006. Be able to analyze, synthesize and reason critically.
G008. Be able to present ideas, problems and scientific results orally and in writing.

Competences of the Fundamental Physics module (all generic):
CM01. Be able to describe the branches of current Physics.
CM02. Be able to raise and solve basic problems of these branches.
CM03. Be able to transmit basic ideas from fundamental physics to non-specialized public.
CM04. Be able to use several textbooks per subject.
CM05. Be able to lead and participate in group work.

Theoretical and Practical Contents

Program
* Introduction. Tensor analysis elements.
* The Equivalence Principle.
* Einstein's equations of the gravitational field. The solution of Schwarzschild.
* The classic experimental tests of general relativity. Black holes. Gravitational radiation.
* Physical cosmology.
* Cosmological models.

TEACHING METHODS

Lectures on theoretical aspects, and practical problem-solving sessions.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	6	18						
Horas de Actividad No Presencial del Alumno/a	54	9	27						

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 70%
- Exercises, cases or problem sets 15%
- Individual assignments 15%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Not taking the ordinary call (convocatoria ordinaria) exam equals giving up the call (renuncia a la convocatoria).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

"Este método de evaluación podría sufrir cambios si las directrices de las autoridades sanitarias así lo estableciesen. Las modificaciones se anunciarían oportunamente, contando con las estrategias y herramientas necesarias para garantizar el derecho del alumnado a ser evaluado con equidad y justicia."

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Bibliografía
* B. Schutz (2003) Gravity from the ground up (Cambridge University Press)
* P.J.E. Peebles (1993) Principles of physical cosmology (Princeton University Press)
* S. Weinberg (1972) Gravitation and Cosmology: Principles and applications of the general theory of relativity (Wiley and sons, New York).

Detailed bibliography

Will be announced during the course.

Journals

Web sites of interest

OBSERVATIONS

COURSE GUIDE 2024/25

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

Degree GFISIC30 - Bachelor`s Degree in Physics **Year** .

COURSE

26655 - Astrophysics **Credits, ECTS:** 6

COURSE DESCRIPTION

Introduction to Astrophysics: classification of spectra, stellar atmospheres, interior of stars, equilibrium and stellar evolution.
Galaxies: structure and evolution.
Introduction to cosmology: primitive universe, dark matter and dark energy.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Degree competences (all transversal):
G001. Learn to pose and solve problems correctly.
G005. Be able to organize, plan and learn autonomously.
G006. Be able to analyze, synthesize and reason critically.
G008. Be able to present ideas, problems and scientific results orally and in writing.

Competences of the Fundamental Physics module (all generic):
CM01. Be able to describe the branches of current Physics.
CM02. Be able to raise and solve basic problems of these branches.
CM03. Be able to transmit basic ideas from fundamental physics to non-specialized public.
CM04. Be able to use several textbooks per subject.
CM05. Be able to lead and participate in group work.

Theoretical and Practical Contents

Programme:

1. Introduction to Astronomy: celestial sphere, celestial mechanics, continuous spectrum of light.
2. Stellar spectra: classification, Boltzmann equation, Saha equation, Hertzsprung-Russell diagram.
3. Binary systems: classification of binaries, nearby systems.
4. Stellar atmospheres: transport of energy, opacity.
5. Star interior: equilibrium, nuclear reactions, polytropes, Vogt-Russell theorem.
6. Stellar evolution: Jeans mass, main sequence, post-main sequence evolution.
7. Galaxies: morphology and classification, galactic dynamics, dark matter.
8. Cosmology: large-scale structure, early universe, accelerated expansion.

TEACHING METHODS

Lectures on theoretical aspects and practical problem-solving classes.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	3	21						
Horas de Actividad No Presencial del Alumno/a	54	4,5	31,5						

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Not taking the ordinary call (convocatoria ordinaria) exam equals giving up the call (renuncia a la convocatoria).

In case the sanitary conditions do not allow for a face-to-face evaluation, an online evaluation will be activated and the students will be duly informed.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Not taking the extraordinary call exam equals giving up the call.

In case the sanitary conditions do not allow for a face-to-face evaluation, an online evaluation will be activated and the students will be duly informed.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

[1] B. Carrol and D. Ostlie, An Introduction to Modern Astrophysics, Pearson (2007).
[2] R. Kippenhahn and A. Weigert, Stellar Structure and Evolution, Springer-Verlag (1990).
[3] E. Novotny, Introduction to Stellar Atmospheres and Interiors, Oxford University Press (1973).
[4] D. Maoz, Astrophysics in a Nutshell, Princeton University Press (2007).

Detailed bibliography

[5] A. Unsold and B. Baschek, The New Cosmos, 4th ed., Springer-Verlag (1991).
[6] M. Zeilik, S. A. Gregory and E. V. P. Smith, Introductory Astronomy and Astrophysics, 3rd ed., Saunders College Publishing (1992).
[7] M. Harwit, Astrophysical Concepts, 4th ed., Springer (2006).
[8] A. R. Choudhuri, Astrophysics for Physicists, Cambridge University Press (2010).
[9] S. Chandrasekhar, An introduction to the study of Stellar Structure, Dover Publications (1958).
[10] A. Liddle, An Introduction To Modern Cosmology, Wiley (2015).
[11] P. Coles and F. Lucchin, Cosmology, The Origin and Evolution of Cosmic Structure, 2nd ed., Wiley (2002).

Journals

Web sites of interest

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GFISIC30 - Bachelor`s Degree in Physics	**Year**	Fourth year

COURSE

26656 - Themes of Physics — **Credits, ECTS:** 6

COURSE DESCRIPTION

The contents varies changing every year according to the students' preferences. Some popular examples of the subjects treated are Geophysics, Black Holes, Nanophysics, Graphene, History of Physics, Gravitational lenses, Origin and fate of the Universe, the concept of Time, Entanglement, etc. Subjects on the border with physics can also be discussed. Participation of the students is required, and they will have to present in a subject in the classroom to be discussed by all.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Degree competences (all transversal):
G001. Learn to pose and solve problems correctly.
G005. Be able to organize, plan and learn autonomously.
G006. Be able to analyze, synthesize and reason critically.
G008. Be able to present ideas, problems and scientific results orally and in writing.

Competences of the Fundamental Physics module (all generic):
CM01. Be able to describe the branches of current Physics.
CM02. Be able to raise and solve basic problems of these branches.
CM03. Be able to transmit basic ideas from fundamental physics to non-specialized public.
CM04. Be able to use several textbooks per subject.
CM05. Be able to lead and participate in group work.

Theoretical and Practical Contents

The contents will change every year adapting itself to the fashionable subjects, to the interests of a majority of students, or similar circumstances.

TEACHING METHODS

Clases participativas, discusiones sobre temas de interés, y algunas clases magistrales.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	10	40	10						
Horas de Actividad No Presencial del Alumno/a	15	60	15						

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Individual assignments 60%
- Oral presentation of assigned tasks, Reading¿ 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The student has the right to waive the call in writing one month before the start of the exam period.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

Any contemporary book on Physics, together with the Journals:

Scientific American

Physics World

Detailed bibliography

Journals

Investigación y Ciencia

Physics World

Suplemento Tercer Milenio (EL Heraldo de Aragón).

New Scientist

Web sites of interest

https://francis.naukas.com

https://culturacientifica.com/catedra-de-cultura-cientifica/

https://naukas.com

http://www.newpackettech.com/Resources/Susskind/

OBSERVATIONS

COURSE GUIDE 2024/25

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

Degree GFISIC30 - Bachelor`s Degree in Physics **Year** Fourth year

COURSE

26657 - Structural Properties of Solids **Credits, ECTS:** 6

COURSE DESCRIPTION

In this course the basic elements necessary to describe the microscopic properties of crystalline matter are presented. The first topic introduces the necessary elements for a classification based on the geometric ordering of atoms. The next topic discusses the classification of solids based on the valence electronic structure of the atoms. The third theme describes the physical properties and the effect of symmetry on them. Finally, the bases of crystal diffraction are presented as a technique for the determination of crystalline structures.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

- To know and to handle the physical and mathematical fundamentals of the diffraction of X-rays and electrons for the structural analysis of matter.
- Development of skills to visualize three-dimensional structures and recognize different structures.
- Identify the symmetry-elements and operations, lattice-types, crystalline systems, point-groups and space-groups, as well as notation systems.

Theoretical and Practical Contents

Structural Properties of Solids (6ECTS, optional, 4th year)

Syllabus

Crystal symmetry
1. Introduction to the structure of solids. Symmetry-elements and transformations. Proper and improper operations. Helical axes and sliding planes. Bravais lattice. Point groups. Crystal systems and Bravais lattices in 2 and 3 dimensions. Wigner-Seitz lattice. Space groups. Setting standard. Transformations between different settings. Symmorphic and non-symorphic groups. Chirality and enantiomorphism. Wickoff positions. Type structures.
2-Classification of solids and cohesion energy
Molecular bonds. Molecular, ionic and covalent solids. Ionic radii. Stability of ionic structures. Hydrogen bond. Cohesion, general concepts. The noble gas solids. Lennard-Jones potential. Madelung’s constant. Cohesion energy in metals.
3-Physical properties of solids
Crystal anisotropy. Tensor physical properties. Symmetry of physical properties: reduction of tensors. Curie-Neumann principle. Rank 1 tensors: polarization. Rank 2 tensors: tension and deformation. Propagation of elastic waves: elastic constants. Piezoelectricity. Thermodynamic properties of crystals: thermoelastic effect, heat of deformation, direct effects, coupled effects. Pyroelectricity. Examples of optical tensors.
4-Diffraction and solid structure determination
Physical bases of diffraction. Reciprocal lattice. X-rays, neutrons and electrons. Diffraction geometry. Diffraction by gases, liquids and solids. Laue equations. Bragg’s law. Structure factor.

TEACHING METHODS

The development of course content will be done through in-class lessons. The resolution of exercises will be done by the teacher and students will have to do the presentation of their work. The course is complemented with the contents presented in the corresponding course in Egela, where collections of exercises and exams from previous courses can be found.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	3	21						
Horas de Actividad No Presencial del Alumno/a	54	4,5	31,5						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Exercises, cases or problem sets 50%
- Oral presentation of assigned tasks, Reading¿ 50%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

P : Participation in classroom practice sessions. It includes periodic delivery of exercises resolved in class.
T : Exhibition of works carried out individually or in groups.
E: Final exam.
Three options are considered for the calculation of the final grade:
Option 1: Continuous evaluation 1: P + T
Option 2: Continuous evaluation 2: (P + T) × 0.7 + E × 0.3
Option 3: Final exam: E.
By default, option (1) will be assumed. To take advantage of option (3) the intention to renounce continuous assessment must be communicated in writing to the teacher before November 15. People who appear on the day of the exam without having renounced the continuous evaluation will take advantage of option (2).

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Final exam, whose result will be 100 % of the final grade.

MANDATORY MATERIALS

Curso en Egela: https://egela.ehu.eus/course/view.php?id=21799

BIBLIOGRAPHY

Basic bibliography

- Malgrane, C., Ricolleau, C., Schlenker, M., Physical Properties of Crystals. Ed. Springer 2014, ISBN 978-94-017-8993-6 (eBook).
- Ashcroft, N.W., Mermin, N.D. Solid State Physics. Holt, Rhinehart and Winston 1976.
- Giacovazzo, C., Fundamentals of Crystallography Oxford Univ Press, 1992.
- Nye, J.F., Physical Properties of Crystals: Their Representation by Tensors and Matrices Oxford Univ Press, 1985.

Detailed bibliography

Journals

Web sites of interest

Bilbao Crystallographic Server: www.cryst.ehu.eus
Inorganic Crystal Structure Database (ICSD): webbdcrista1.ehu.es/icsd/index.php
Materials Project: materialsproject.org

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GELECT30 - Bachelor`s Degree in Electronic Engeineering	**Year**	Fourth year

COURSE

26847 - Digital Systems Design	**Credits, ECTS:**	6

COURSE DESCRIPTION

Digital Systems Design is an optional subject in 4th year of the Degree in Electronic Engineering and in the 5th year of the double Degree in Physics and Electronic Engineering. In particular, the subject is part of the speciality General Purpose Electronic Systems. The subject focuses on providing students with knowledge and skills to allow them to tackle an advanced project in designing a digital system in different fields of application, using programmable logic devices and the latest technologies of design with VHDL. Architectures and designs for high speeds, optimisation of resources and optimisation of consumption.
In order to approach the design of digital systems it is necessary for students previously study the 3rd year subject of the Degree in Electronic Engineering, Digital Electronics subject which introduces the theoretical and practical fundamentals.
In relation to the professional field, Digital Systems Design is an eminently practical course that contributes to a successful profile for students and their insertion in different sectors where the design of circuits and digital electronic systems has a wide implantation: Consumer Electronics and Professional Electronics (including Industrial, Electromedicine, Defence and Instrumentation).

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

At the end of the course students are expected to have acquired the following competences:
- An ability to acquire dexterity in advanced aspects of the analysis and design of circuits and current digital electronic systems.
- An ability to understand and apply the most modern methods and techniques used in the planning, design and operation of circuits and complex digital electronic systems in various areas of application.
- An ability to understand and manage with ease computer tools to help design digital circuits on reconfigurable devices, promoting the use of ICTs.
- Being able to follow and understand the development and evolution of electronic devices and technologies, particularly in the field of digital electronics.
- Being able to approach the resolution of real practical problems, individually or in groups, in the development of digital electronic systems.
- An ability to communicate, both orally and in writing, knowledge, results and ideas related to analogue electronics.

Theoretical and Practical Contents

1- Introduction to digital systems. Evolution of integrated circuit technology. Moore's Law, Standard integrated circuits. Application-specific integrated circuits (ASIC).

2- Programmable logic devices: technologies and architectures. Background: PROM, PAL, PLA, SPLD devices. Complex programmable logic devices (CPLDs). EPROM and EEPROM technologies. Field programmable gate arrays (FPGAs). SRAM technology. Families of current devices. System on a programmable chip (SoPC).

3- Design methodologies
Tools to help the design of digital systems. Design flow: design input, synthesis, simulation and implementation. Hardware description languages (HDL) standard: VHDL and Verilog. Other languages used in the description of systems.

4- System design with VHDL I
Review of basic concepts of the VHDL language for synthesis. Structure of the code. Data types, operators and attributes. Signals and variables. Concurrent sentences. Sequential sentences. Design examples: combinational circuits, memory elements, registers, counters, state machines.

5- System design with VHDL II
Hierarchical design, use of "packages" and components. Generic components. Design of typical subsystems: arithmetic and logic operations, data paths, control units, memories, etc. Intellectual property blocks (IP blocks). Efficiency, portability and scalability of the code. Design of a digital system of practical interest: specification, synthesis, simulation and implementation on a current device.

6- High-speed architectures
System speed: measurement parameters. High performance architectures. Low latency architectures. Timing and clock signals.

7- Optimization of resources

Reuse of logical resources. Control of the management of resources. Shared logical resources. "RESET" structures: impact on the optimization of the area.

8- Optimization of consumption
Power consumption in CMOS technology. Terms of consumption in CPLDs and FPGAs. Low consumption families. Techniques to reduce consumption in CPLDs and FPGAs.

TEACHING METHODS

The subject is taught through lectures (20 h), practicals (10 h) and seminars (5 h). In addition to classroom practicals, the course also includes laboratory practicals (15 h) and computer practicals (10 h). In the first half of the course, theory classes are present the fundamentals of the technology of programmable devices, from the first devices to their current state. The theory classes of the second half are on the VHDL language. With regard to the theoretical part of the course, there are exercises in the design of circuits and digital systems. Periodically a class is devoted to discussing the solutions proposed by the students. Learning is complemented with the design, programming and verification of digital systems of practical interest in the laboratory using computational tools to aid design and development cards. In addition, the eGela tool is used as a means of communicating with students and as a platform for disseminating material and teaching resources.
Además, se utilizará la herramienta Moodle como medio de comunicación con el alumno y como plataforma de difusión de material y recursos docentes.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	20	5	10	15	10				
Horas de Actividad No Presencial del Alumno/a	30	7,5	15	22,5	15				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Exercises, cases or problem sets 30%
- Teamwork assignments (problem solving, Project design) 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

En la evaluación de la asignatura de tipo continuo se valorará:

- Prácticas e informes: 30 %
- Exposición oral de trabajos: 10%
- Prueba escrita individual: 60% de la nota de la asignatura

La prueba escrita constará de problemas a resolver, cuestiones de teoría aplicadas a los problemas propuestos y preguntas relacionadas con las prácticas de laboratorio. La calificación final se obtendrá de la media ponderada de las calificaciones previas, pero es necesario sacar una nota mínima de 5 sobre 10 en la prueba final individual.
Además, la realización de las prácticas de laboratorio es obligatoria para aprobar la asignatura por el sistema de evaluación continua.
A lo largo del curso se irán dando orientaciones de mejora de los trabajos entregados para guiar al alumno en la mejora de posteriores entregas.

Los y las estudiantes que no quieran participar en la evaluación continua deberán solicitar por escrito al responsable de la asignatura la renuncia a la evaluación continua en un plazo de 9 semanas desde el inicio del cuatrimestre.

El sistema de evaluación final consistirá en una prueba escrita individual y un examen de prácticas

- Prueba escrita individual: 60% de la nota de la asignatura
- Examen de prácticas de laboratorio y exposición oral: 40% de la nota

La prueba escrita constará de problemas a resolver y cuestiones de teoría aplicadas a los problemas propuestos. La calificación final se obtendrá de la media ponderada de las calificaciones previas, pero es necesario sacar una nota mínima de 5 sobre 10 en la prueba escrita individual. El examen de prácticas de laboratorio se realizará después de haber aprobado el examen escrito e incluirá la redacción de informes y una exposición oral.

Dado que el peso de la prueba final es superior al 40% de la calificación de la asignatura, bastará con no presentarse a dicha prueba final para que la calificación final de la asignatura sea no presentado o no presentada.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

La evaluación de esta asignatura se realizará a través del sistema de evaluación final y conservará los resultados positivos obtenidos en la evaluación continua.

MANDATORY MATERIALS

Página WEB de la asignatura en eGela

BIBLIOGRAPHY

Basic bibliography

* S. Brown and Z. Vranesic, Fundamentals of digital logic with VHDL design, Mc Graw Hill, 3º ed., 2008, ISBN: 978-0-077-22143-0.

Detailed bibliography

* S. Kilts, ADVANCED FPGA DESIGN: Architecture, Implementation, and Optimization, John Wiley and Sons, 2007, ISBN: 978-0-470-05437-6.
* P.P. Chu, FPGA PROTOTYPING BY VHDL EXAMPLES, John Wiley and Sons, 2008, ISBN: 978-0-470-18531-5.
* P.P. Chu, RTL HARDWARE DESIGN USING VHDL. Coding for Efficiency, Portability, and Scalability, John Wiley and Sons, 2006, ISBN: 978-0-471-72092-8.

Journals

Web sites of interest

* Notas de aplicación y bibliografía específica de los principales fabricantes de dispositivos programables: www.xilinx.com y www.altera.com.

OBSERVATIONS

La asignatura utilizará la herramienta eGela para la gestión, seguimiento e intercambio de información a lo largo del curso.

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GELECT30 - Bachelor`s Degree in Electronic Engeineering	**Year**	Fourth year

COURSE

26848 - Microelectronics & Micro-systems	**Credits, ECTS:**	6

COURSE DESCRIPTION

La asignatura Microelectrónica y Microsistemas es una asignatura optativa de 4º curso del Grado en Ingeniería Electrónica, dentro del módulo M06: "Sistemas Electrónicos de Propósito General".

Esta materia presupone conocimientos sobre materiales semiconductores así como sobre la estructura y operación de dispositivos electrónicos básicos.

La asignatura está centrada en los procesos tecnológicos y en las características y diseño de circuitos y microsistemas integrados. Sus contenidos tienen una importante relación con las siguientes asignaturas del Grado en Ingeniería Electrónica: Dispositivos Electrónicos y Optoelectrónicos, Sensores y Actuadores, y Diseño de Sistemas Digitales.

La asignatura Microelectrónica y Microsistemas contribuye a la formación en el diseño de sistemas electrónicos integrados, una visión amplia del proceso tecnológico de diseño y micro y nanofabricación en sala blanca.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

La asignatura comprende las bases teóricas y los conocimientos tecnológicos para la fabricación de micro/nano dispositivos y sistemas. Se explican los procesos básicos de fabricación e integración de circuitos electrónicos y de micromecanizado. Se abordan diferentes ámbitos de aplicación que incluyen tecnologías de circuitos integrados, diseño y fabricación de dispositivos MEMs, microsensores, etc.

Theoretical and Practical Contents

Programa

1- Introducción a la industria microelectrónica.
Materiales. Fabricación de obleas. Control de la contaminación, sala blanca. Empaquetado. Parámetros de producción.
2-Procesos de fabricación de circuitos integrados.
Epitaxia. Deposición de capas delgadas. Crecimiento de capas delgadas. Procesos litográficos. Grabado. Oxidación. Difusión. Implantación de iones. Procesos de lavado (RCA, agua DI). Planarización (CMP). Interconexiones y contactos.
3- Tecnologías de integración electrónica.
Pozos, aislamientos y contactos. MOS. CMOS. Bipolar. BiCMOS.
4- Diseño físico de un circuito VLSI.
Layout. Capas. Reglas de diseño.
5- Tecnología del micromecanizado de silicio.
Micromecanizado en volumen. Micromecanizado en superficie. Proceso LIGA, micromoldeado. Soldadura de obleas de silicio.
6- Integración de microsistemas.
Estructuras. Compatibilidad con el proceso de ICs, preprocesado, postprocesado, fabricación integrada.
7- Diseño y fabricación de un microsensor.
8- Evolución de las tecnologías.
Nuevos materiales y procesos. Nanotecnología.

Bibliografía obligatoria
*

Bibliografía básica
* FALTA

Bibliografía de profundización
* FALTA

Revistas
*

Direcciones de Internet
*

TEACHING METHODS

La asignatura se imparte a través de clases magistrales, clases prácticas en aula para la resolución de problemas propuestos en guías, seminarios y prácticas de procesos y caracterización en laboratorio.
El material docente se pondrá a disposición del alumno en la web del Campus Virtual de la UPV/EHU a través de la plataforma Moodle.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	5	5	20					
Horas de Actividad No Presencial del Alumno/a	45	7,5	7,5	30					

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 65%
- Exercises, cases or problem sets 20%
- Individual assignments 10%
- Oral presentation of assigned tasks, Reading¿ 5%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

La evaluación de la asignatura se realizará a partir de las siguientes contribuciones :

10% Ejercicios entregables : resolución de ejercicios en clase y/o entrega de ejercicios resueltos manuscritos.

10% Trabajo de preparación y realización de prácticas de laboratorio.

20% Trabajo individual : presentación escrita y oral.

60% Pruebas de clase : uno o dos controles.

- Prueba escrita consistente en la resolución de ejercicios, problemas y cuestiones teóricas.

- No se permitirá utilizar libros, apuntes u otro tipo de información relacionada con la asignatura, salvo la aportada por el profesor el día del examen.

- Se realizará con tinta azul o negra, no con lápiz.

- Será necesario disponer de calculadora y regla.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

La evaluación de esta asignatura es de tipo mixto y se realiza a partir de:

- Trabajos y ejercicios entregables (10%): resolución de ejercicios en clase y/o entrega de ejercicios resueltos manuscritos. Se valora la presentación, estructura, redacción, explicaciones y conclusiones.

- Prácticas e informes (10%). La realización de las prácticas de laboratorio es obligatoria para aprobar la asignatura.

- Memoria de un trabajo individual (10%).

- Exposición pública de un trabajo individual (5%).

- Prueba final (65%). Esta prueba consistirá en la resolución de ejercicios, problemas y cuestiones teóricas. No se permitirá utilizar libros, apuntes u otro tipo de información relacionada con la asignatura, salvo la aportada por el profesor el día del examen. Se realizará con tinta azul o negra, no con lápiz. Será necesario disponer de calculadora y regla.

A aquellos alumnos que no hayan entregado los trabajos y ejercicios propuestos por el profesor durante el curso se les podrá solicitar que presenten estos trabajos para aprobar la asignatura.

Para renunciar a la convocatoria extraordinaria será suficiente con no presentarse a la prueba final.

MANDATORY MATERIALS

Página WEB de la asignatura en el gestor de aulas virtuales eGela.

BIBLIOGRAPHY

Basic bibliography

* Michael Quirk and Julian Serda, "Semiconductor Manufacturing Technology", Prentice Hall, 2001.
* Stephen A. Campbell, "The Science and Engineering of Microelectronic Fabrication", Oxford University Press, 2002.

Detailed bibliography

* Nadim Maluf, "An Introduction to Microelectromechanical Systems Engineering", Second Edition. Artech House Publishers; 2nd edition (June 2004).
* Marc J. Madou, "Fundamentals of Microfabrication: The Science of Miniaturization", Second Edition. CRC; 2nd edition (March 13, 2002).

Journals

* IEEE Nanotechnology Magazine

Web sites of interest

* en.wikipedia.org/wiki/Microelectronics

OBSERVATIONS

COURSE GUIDE 2024/25

Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GELECT30 - Bachelor`s Degree in Electronic Engeineering	**Year**	First year

COURSE

26662 - Foundations of Programming — **Credits, ECTS:** 6

COURSE DESCRIPTION

The only requirement to take this subject is a general knowledge of computer science and basic programming skills, such as those provided by the subject "Introduction to Computer Science" during the first semester. The student should be also familiar with basic mathematical concepts on linear algebra, geometry and analysis. The subject introduces basic and more advanced search and sorting algorithms and studies their computational efficiency (especially, time complexity), by applying algorithm analysis techniques and using asymptotic notation. Then, the concept of abstract data type (ADT) is introduced and several ADTs are studied in increasing order of complexity, as well as some algorithm design techniques. The examples and exercises are supported by a high level programming language used in the current scientific-technological environment. The subject provides the knowledge and skills needed to solve algorithmic problems of medium complexity that will allow the students to undertake modeling and simulation tasks in other subjects of the degree.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SPECIFIC COMPETENCES
- To know the basics of current programming techniques: data structures, structured programming and object-oriented programming.
- To know and apply methods to study and compare the computational complexity of algorithms.
- To be able to apply a rigorous programming methodology based on the knowledge of data structures and computing methods for the development of software projects.
- To master a general-purpose programming language which is commonly used in today's scientific-technological environments, being able to use it for the implementation of basic algorithms.
- To be able to present a programming project clearly and concisely, and to explain the design decisions made during its development.

LEARNING OUTCOMES
- To know the main features and the most common implementations of basic data structures: linear (list, stacks and queues) and non-linear structures (hash tables, trees and graphs), and to be able to identify the most suitable structures depending on the application and how to integrate them in more general designs.
- To know and apply computational complexity analysis techniques, in order to compare two or more algorithms with each other and choose the best one (in terms of efficiency) for some given problem and context.
- To design new ADTs, exploit existing ADTs and apply basic algorithm design techniques to solve problems in a structured, clear and efficient manner.
- To be a productive part of a team in a real programming environment, using a high level programming language to solve algorithmic problems, analyzing alternative solutions, identifying the ADTs that are required, exploiting those that are already available, designing and implementing those that are not, and using running time profiles to make a decision about the most suitable approach.

Theoretical and Practical Contents

CONTENTS

1. Search and sorting algorithms
  - Basic search schemes: sequential search and binary search
  - Basic sorting schemes: insertion, selection and bubble sort
  - Partition sort (quicksort)
  - Merge sort

2. Analysis of the computational efficiency of algorithms
  - Asymptotic notation versus running time profiles
  - Analysis of control structures
  - Analysis of recursive algorithms
  - Divide and Conquer algorithms

3. Abstract Data Types (ADT)
  - ADT-based design
  - Object Oriented Programming (OOP)
  - Study of cases

4. Linear ADT
  - Stacks
  - Queues
  - Priority queues

5. Non-linear ADT
  - Hash tables
  - Heaps
  - Trees
  - Binary search trees

6. Graphs (advanced topic)
  - Definitions, operations and representations
  - Paths and connectivity
  - Minimum spanning trees
  - Greedy algorithms
  - Shortest paths
  - Dynamic programming algorithms

HANDS-ON LEARNING ACTIVITIES

Three open problems (of increasing complexity) are proposed, related to the topics developed in lectures. For each of them, students must develop one or several algorithmic solutions and, depending on the case, write a brief report (results, running time profiles, etc.), which will be uploaded to the e-gela (Moodle-based LMS) platform. The proposed problems will change every year, but their general objectives will be: (1) to strengthen the knowledge about data structures and the programming skills acquired during the first semester in the subject "Introduction to Computer Science"; (2) to study the computational efficiency of algorithms from a practical point of view (that is, by obtaining running time profiles); and (3) to design, develop and apply one or several ADTs in a realistic situation.

TEACHING METHODS

The teaching team employs five different teaching/learning modalities:

(1) Lectures, in which the instructor exposes a topic based on a slide presentation, with notes on the board and often with the development of code examples on the computer. Lectures are fundamentally unidirectional, though students are invited to ask any questions that may arise. Lecture notes, code examples, exercises, and even relevant links for those interested, are provided through the e-gela platform.

(2) Problem-solving sessions, in which the students, with the help of the instructor, present and discuss their solutions to the exercises. This modality is essentially interactive. Eventually, these sessions are also used to solve doubts about the contents exposed in lectures or about the hands-on (programming) sessions. Commented solutions to the exercises are also provided through the e-gela platform.

(3) Hands-on (programming) sessions, in which the students, with the support of the teaching team, write and debug code in a programming environment. Each student goes through seven highly interactive sessions that take place in a computer lab. As noted above, three different problems (of increasing complexity) are proposed, each supplied with the necessary datasets, designed specifically to develop aspects discussed in lectures. Students must encode algorithmic solutions in a programming language and write a brief report with the obtained results. These sessions aim to provide the students with confidence in the application of the acquired knowledge and to develop creative skills through the interaction with the teaching team and other students.

(4) Seminars, in which advanced topics about the programming language are exposed and discussed. Each student attend to five one-hour seminars in a computer lab, just before the first five hands-on sessions, so that they can check and explore the discussed topics by themselves in a programming environment.

(5) Tutorials, in which instructors deal with students at their office, to answer questions about the contents, the proposed exercises or the hands-on sessions. This teaching modality allows for a more direct and personal interaction. Though there is an official time slot for tutorials, students can set an appointment at any time, as long as the instructors are available. Finally, students can also raise questions through e-mail, the instructors placing their answers usually within two days.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	5	10		15				
Horas de Actividad No Presencial del Alumno/a	45	7,5	15		22,5				

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Individual assignments 20%
- Teamwork assignments (problem solving, Project design) 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the First Call, there will be two possible assessment paths. In the CONTINUOUS ASSESSMENT path (which is the default path), the final grade is computed as follows:

- Written exam: 60%.
- Hands-on sessions (delivery of reports in term, and where appropriate, explanation or defense): 20%
- Individual / group work (delivery of exercises in term, and if applicable, explanation or defense): 20%

Those students who wish to follow the FINAL ASSESSMENT path should apply for their resignation to the continuous assessment path BEFORE THE WEEK 10 OF THE SEMESTER.

The final grade in the final assessment path will be computed as follows:

- Written exam: 60%.
- Computer programming test: 40%.

The time, place and other conditions of the computer programming test will be announced at least ONE MONTH in advance.

In any case, it will be required a grade of 4 (out of 10) in the written exam to pass the subject.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the Second Call, as established by the University of the Basque Country regulations, only the FINAL ASSESSMENT path will be applied. Two possible modalities are observed:

* MODALITY A (default): The grades of hands-on sessions and individual / group work are kept, so that the student just takes the written exam. Under this modality, the final grade will be computed as follows:

- Written exam: 60%.
- Hands-on sessions (delivery of reports in term, and where appropriate, explanation or defense): 20%
- Individual / group work (delivery of exercises in term, and if applicable, explanation or defense): 20%

* MODALITY B: This modality establishes the same conditions as for the FINAL ASSESEMENT path defined in the First Call. The final grade will be computed as follows:

- Written exam: 60%.
- Computer programming test: 40%.

The time, place and other conditions of the computer programming test will be announced at least TEN (10) DAYS in advance.

Those students who wish to choose MODALITY B should apply for it at least FOURTEEN (14) DAYS BEFORE the date established for the written exam. If no communication is received, it will be understood that the student chooses MODALITY A.

In any case, it will be required a grade of 4 (out of 10) in the written exam to pass the subject.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

1. Bradley N. Miller, David L. Ranum. Problem Solving with Algorithms and Data Structures Using Python (Second Edition). Franklin, Beedle & Associates, 2011.
2. Rance D. Necaise. Data Structures and Algorithms Using Python. John Wiley & Sons, 2011.
3. John V. Guttag. Introduction to Computation and Programming Using Python (Third Edition). The MIT Press, 2021.
4. Gilles Brassard, Paul Bratley. Fundamentals of Algorithmics. Pearson, 1996.
5. Mark Summerfield. Programming in Python 3. A Complete Introduction to the Python Language (Second Edition). Addison-Wesley Professional, 2010.

Detailed bibliography

6. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein. Introduction to Algorithms (Third Edition). The MIT Press, 2009.
7. Steven S. Skiena. The Algorithm Design Manual (Second Edition). Springer, 2008.
8. Naomi Ceder. The Quick Python Book (Third Edition). Manning Publications, 2018.
9. David M. Beazley. Python Essential Reference (4th Edition). Addison-Wesley Professional, 2009.
10. Mark Lutz. Learning Python (Fifth Edition). O'Reilly Media, 2013.

Journals

Web sites of interest

Problem Solving with Algorithms and Data Structures Using Python - Official Website
https://runestone.academy/runestone/books/published/pythonds/index.html

MIT OCW Introduction to Computer Science and Programming in Python
https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-0001-introduction-to-computer-science-and-programming-in-python-fall-2016/

Python Programming Language - Official Website
http://python.org/

Python 3 documentation
https://docs.python.org/3/

The Python 3 Tutorial
https://docs.python.org/3/tutorial/

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GELECT30 - Bachelor`s Degree in Electronic Engeineering	**Year**	Fourth year

COURSE

26849 - Communications Electronics	**Credits, ECTS:**	6

COURSE DESCRIPTION

Course description: Communication Electronics is dedicated to the introduction of general aspects of the communication systems -use of the electromagnetic spectrum, characteristics of the transmission channels, modulation, and access techniques and the architectures of the electronic systems for communications- and the study of circuits and basic electronic subsystems used in analog and digital communications. Various critical aspects related to the design of the physical layer and the appropriate solutions at system and circuit levels are addressed.

Context: Communication Electronics is an optional subject of the Electronic Engineering Degree that belongs to the minor "General Purpose Electronic Systems". It is studied in the 2nd semester in the 4th year. To pursue this subject, the students must have a basic knowledge of circuits (amplifiers, oscillators, filters...). Communication Electronics is also related to the optional subject: High-Frequency Systems, (1st semester, 4th year) where the basic techniques of microwave engineering are studied.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

LO1: Correctly identify the different architectures for analog and digital modulation and demodulation, distinguish their main functional blocks and recognize the fundamental characteristics of a communications system.

LO2: Analyze and calculate with precision the parameters and figures of merit (noise figure, gain, compression, OIP3) of a transmitter and/or receiver system.

LO3: Synthesize in a technical document the functional parameters and technical data of a communication circuit or sub-system as in a data sheet from device manufacturers.

LO4: From particular specifications, design, simulate, built and characterize a communication sub-system in the laboratory.

LO5: Extract the relevant information of the electronic components from the manufacturer's data sheets.

Theoretical and Practical Contents

1. Introduction
Use of the electromagnetic spectrum. Transmission Channels. Modulation and access techniques. Bandwidth and Information Theory. Electronic communications systems

2- Analog communications
Amplitude modulation, frequency and phase modulation. AM transmitters and receivers. FM transmitters and receivers. Case Studies.

3- Digital communications
Binary modulation techniques ASK, FSK, PSK and DPSK. Modulation and demodulation schemes for binary modulation. M-ary modulation techniques: QPSK and QAM. Probability of error and error rate. IQ Modulator. Case studies.

4- Electronic communication systems
Main parameters of a communication system. Noise, linear and non-linear distortion, and intermodulation. Figures of merit. Types of transmitters and receivers.

5- Basic blocks of an electronic communication system
Main functional blocks of a communication transmitter / receiver system. Amplifiers, filters. Mixer circuits: Single diode mixer, balanced and double balanced mixers. Phase locked Loops (PLLs) and frequency synthesis. Modulation and demodulation with PLLs.

TEACHING METHODS

The subject is developed in lectures, labs and seminars. In the lectures the theoretical concepts related to the subject are explained. They are illustrated with simple examples. A list of questions and problems to solve are proposed in each chapter of problems. The problems will be corrected and discussed in the classroom, promoting the active participation of

the students. Practical examples will be developed in the seminars.
The education is complemented by the design, assembly and verification of Phase Locked Loop in the electronic instrumentation laboratory.
Finally, a collaborative project is carried out in groups of two or three people. It consists in the design, assembly and measurement in the laboratory of a representative case study from the sub-systems studied in class.
In addition, the eGELA platform will be used for communication with students and for the dissemination of teaching material and resources.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	5	10	5	10				
Horas de Actividad No Presencial del Alumno/a	45	7,5	15	7,5	15				

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 50%
- Collaborative project

Nota: Estos porcentajes hacen referencia a la evaluación contínua. La evaluación final consta de un único examen con el 100% de la nota 50%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Continuous evaluation:

- Collaborative project: 50%
- Written test: 50%

At least 3.5 points out of 10 must be obtained in the written test to pass the course.

Final evaluation:

- Final exam: 100%

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Final exam: 100%

MANDATORY MATERIALS

eGELA platform

BIBLIOGRAPHY

Basic bibliography

W. Tomasi, "Electronic Communications Systems". Prentice Hall, 2006.

David M. Pozar, "Microwave and RF Design of Wireless Systems", John Wiley & Sons, 2001

Detailed bibliography

D. O. Pederson, K. Mayaram, "Analog Integrated Circuits for Communication. Principles, Simulation and Design". Kluwer Academic Publishers

Journals

* IEEE Communications Magazine

Web sites of interest

https://www.nasa.gov/directorates/heo/scan/spectrum/txt_accordion3.html

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25

Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GQUIMI30 - Bachelor`s Degree in Chemistry	**Year**	Second year

COURSE

26113 - Organic Chemistry I	**Credits, ECTS:**	9

COURSE DESCRIPTION

En esta asignatura se aborda el estudio de las propiedades estructurales, físicas y químicas de los principales hidrocarburos y grupos funcionales de la química orgánica, así como sus métodos de preparación, abordando también los mecanismos de los principales tipos de reacciones.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

En esta asignatura se aborda el estudio de las propiedades estructurales, físicas y químicas de los principales hidrocarburos y grupos funcionales de la química orgánica, así como sus métodos de preparación, abordando también los mecanismos de las principales tipos de reacciones.
Se pretende que el alumno desarrolle las competencias básicas definidas en el RD1393/2007 para este nivel en el ámbito de la química, así como las generales M2T1, M2T2, M2T3 y MT2T4 del Módulo Fundamental.

Theoretical and Practical Contents

Hidrocarburos Alcanos y cicloalcanos. Alquenos y polienos. Alquinos. Benceno y arenos. Estructura, obtención y reactividad.
Grupos funcionales con un enlace sencillo carbono-heteroátomo Halogenuros de alquilo y arilo. Alcoholes, glicoles y fenoles. Éteres y epóxidos. Aminas y nitrocompuestos. Estructura, obtención y reactividad.
Grupo carbonilo y derivados Aldehídos y cetonas. Estructura, obtención y reactividad.
Grupo carboxilo y derivados Ácidos carboxílicos. Haluros de acilo. Cetenas. Anhídridos. Ésteres. Amidas. Nitrilos. Estructura, obtención y reactividad.

TEACHING METHODS

Las sesiones de Seminario (S) y Práctica de aula (GA) se utilizarán para trabajar ejercicios, cuestiones y problemas relacionados con la teoría impartida en las sesiones de clase magistral.

TYPES OF TEACHING

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

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

La evaluación final será el resultado de las siguientes pruebas:
1. Exámenes. Dos exámenes parciales y uno final. La materia incluída en cada exámen parcial se liberará obteniendo más de un cinco en cada uno de ellos. Los alumnos que no aprueben por parciales deberán realizar el exámen final. Los exámenes consistirán en una prueba teórico-práctica escrita sobre los conceptos tratados en la asignatura. Se valorará el planteamiento adecuado de las cuestiones realizadas, así como la coherencia y exactitud de las respuestas dadas. Porcentaje en la calificación final:

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Examen final escrito. Porcentaje en la calificación final: 100%.
No presentarse al examen escrito supondrá la renuncia a la convocatoria de evaluación y constará como un No Presentado. (Normativa de gestión para las enseñanzas de grado y de primer y segundo ciclo para el curso 2015/16)

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

8.P. Y. Bruice, , QUÍMICA ORGÁNICA, 5ª Edición, Ed. Pearson Prentice Hall, México, 2008.
2.F. A. Carey, QUÍMICA ORGÁNICA, 6ª Edición, Ed. McGraw-Hill, México, 2006.
3.L. G. Wade, Jr., QUÍMICA ORGÁNICA, 5ª Edición, Ed. Pearson Prentice Hall, Madrid, 2004.
4.R. T. Morrison, R. N. Boyd, QUÍMICA ORGÁNICA, 5ª Edición, Ed. Pearson Educación, México, 1998.
5.K. P. C. Vollhardt, N.E. Schore, QUÍMICA ORGÁNICA, 5ª ed., Omega, S.A., Barcelona, 2008
6.K. P. C. Vollhardt, N.E. Schore KIMIKA ORGANIKOA, 1ª ed., UPV/EHU, Leioa, 2008
7.J. E. McMurry, QUÍMICA ORGÁNICA, 5ª ed., International Thomson editores S.A, México, 2001
1.F. García, J. A. Dobado, PROBLEMAS RESUELTOS DE QUÍMICA ORGÁNICA, Paraninfo, 2007..

Detailed bibliography

1. F. A. Carey, R. J. Sundberg, ADVANCED ORGANIC CHEMISTRY, Partes A y B, 5ª Edición, Springer, 2007.
2. M. B. Smith, J. March, MARCH¿S ADVANCED ORGANIC CHEMISTRY: REACTIONS, MECHANISMS AND STRUCTURE, Wiley, 2007

Journals

The Journal of Organic Chemistry: http://pubs.acs.org/journal/joceah
Organic Letters: http://pubs.acs.org/journal/orlef7
European Journal of Organic Chemistry: http://www3.interscience.wiley.com/journal/27380/home
Tetrahedron: http://www.sciencedirect.com/science/journal/00404020
Tetrahedron Letters: http://www.sciencedirect.com/science/journal/00404039
Organic and Biomolecular Chemistry: http://www.rsc.org/Publishing/Journals/Ob/Index.asp
The Journal of Chemical Education: http://jchemed.chem.wisc.edu/

Web sites of interest

Organic Chemistry Portal: http://www.organic-chemistry.org/
Organic Resources Wordwide: http://www.organicworldwide.net/
Grupo especializado de química orgánica de la RSEQ: http://www.ucm.es/info/rsequim/geqo/
Chemical and Engineering News: http://www.ucm.es/info/rsequim/geqo/
Blog de Química: http://elblogdebuhogris.blogspot.com/

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GINQUI30 - Bachelor`s Degree in Chemical Engineering	Year	Second year

COURSE

26753 - Heat Transmission	Credits, ECTS:	6

COURSE DESCRIPTION

Heat transfer is a basic science that deals with the rate of thermal energy transfer. It has a wide area of application, ranging from biological systems to common household appliances, residential and commercial buildings, industrial processes, electronic devices and food processing. Students should have adequate background in calculus and physics, related to thermodynamics, fluid mechanics and differential equations before tackling the study of heat transfer

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

General Competences:
The general competences of the degree that are assigned to this subject are:
M02CM05: Compare and select technological alternatives, integrating technical, economic, environmental and social impact criteria.
M02CM08: Use information and communication technologies applied to learning and manage information sources (databases).
M02CM09: Communicate and transmit in writing and orally the knowledge and results acquired in a multidisciplinary environment.
M02CM12: Solve problems of the common subjects of the industrial branch, raised with quality criteria, sustainability and ethical criteria.
Specific Competences:
M02CM01: Analyze, model and calculate equipment and installations for handling solid materials and heat transfer fluids.
In view of the specific competences of the degree the teaching objectives (TO) for this subject are:
TO-1: To understand the fundamentals and basic equations of heat transfer mechanisms.
TO-2: To know how to perform the non-steady state analysis of conduction heat transfer in simple geometries.
TO-3: To become familiar with the empirical correlations for the determination of heat transfer coefficients.
TO-4: Understand the analysis of heat transfer in systems of combined mechanisms to predict the contribution of each one.
TO-5: Know how to analyze, model, calculate and dimension equipment and installations for heat transfer.
The following Learning Outcomes (RA) are established to determine the scope of the teaching objectives (TO):
RA-1: Identify and understand the fundamentals heat transfer mechanisms and their combination.
RA-2: Apply the energy balance in systems with heat transfer.
RA-3: Apply Fourier's law in solids with plane, cylindrical, spherical and extended surface geometries in steady state to calculate heat transfer.
RA-4: Analyze the transient state in solids with negligible internal resistance and in solids with plane, cylindrical, spherical, and semi-infinite solid geometries with internal resistance.
RA-5: Solve problems of heat transfer by conduction by means of numerical calculation.
RA-6: Identify the type of existing convection and choose the most appropriate correlation for the estimation of the convection coefficient for both single-phase and phase-change systems.
RA-7: Analyze and calculate the heat transmitted in a system by convection, radiation and combined mechanisms.
RA-8: Analyze and dimension, from the thermal point of view, heat exchangers evaporators.

Theoretical and Practical Contents

Syllabus
1.- Basic fundamentals of heat transfer.
Introduction. Heat transfer in engineering. Heat and other forms of energy. Energy balances. Heat transfer mechanisms: conduction, convection and radiation. Combined heat transfer systems. Units and dimensions.
2.- Heat transfer by conduction in steady state.
Introduction. Model for heat conduction: Fourier's Law. Thermal properties of matter. Heat generation. General equation of heat conduction. Initial and boundary conditions. Heat conduction through flat plates. Concept of thermal resistance. Compound wall. Heat conduction through cylinders and spheres. Critical insulation radius. Extended surfaces: fins. Unidirectional conduction with uniform energy generation. Conduction in two and three directions. Numerical methods: finite differences.
3.- Heat transfer by conduction in non-stationary state.
Introduction. Systems with negligible internal resistance: Analysis of concentrated systems. Spatial effects: plane wall with convection, radial systems with convection and semi-infinite solid. Multidimensional systems. Numerical methods: finite differences.
4.- Analysis of convective heat transfer.
Introduction. Nusselt number. Classification of fluid flows. Convection boundary layers: Velocity boundary layer. Thermal boundary layer: Prandtl number. Conservation equations of mass, quantity of motion and energy for laminar flow over a

flat plate. Analogies between the amount of motion and heat transfer.
5.- Forced convection.
Forced convection. Forced external convection: Parallel flow over flat plates; Flow around cylinders and spheres; Flow over banks of tubes. Forced internal convection: Laminar flow; Turbulent flow.
6.- Natural convection.
Introduction. Equation of motion and Grashof number. Calculation of natural convection coefficients on surfaces: effect of geometry. Natural convection inside closed enclosures. Natural and forced convection combined.
7.- Heat transfer with phase change.
Introduction. Heat transfer in boiling. Pond boiling. Flow boiling. Heat transfer in condensation. Film condensation. Film condensation in horizontal tubes. Condensation by droplet condensation.
8.- Heat exchangers.
Types of heat exchangers. Total heat transfer coefficient. Fouling factor. Analysis of heat exchangers. Concentric tube heat exchangers: basic design equation. Multitubular and compact heat exchangers: correction factor. Analysis by the effectiveness-number of transfer units method.
9.- Heat transfer by radiation.
Nature of thermal radiation. Interaction of radiation with matter: absorption, reflection and transmission. Emission from a surface by radiation: Stefan-Boltzmann law. Emissivity. Heat transmission between black surfaces. Viewing factors. Gray surfaces. Radiosity. Heat transfer between gray surfaces forming an enclosure. Heat transfer with emitting and absorbing gases.

TEACHING METHODS

Lectures (L): Development of the basic principles of Heat Transfer.

Classroom (CG) and Computer Group (COG) Classes: Resolution of questions (theoretical and/or practical), exercises (theoretical and/or practical) and problems on blackboard and computers.

Seminar classes (S): Discussion and resolution of doubts, and control of the acquired competences.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30	5	20		5				
Horas de Actividad No Presencial del Alumno/a	45	10	30		5				

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 85%
- Exercises, cases or problem sets 15%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS Evaluation.
The overall grade required to pass the subject is 50% (a 5 out of 10).
Written assessment tests: Weight of 70 to 90%.
The written test done during the course will evaluate the acquisition of the competences of the subject. The last test (Final Test) is an evaluation of the subject as a whole, where the student must show that he/she has integrated all the knowledge.
Minimums: In the last written test you must obtain more than 4.0 out of 10 in theory and more than 4.0 out of 10 in problems to pass the course. In the problems test, the student must score in all the exercises; an unanswered exercise or a zero score will be considered as a failed test.
Individual and/or group work: Weight of 10-30%.
The following activities will be considered in this section:
Resolution of exercises/problems/case studies.
Computer practices.
Written reports.
Participation in seminars.
Minimum: Attendance and/or participation and/or delivery of 60% of the proposed activities.
Students who do not show up for the Final Exam will be graded with "NOT PRESENTED".

NON-CONTINUOUS evaluation.
Students who wish to be evaluated by means of a final evaluation system must communicate it to the teaching staff in the terms and deadlines established in the UPV/EHU Evaluation Regulations (article 8.3).
Students who opt for the final evaluation system must take the Final Exam (70-90%) plus an Additional Exam (10-30%) that demonstrates the acquisition of the competences of the subject.
Minimums: In the Final Test must obtain more than 4.0 out of 10 in theory and more than 4.0 out of 10 in problems to pass the course. In the Problem Test, the student must score in all the exercises; an unanswered exercise or a zero score will be a failed test.
To pass the course, the minimum grade in both the Final Test and the Additional Test is 5 out of 10.
Students who do not take the written test will be graded with "NOT PRESENTED".

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The final grade: Final written test to be developed (Theory and Problems). The overall grade required to pass the subject is 50% (5 out of 10).
Minimums: In the final written test must obtain more than 4.0 out of 10 in theory and more than 4.0 out of 10 in problems to pass the subject. In the Problem Test you must score in all the exercises, an unanswered exercise or a zero score will be a failed test.
Students who do not take the written test in the extraordinary exam will be graded with "NOT PRESENTED". NOT PRESENTED".

MANDATORY MATERIALS

Textbook for the completion of the examination of problems having thermophysical properties of materials, heat transfer equations and correlations, values of physical constants and unit conversion factors.

BIBLIOGRAPHY

Basic bibliography

Cengel, Y.A. y Ghajar, A.J.; Heat and mass transfer fundamentals and applications (4TH Ed.) Mc Graw Hill, México D.F. 2011.

Kreith, F. y Bohn, M.S.; Principles of Heat Transfer, Thomson Learning, México 2001.

Incropera, F.P. y DeWitt, D.P.; Fundamentals of Heat and Mass Transfer, Prentice Hall, México, 1999

Detailed bibliography

McCabe, W.L. Smith, J.C. y Harriot, P; Unit Operations of Chemical Engineering; Mc Graw Hill, Madrid 1991

Lienhard IV, J.H., Lienhard V, J.H., A Heat Transfer Textbook (3rd Ed.), Phlogiston Press, Cambridge 2002

Coulson, J.M.; Richardson, J.F.; Chemical Engineering; Vols. 1 y 2:, Butterworth-Heinemann, Oxford 1999

Journals

Web sites of interest

OBSERVATIONS

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOLO30 - Bachelor`s Degree in Biology	**Year**	First year

COURSE

26710 - Biochemistry I	**Credits, ECTS:**	6

COURSE DESCRIPTION

In Biochemistry I, students will acquire basic knowledge of the molecular structures and functions making up living organisms. They will also develop essential laboratory skills to conduct simple biochemical experiments, and learn how to accurately describe, analyze, and critically interpret their findings.

Biochemistry I is a critical subject that, along with Biochemistry II, lays the groundwork for many of the subsequent courses in this field. It provides students with a strong foundation in the basic principles of biochemistry, which are essential to understand complex topics in the future.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIES / LEARNING OUTCOMES

Cross-cutting skills:

· Develop the ability for analysis, synthesis and critical reasoning in the application of the scientific method.

· Develop autonomous learning and adaptation to new situations.

· Develop ethical commitment and the ability to participate in social debate.

Specific skills:

· Acquire structural and functional knowledge of the molecules making up living beings, including their basic components and polymeric structures.

· Recognize the structures of different types of biomolecules.

· Understand the fundamentals of enzymatic reactions, including the concepts of catalysis, kinetics, and enzymatic inhibition.

· Apply acquired knowledge to solve qualitative and quantitative problems.

· Develop basic laboratory skills required to conduct simple biochemical experiments.

Theoretical and Practical Contents

Theoretical and practical contents

Syllabus:

Topic 1. Concept of biochemistry. Its historical evolution. Place of Biochemistry among the experimental sciences. Objectives of Biochemistry.

Topic 2. Bioelements and biomolecules. Functional groups and bonds. Three-dimensional structure of biomolecules: isomerism and stereospecificity. Configuration and conformation.

Topic 3. Water as a solvent. Colligative properties. pH and buffers. Buffers of biological interest.

Topic 4. Proteins. Amino acids. The peptide bond. Peptides: structure and properties. Structural levels in proteins. Protein sequencing. Native structure and denaturation. Protein functions. Basic concepts for protein purification. Purity criteria.

Topic 5. Enzymes. Nomenclature and classification. Catalysis: thermodynamic and kinetic aspects. Enzyme kinetics. Michaelis-Menten equation. Graphical determination of Vmax and Km. Units of enzyme activity. Enzyme inhibition and regulation. Concept and types of inhibition. Covalent modifications of enzymes. Allosteric enzymes.

Topic 6. Carbohydrates. Functions and classification. Simple monosaccharides and derivatives. Oligosaccharides. Polysaccharides.

Topic 7. Nucleic acids. Concept and biological interest. Pyrimidine and pyrimidine bases. Nucleosides and nucleotides.

Polynucleotides: primary, secondary and tertiary structure. Nucleic acid sequencing. Free nucleotides with specific functions. Intermediates of cellular chemical energy, cofactors of enzymatic reactions, cellular communication.

Topic 8. RNA. Composition and structure. Types of RNA: heterogeneous nuclear, small nuclear, transfer, ribosomal, messenger, viral. Catalytic RNA.

Topic 9. DNA. Structure and properties. Levels of structuring: A, B and Z helices. DNA as genetic material. Chromatin structure. Optical properties of DNA: fusion and renaturation. DNA hybridization. DNA-RNA hybrids.

Topic 10. Lipids. Functions and classification. Saponifiable and non-saponifiable lipids.

Topic 11. Biological membranes. Lipid bilayers. Composition, structure and properties. Membrane proteins. Dynamics of components. Liposomes.

The theoretical content described above will be applied to solve exercises and problems in class, as well as in laboratory sessions. During these laboratory sessions, students will have the opportunity to apply the knowledge they have acquired and develop their practical skills in a supervised setting.

1st session. Learning the use of automatic pipettes, pH measurement and preparation of buffer solutions.

2nd session. Quantification of sugars and use of a sucrose standard curve.

3rd session. Quantification of sucrose in breakfast cereals.

4th session. Separation of macromolecules by Gel Filtration Chromatography.

TEACHING METHODS

Topics 1 to 11 outlined in the syllabus will be explained in detail during lectures (M).

In classroom practices (GA), students will solve qualitative and quantitative exercises and problems related to the concepts covered in the lectures. In seminars (S), students will work on solving a simple biochemical question using the techniques they have learned.

In the laboratory sessions, students will carry out the four practical activities described above. Attendance to the practical sessions is mandatory.

In computer practical session, students will use the Jmol program to visualize biomolecules, including their isomerism and their structural and functional variability.

The theoretical content described above will be applied to solve exercises and problems in class, as well as in laboratory sessions. During these laboratory sessions, students will have the opportunity to apply the knowledge they have acquired and develop their practical skills in a supervised setting.

1st session. Learning the use of automatic pipettes, pH measurement and preparation of buffer solutions.

2nd session. Quantification of sugars and use of a sucrose standard curve.

3rd session. Quantification of sucrose in breakfast cereals.

4th session. Separation of macromolecules by Gel Filtration Chromatography.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	37	2	6	12	3				
Horas de Actividad No Presencial del Alumno/a	55,5	3	9	18	4,5				

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Exercises, cases or problem sets 35%
- Teamwork assignments (problem solving, Project design) 5%
- praktiken azterketa (garatu beharreko galderak eta ariketak) 60%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EVALUATION SYSTEM

Final evaluation system

QUALIFICATION TOOLS AND PERCENTAGES

· Practical sessions (exercises, problems…) 35%

· Teamwork (problem solving, Project design) 5%

· Written exam (multiple choice questions + short questions) 60%

ORDINARY ASSESSMENT SESSION: GUIDELINES AND OPTING OUTANCE

The assessment of the Biochemistry I course is divided into three sections:

a) 60% Written exam (multiple-choice questions and short questions).

b) 35% Laboratory, classroom and computer practical sessions (20% GL+10% GA+5% GO).

c) 5% Teamwork (problem solving, project design, etc).

The criteria for assessing the sections are as follows:

· Appropriateness of the answers, integration of information, approach to and development of the problem exercise, correct use of units of measurement, and clarity and precision of language.

· Adequate execution of the experimental protocol, analysis and interpretation of

results, and effective presentation of findings.

· Correct approach and execution of exercises, as well as thorough completion and presentation of assigned tasks.

The final grade for the course will be calculated by adding the partial grades of each assessed section. To pass the course and to have your overall grade calculated, you must obtain a minimum percentage of the maximum grade in each of the following sections:

a) Written test: 50%.

b) Laboratory practice test: 40%.

c) Classroom practice test: 30%.

Attendance to laboratory session is mandatory.

Waiving: Failing to take the final exam is sufficient to waive the final grade.

Not taking the final exam is enough to receive a grade of "not presented" for the course.

The use of books, notes, phones, electronic devices, computers, or other equipment is not allowed during assessment tests (except for a calculator*). If any academic dishonesty or fraudulent practices are detected, the protocol on academic ethics and prevention of such practices at UPV/EHU will be enforced.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

EXTRAORDINARY ASSESSMENT SESSION: GUIDELINES AND OPTING OUT

The final grade will be calculated by adding the grades obtained in the following sections:

a) Written exam (multiple-choice test and short questions) (70%)

b) Laboratory sessions (20%)

c) Classroom practical sessions (10%)

The grades of the sections passed will be kept for the extraordinary assessment session of that school year (until July) if the subject is failed in the ordinary call. Neither the computer practices nor the seminars will be assessed in the extraordinary session; however, if these sections are passed in the ordinary session, those grades will be maintained for the extraordinary session and the corresponding percentage will be deducted from the written test.

The final grade of the course will be obtained by adding the grades of each assessed section. In order to pass the subject, and averaged with the other sections of the subject, the minimum percentage over the maximum grade must be obtained in the following sections:

a) Written test: 50%.

b) Laboratory practice test: 40%.

c) Classroom practice test: 30%.

Attendance of laboratory sessions is mandatory. Students that do not attend those laboratory sessions during the ordinary session, will not have another chance to do so during the extraordinary session.

Not taking the written test will be qualified as "not presented" in the final grade for the course.

The use of books, notes, phones, electronic devices, computers, or other equipment is not allowed during assessement tests (except for a calculator*). If any academic dishonesty or fraudulent practices are detected, the protocol on academic ethics and prevention of such practices at UPV/EHU will be enforced.

MANDATORY MATERIALS

MATERIALS REQUIRED

The eGela webpage (http://egela.ehu.eus) will be used to publish the course guide and information about the activities performed in the laboratory, computer room and classroom.

Before entering the laboratory, students must carefully read the protocol for the corresponding session. This protocol will be uploaded to eGela.

BIBLIOGRAPHY

Basic bibliography

RECOMMENDED READINGS

Basic bibliography

Lehninger Principles of Biochemistry, (2012) 6th Edition, Nelson D.L. & Cox. M. M., Freeman and Company, New York.

Bioquímica (2013) (6ª ed) Stryer L., Berg J. M. & Tymoczko J. L., Editorial Reverte, Barcelona.

Bioquímica curso básico (2014) Tymoczko J. L. , Berg J. M., Stryer L., Editorial Reverte, Barcelona

BIOQUÍMICA Las bases moleculares de la vida (2009) 4 Ed., McKee T. & McKee. J.R., McGraw Hill Interamericana Editores, México.

Detailed bibliography

In-depth bibliography

Molecular Biology of the Cell (2008) (5th ed) Alberts A., Johnson A., Lewis J., Raff M., Roberts K. & Walter P., Garland Science, New York.

Fundamentals of Biochemistry (2006) 2nd ed., Voet D., Voet J.G. & Pratt CW., John Wiley & Sons, New York.

Bioquímica (2002) 3ª edición, Mathews, C.K. & van Holde, K.E., McGraw Hill Interamericana, Madrid.

Journals

Journals

· Nature

· Science

· Investigación y Ciencia

Web sites of interest

http://www.biology.arizona.edu/default.html
http://wwwbioq.unizar.es/
http://www.zientzia.net
http://www.ehu.es/biomoleculas
http://www1.euskadi.net/euskalterm/indice

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GBIOLO30 - Bachelor`s Degree in Biology	**Year**	Second year

COURSE

26833 - Molecular Genetics	**Credits, ECTS:**	6

COURSE DESCRIPTION

This subject analyzes the structure of hereditary material and the functioning of genes and genomes in eukaryotes, bacteria and viruses. The structure of DNA and its properties are described in order to understand its behavior as genetic material. The implication of this structure in the transmission of DNA is analyzed, and the different molecular techniques for analysis and manipulation of genetic material are described. The bases of gene expression and its regulation in prokaryotes and eukaryotes are established. The variations in DNA, its repair and the implications of the change at a pathological and evolutionary level are analyzed in detail. Special emphasis is placed on human pathologies derived from genetic alterations as well as on the study of the human genome.

This subject is based on the knowledge acquired by students in the Genetics subject of the first semester, in addition to other basic subjects such as Cellular Biology, Biochemistry and Microbiology. The contents are also related to specific topics in Genetics, such as Genetic Engineering and Genomics. The contents worked on serve as a basis for the optional Genetics subjects of the Degree.
Molecular Genetics is basic for the professional and/or research practice of Bioscience graduates.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

1. Students know the organization of hereditary material, mainly the structural differences of prokaryotic and eukaryotic genes and genomes.
2. They understand the processes that allow the maintenance and transfer of the information contained in DNA, as well as the molecular and pathological implications of its changes.
3. They understand the need for the regulation of gene expression in time and space and the differences between prokaryotic and eukaryotic organisms.
4. They understand and use the basic techniques for analyzing genetic material and apply them to design simple experiments and/or to solve specific current problems.
5. They know, critically evaluate and use the various sources of information through new technologies to obtain, organize, interpret and communicate scientific information related to the subject under study.

Theoretical and Practical Contents

NATURE AND STRUCTURE OF HEREDITARY MATERIAL
Topic 1.- Identification of hereditary material. Requirements of hereditary material. Demonstration of nucleic acids as hereditary material. Primary and secondary structure of DNA and RNA.

Topic 2.- Physical-chemical characteristics of hereditary material and basic analytical techniques: DNA extraction and purification, Absorbances, Denaturation-renaturation (hybridization), Molecular separation (centrifugation and electrophoresis), Modifications through the use of enzymes, PCR and sequencing.

Topic 3.- Composition and organization of genomes. Viral and bacterial genomes. Plasmids. Organelle genomes. Genomes of eukaryotes.

Topic 4.- Anatomy of prokaryotic and eukaryotic genomes. Sequences in prokaryotic genomes: prokaryotic gene structure. Types of sequences in eukaryotes: coding vs non-coding; repeated vs single sequence; sequences with structural function. Eukaryotic gene structure.

REPLICATION AND MUTATION OF HEREDITARY MATERIAL
Topic 5.- Replication and recombination. Semiconservative replication. Replicative structures: the theta model; the rolling circle model; the D-loop model. DNA synthesis in E. coli, enzymatic model. DNA synthesis in eukaryotes. Replication in telomeres and function of telomerase.

Topic 6.- Gene mutation. Mutation as a random event. Types of mutations. Molecular mechanisms of spontaneous and induced mutations by physical and chemical agents.
Detection of mutagenic agents: Ames Test. Repair mechanisms.

Topic 7.- Mobile genetic elements. Types of transposable elements and transposition mechanism in prokaryotes. Types of transposable elements and transposition mechanism in eukaryotes. Mutagenic effects of transposons.

GENE EXPRESSION AND REGULATION
Topic 8.- Transcription in prokaryotes and eukaryotes. General characteristics of transcription in prokaryotes and eukaryotes. Mechanism of initiation, elongation and termination of transcription in monocistronic and polycistronic genes of prokaryotes. Transcription in eukaryotes: RNA polymerase I, II and III and cis and trans elements. Mechanism of transcription initiation, elongation and termination in eukaryotes; histones in transcription. Maturation of RNAs and splicing.

Topic 9.- Translation and the genetic code. Characteristics of the genetic code. Translation process in prokaryotes and eukaryotes: initiation, elongation and termination. Characteristics of proteins. Proteome.

Topic 10.- Fundamentals of expression regulation in prokaryotes. A general perspective: positive/negative control, inducible/repressible system. The lactose inducible system: positive and negative control of lac operon transcription. The repressible tryptophan system: negative control of transcription of the trp operon and control of translation by attenuation.

Topic 11.- Fundamentals of expression regulation in eukaryotes. Levels and stages of regulation of gene expression. Chromatin conformation. Specific transcription activators: response elements to hormones, metals, tissues. Alternative promoters, alternative splicing and alternative poly-A tail. Posttranscriptional and translational regulation. RNA silencing.

ADVANCED TOPICS IN MOLECULAR GENETICS
Topic 12.- Introduction to Genomics. Genome sequencing and annotation strategies. Metagenomics. Analysis of genome variability. Other omics: transcriptomics, proteomics, metabolomics, epigenomics.

Topic 13.- Cancer genetics. General characteristics of cancer. Proto-oncogenes and tumor suppressor genes. Hereditary predisposition to cancer. Non-coding RNAs (lncRNAs and miRNAs). Genomic analyzes and clinical applications derived from knowledge about cancer.

Topic 14.- Genetic Engineering and biotechnological applications of recombinant DNA: Definition and objectives. General gene analysis and manipulation system. Control of the expression of heterologous genes. Applications in basic research and biotechnology. Gene therapy.

Practice program

P1.- Genotypic and population analysis of the Alu insertion in the tPA gene using PCR and forensic applications.
P2.- Detection and characterization of species in processed meat samples using multiplex mtDNA PCR.
P3.- Mutagenesis assays (I): Harlequin chromosomes and Sister Chromatid Exchange (SCE).
P4.- Mutagenesis test (II): Ames test.
S-1.- Identification of mutations and experimental design for their identification in human diseases.
S-2.- Molecular basis of human genetic diseases

TEACHING METHODS

Various teaching modalities are used in this subject:
- In the master classes, theoretical concepts and their application to problem solving are worked on.
- In seminar classes, classroom practices and laboratory practices, you work as a team. In these teaching modalities, the experimental design, the resolution of practical cases and the molecular bases that determine the appearance of genetic pathologies are delved into.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	35	5	5	15					
Horas de Actividad No Presencial del Alumno/a	55	15	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 methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 20%
- Multiple choice test 20%
- Exercises, cases or problem sets 20%
- Teamwork assignments (problem solving, Project design) 40%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS ASSESSMENT
In this evaluation system, laboratory practices and seminars are mandatory.
This evaluation system includes an individual final exam and various tests that are carried out in groups:
(1) The final written test has a value of 60% in the final grade and consists of test questions (20%), short questions (20%) and two problems to solve (20%). You must obtain at least 4 points in each section.
2) The written tests carried out in groups and that are part of the continuous evaluation include resolution of theoretical and practical problems and the delivery of reports related to the experimental work carried out in the laboratory and seminar sessions (40%).
The evaluation of group activities will be individualized based on the level of commitment and personal involvement with the group work carried out. The minimum grade will be 5.

FINAL EVALUATION
In the case of final evaluation, students must submit in writing to the teaching staff responsible for the subject the waiver of continuous evaluation within a maximum period of 9 weeks from the beginning of the subject.
If you choose this evaluation system, questions about laboratory practices and seminars will be included in the final exam.

ACADEMIC ETHICS
During the development of the evaluation tests, the use of books, notes or notes, as well as telephone, electronic, computer, or other devices or devices by students, will be prohibited. Only a calculator is allowed. In any case of dishonest or fraudulent practice, the provisions of the protocol on academic ethics and prevention of dishonest or fraudulent practices in evaluation tests and academic work at the UPV/EHU will be applied.

CALLS
For students subject to both continuous and final evaluation, it will be enough to not take the final test for the final grade of the subject to be "not presented" or "not presented.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary call the final grade will be established in the same way as in the ordinary call. If the continuous evaluation provides negative results, the final test will be 100% of the subject.

ACADEMIC ETHICS
During the development of the evaluation tests, the use of books, notes or notes, as well as telephone, electronic, computer, or other devices or devices by students, will be prohibited. Only a calculator is allowed. In any case of dishonest or fraudulent practice, the provisions of the protocol on academic ethics and prevention of dishonest or fraudulent practices in evaluation tests and academic work at the UPV/EHU will be applied.

CALLS
For students subject to both continuous and final evaluation, it will be enough to not take the final test for the final grade of the subject to be "not presented" or "not presented."

MANDATORY MATERIALS

The teachers will provide the students with the following material:

THEORY SCHEMES AND COLLECTION OF FIGURES to facilitate the monitoring of classes on theoretical content.
PROBLEM COLLECTION: this collection will be the basic material for learning case resolution; It will be used in the classroom during master classes and must be used by the student as material for personal work.
LABORATORY PRACTICE PROTOCOL: the objectives of each activity, its theoretical foundation, its technical development and some questions that each student must answer during or after completing the corresponding practice are included. Reading the protocol is mandatory before carrying out the corresponding practice.
All this documentation will be available to students in the virtual classroom of the subject.

BIBLIOGRAPHY

Basic bibliography

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*BROOKER R.J. (2012) Genetics. Analysis & Principles. 4th edition McGraw Hill. www.mhhe.com/brooker
*HERRÁEZ A. (2012) Biología Molecular e Ingeniería Genétic. 2ª ed. Elsevier
*GRIFFITHS AJF, WESSLER SR, CARROLL SB, DOEBLEY J (2015) An introduction to genetic analysis. 11th edition. FREEMAN AND CO (978-1429229432)
*HARTL DL, JONES EW (2011) Genetics. Analysis of Genes and Genomes. Jones and Bartlett Publishers 8/e. (ISBN: 978-1449635962)
*HARTWELL L, GOLDBERG L, FISCHER JA, HOOD L, AQUADRO CF (2010) Genetics. From Genes to Genomes. 5nd edition. McGraw-Hill (ISBN-978-0073525310)
*KLUG, WILLIAM S; CUMMINGS, MICHAEL R.; SPENCER, CHARLOTTE; PALLADINO MICHAEL A. (2008). Concepts of Genetics. 9ª edición. Pearson Higher Education. http://www.aw-bc.com/klug/
*PIERCE B.A. (2014) Genética. Un enfoque conceptual. 5ª ed. Editorial Médica Panamericana
*PIERCE,B.A. (2015) Genetics Essentials: Concepts and Connections. (3rd Ed.). W. H. Freeman and Co. ISBN: 1464190755

Detailed bibliography

*BROWN T.A. (2007) Genomes 3. 3rd edition. Garland Science Publishing.
*LEWIN B. (2009) Genes IX. Jones and Bartlett Publisher
*STRACHAN, T., READ, A. (2010). Human Molecular Genetics. 4rd ed. Garland Publishing.

Journals

Nature Review Genetics
Nature
Science
PLOS Genetics,
G3: Genes-Genomes-Genetics,
BioMedCentral
Heredity
Trends in Genetics

Web sites of interest

http://www.ncbi.nlm.nih.gov/omim
http://www.ncbi.nlm.nih.gov/pubmed
https;//www.ensembl.org
http://www.bioinformatics.nl/primer3plus
http://www.geneclinics.org/
http://www.biologia.arizona.edu/molecular_bio/problem_sets/Recombinant_DNA_Technology/recombinant_dna.html
http://www.accessexcellence.org/RC/VL/GG/
http://www.dnaftb.org/
http://web.ornl.gov/sci/techresources/Human_Genome/education/index.shtml
http://www.genome.gov/GlossaryS/

OBSERVATIONS

Interesting links:

www.genome.gov/sglossary.cfm
teknopolis.elhuyar.org
www.zientzia.eus

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GGEOLO30 - Bachelor`s Degree in Geology	**Year**	Third year

COURSE

26795 - Metamorphic Petrology	**Credits, ECTS:**	6

COURSE DESCRIPTION

Metamorphic Petrology studies the modifications that affect igneous, sedimentary and even other pre-existing metamorphic rocks in the Earth's interior, under environmental conditions (pressure, temperature, fluids and stress regime) different from those in which they originated. For this purpose, theoretical concepts, experimental data and sample examination in the laboratory and in the field are used. Metamorphic Petrology is closely linked to Igneous Petrology, Geochemistry, Mineralogy and Tectonics.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Understand and correctly apply the meaning of data relating to the chemical composition, mineralogy, texture and structure of metamorphic rocks in order to correctly establish the physical (P-T) and chemical (X) conditions of formation and their evolution in space and time.

OBJECTIVES
To know the main types of metamorphic rocks and be able to develop from their petrological study hypotheses about the processes and contexts in which they originated (petrogenesis).

SPECIFIC SKILLS:
M03GM3.3: Knowledge igneous and metamorphic rocks, their characteristics and their geodynamic environment of formation.
M03GM3.4: Identify the main igneous and metamorphic rocks in hand sample and using petrographic microscopy.
M03GM3.6: Observe in the field the most common geological structures and endogenous rocks and produce a field notebook.

TRANSVERSAL SKILLS:
G003: Ability to search for and manage information.
G004: Ability to apply knowledge in practice.
G005: Autonomous and creative learning and work.
G007: Ability to organise, plan and manage time.
G008: Determination, perseverance and responsibility in the tasks entrusted.
G009: Oral and written communication in native and scientific languages.
G010: Motivation for quality and a job well done.

GENERAL SKILLS OF THE DEGREE:
G011: Know and use of theories, paradigms, concepts and principles of geology.
G012: Correct use of terminology, nomenclature, conventions and units in geology.
G013: Acquire a spatial and temporal vision of geological processes and their effects (minerals, rocks, fossils, structures, reliefs, etc.) on the planet Earth.
G015: Carry out field and laboratory work in a responsible and safe manner.
G016: Produce subsurface models from surface and geophysical data.
G017: Obtain, process, analyse and interpret field and laboratory data and observations using appropriate techniques and instruments, and document the results appropriately in written reports or field notebooks.
G020: Know how to apply geological knowledge to explore, evaluate, extract and manage natural resources in accordance with social demand and in a sustainable manner.
G022: Achieve field experience in a variety of geological settings in terms of rocks, structures, landscapes and other natural features.

Theoretical and Practical Contents

THEORETICAL CONTENTS:
- Review of fundamental concepts. Limits of metamorphism (diagenesis to partial melting), metamorphic agents and changes (temperature, pressure, deviatory stresses, fluids, chemical composition, space and time), types of metamorphism. Progressive nature of metamorphism. Compositional groups of metamorphic rocks.
- Structures and microstructures of metamorphic rocks. Main metamorphic textures and their relation to the type of metamorphism generating them. Development of metamorphic fabrics. Types of foliation and lineation. Deformation, blastesis and recrystallisation processes, and their mutual relationships.
- Classification and nomenclature of metamorphic rocks. Rock types associated with specific metamorphic contexts or protoliths. Modifying terms.
- Progressive nature of metamorphism, metamorphic gradients Index minerals, mineral zones and isograds.

Metamorphic grade. Metamorphic facies: concept, historical evolution, representation in P-T space, classification and limitations of their use.
- Equilibrium in natural systems. Graphical representation of mineral paragenesis. Composition-paragenesis diagrams. ACF, A'KF, AFM, CAS and CMS diagrams. Choice of the appropriate diagram according to the lithology.
- Metamorphic reactions. Types of reactions: univariant and divariant, phase transformation, devolatilisation, solid-solid, ion exchange, etc. Representation of reactions in composition-paragenesis diagrams. Petrogenetic grids. Geobarometers, geothermometers and geochronometers.
- Progressive transformations in different lithologies and under different metamorphic gradients: metamorphism of pelitic, mafic, carbonate and ultramafic rocks. Tectonites.
- Metamorphism in open systems: metasomatism.
- Relationships between metamorphism and tectonic context. facies series, P-T-t trajectories and implications on the geodynamic environment.

LABORATORY PRACTICES:
Mineralogical and textural characteristics of metamorphic rocks of different composition (pelitic, basic, carbonate, etc.).

FIELD PRACTICES:
Structural and mineralogical aspects of different types of metamorphic rocks, mapping and interpretation.

TEACHING METHODS

The methodology used to achieve the proposed results is as follows:
- Theoretical classes (M): in the assigned classrooms and timetables.
- Practical classes (GL): They will be developed in two laboratories, one for Optical Microscopy (0.6) and the other for hand samples (0.3), with the teacher guide and in an autonomous way. Different types of metamorphic rocks located in a geological context will be studied in order to fill standardised sheets. Afterwards, technical reports will be produced integrating laboratory data and the geological context of the samples.
- Field trip (GA): The field work consists of the study of different metamorphic areas, including the drawing of geological sections, description of the materials, taking representative photographs, etc., as well as the preparation of a report on the results.

Practical work is an important part of the course, so continuous attending is strongly recommended.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	35			15					10
Horas de Actividad No Presencial del Alumno/a	52,5			22,5					15

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 60%
- Exercises, cases or problem sets 25%
- Field work/exercises
- Prácticas de laboratorio (examen, informes): 40 %
- Prácticas de campo (memoria, examen):10%
  15%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Article 8 of the Evaluation Regulations
Continuous evaluation will include activities during the training period and written test at the official established dates, including exams, practical activities and reports according to the percentage detailed below:
- Laboratory report and exercises: 25%.
- Field report: 15%.
- Final examination at the official date established:
  - Test: 25%.
  - Long questions: 25%.
  - Laboratory practices: 10%.

In order to pass the course, a minimum of 40% of the possible points must be obtained in each of the activities listed above.

Withdrawal: according to article 12.2 of the Evaluation Regulations, in the case of continuous evaluation, as the weight of the final test is higher than 40% of the grade for the subject, if the student does not take part in the exam, the final mark would be "not presented".

The protocol on academic ethics and prevention of dishonest or fraudulent practices in UPV/EHU assessment tests and academic work will be applied.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Artículo 9 de la Normativa de Evaluación
9.1. If the student cannot pass the exam in the continuous evaluation, an extraordinary written exam can be done in order to test the skills and knowledge. 9.3. Results obtained in the continuous evaluation are kept and added up to those obtained in the written exam.

The final evaluation will include different exercises according to the percentage detailed below:
- Laboratory report: 25%.
- Final examination at the official date established:
  - Test: 25%.
  - Long questions: 25%.
  - Laboratory practices: 10%.
  - Field exercise: 15 %.

In order to pass the course, a minimum of 40% of the possible points must be obtained in each of the activities listed above.

The protocol on academic ethics and prevention of dishonest or fraudulent practices in UPV/EHU assessment tests and academic work will be applied.

MANDATORY MATERIALS

In addition to the work material (compass, magnifying glass and geologist's hammer, maps, aerial photos, etc.), students must bring their own Personal Protective Equipment.
This equipment shall consist, at least, of:
- Footwear and clothing suitable for walking in mountain areas.
- Reflective waistcoat.
- Protective glasses and gloves.
- Safety helmet in case of visits to quarries, caves, cliffs, mines, building sites, etc.

If they do NOT bring this material, they will NOT take part in the field practicals, with the academic consequences that may derive from this.

BIBLIOGRAPHY

Basic bibliography

YARDLEY, B.W.D. & WARREN, C. (2021) An introduction to metamorphic petrology. Cambridge University Press, ISBN: 9781108456487
SANDERS, I. (2018) Introducing Metamorphism. Dunedin Academic Press, 157 pp. ISBN: 9781780460642
WINTER, J.D. (2014): Principles of Igneous and Metamorphic Petrology: Pearson New International Edition (2nd edition). 738 pp. ISBN: 9781292021539
CASTRO DORADO A. (1989) Petrografía de rocas ígneas y metamórficas. Paraninfo, 280 pp. ISBN: 9788428316569
YARDLEY, B.W.D., McKENCYE W.S. & GUILFORD C. (1980) Atlas of metamorphic rocks and their textures. Longman, 120 pp. ISBN: 9780582301665

Detailed bibliography

BARD, J.P. (1985) Microtexturas de rocas magmáticas y metamórficas. Masson,177 pp. ISBN: 9788431103675 BEST, M.G. (2002) Igneous and Metamorphic Petrology. Wiley, 752 pp. ISBN: 9781405105880
BLATT, H; TRACY, R; OWENS, B. (2006) Petrology. Igneous, Sedimentary, and Metamorphic. W.H. Freeman, 530 pp.
BUCHER, K. & GRAPES, R. (2011) Petrogenesis of metamorphic rocks. Springer-Verlag, 8th ed. complete rev. of

Winkler's textbook, 428 pp. ISBN: 9780716737438
CASTRO DORADO A. (2015) Petrografía de rocas ígneas y metamórficas. Paraninfo, 280 pp. ISBN: 9788428335164
MASON, ROGER (1990) Petrology of the metamorphic rocks. Unwin Hyman, 2nd ed. 230 pp. ISBN: 9780045520282
PASSCHIER, C.W. TROUW, R.A.J. (2005): Microtectonics. 2nd Ed. Springer Verlag, 371 pp. ISBN 9783540293590
VERNON R, CLARKE GL (2008) Principles of Metamorphic Petrology. Cambridge University Press, 460 pp. ISBN: 978052187178
WINTER, J.D. (2009): Principles of Igneous and Metamorphic petrology (2nd Edition): Prentice Hall, New Jersey, 766 pp. ISBN: 9780321592576
WINTER, J.D. (2001) An introduction to Igneous and Metamorphic petrology. Prentice Hall, 699 pp. ISBN 9780132403429
YARDLEY, B.W.D.(1989) An introduction to metamorphic petrology. Longman, 248 pp. ISBN: 9780582300965

Journals

Web sites of interest

Metamorphic rocks petrology: http://www.alexstrekeisen.it/english/meta/index.php

The United Kingdom Virtual Microscope (UKVM): https://www.virtualmicroscope.org/content/uk-virtual-microscope

RockPTX, a resource for mineralogy and petrology: https://www.rockptx.com/

https://www.earth.ox.ac.uk/~oesis/teaching/metageol/index.html

http://jm-derochette.be/metamorphic_rocks.htm

OBSERVATIONS

Universidad del País Vasco / Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	Cycle	.
Degree	GGEOLO30 - Bachelor`s Degree in Geology	Year	Fourth year

COURSE

26803 - Basin Analysis and Historical Geology	Credits, ECTS:	6

COURSE DESCRIPTION

The aim of Basin analysis and Historical Geology is to provide a broad comprehensive view on the origin, architecture and evolution of sedimentary basins, taking into account that sediments are the main archive of the physico-chemical transformations and biological evolutionary patterns occurring during Earth's history.

The knowledge of sedimentary basins is based on a dynamic multidisciplinary approach that involves a wide range of geological disciplines (Stratigraphy, Subsurface Geology, Structural Geology, Paleontology, Mineralogy, Geochemistry). However, the sedimentary nature of most basin fills makes Sedimentary Geology the key discipline for the study of the changing sedimentary processes through time, the succession of diagenetic phases and products, and the complex relationships that can be established at different temporal and spatial scales between tectonism and sedimentation, as a function of controlling factors such as sea level changes, sediment supply, climate and subsidence.

The understanding of the filling history and dynamic evolution of sedimentary basins is of prime interest for the exploration and management of most energy, mineral and rock natural resources. It also has direct application on environmental and climatic change issues, providing solutions to emerging problems such as the safe subsurface storage of CO_2 and of different radiactive and liquid wastes derived from human activity. It is important to note that the history of Earth and the main events in the evolution of life cannot be fully understood without the critical understanding provided by sedimentary basin analysis.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Geology degree, Module M05 (Global Geology):

-M05GM5.6. To know the analysis methodology on sedimentary basins.

Geology degree, Module M06 (Economic Geology):

-M06GM6.6. To understand the processes that led to the origin of geological energy resources.

General skills related to the above described ones:

-G012. To use properly the geological terms, conventions, codes and units.
-G013. To gain the spatial and temporal vision about geological processes and their products (minerals, rocks, fossils, structures, and so on) on the Earth.
-G016. To make subsurface models based on geophysical and surficial data.
-G017. To take, perform and analyze field and laboratory data with the suitable methods and devices, and then to show the results correctly by means of different kinds of reports.
-G011. To know and use geological concepts, principles, paradigms and theories.
-G022. To show geological field-experience on several subjects such as rocks, structures, geomorphologies and other natural components.

Transversal skills related to the above described ones:

-G004. Capacity for bringing knowledge into practice.
-G006. Group-working ability.
-G001. Power of synthesis and analysis.

Theoretical and Practical Contents

GENERAL CONTENTS

-Methodology for the analysis of sedimentary basins.
-Formation mechanisms.
-Description and classification.
-Sedimentary filling.
-Historical geology.

DETAILED CONTENTS

Basin analysis methodology: conceptual and empirical data on stratigraphy, sedimentary processes, cycles, events, main geotectonic contexts and depositional facies models.
Basic concepts on Earth zonation and dynamics.
Basin formation mechanisms: extension, flexure and shear of the lithosphere; mantle dynamics.
Basins at stable plate areas: cratonic basins; oceanic basins.
Basins at divergent plate areas: rifts, aulacogens, passive margins.
Basins at convergent plate areas: subduction-related trenches, forearc, back-arc, intra-arc, retro-arc, foreland.
Basins at shear areas.
The sedimentary cycle: denudation, sediment transport and input, sedimentation, organic matter.
Subsidence, diagenesis and thermal history. Diagenetic processes and products; organic matter thermal degradation.
Basin fill architecture and prediction models for fossil fuels.
Historical evolution and controlling factors of depositional sequences; origin of rocks with prospective interest.

Historical Geology, introduction; Earth origin; Archean Eon. Proterozoic Eon.
Phanerozoic Eon: Palaeozoic Era; Mesozoic Era; Cenozoic Era.

TEACHING METHODS

Conceptual and deductive methods. Discussion and use of examples.
The student should be interested and aimed to discuss and criticize the proposed subjects, being skill in processing and implementing the information.
-Magistral classes: theoretical concepts.
-Classroom exercises.
-Use of software of interest.
-Field-trips: studied concepts application, case-study analysis, fiel-data obtention and analysis.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	35		6		4				15
Horas de Actividad No Presencial del Alumno/a	52,5		9		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 methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 35%
- Multiple choice test 30%
- Exercises, cases or problem sets 15%
- Oral presentation of assigned tasks, Reading¿ 10%
- Field-trips report and exercises 10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Legal provisions.
Evaluation methods. BOPV 2017-III-3 norm.

8th article.
8.2. Continuous evaluation (during and after the teaching period).
Evaluation methods (exam, exercises, field-trip reports,...).

Continuous evaluation:
-exercise evaluation after handing.
-report evaluation after the last field-trip. A field-exercise per field-trip is carried out by each student.
-evaluation of an oral presentation of a key subject on historical geology.

Exam evaluation:
-Written exam on practical and theoretical subjects.

The final result is obtained with the sum of the above explained evaluation items, following the corresponding percentages. To do this, the written exam should be passed with a mark equal to or above 5 points, that is, the 50 % of the subject.

8.3. If the student decides to withdraw from the examination, the withdrawal must be requested in the first nine weeks from the beginning of the teaching period. In order to formalize this, the student should present a writing form to the head-teacher of the subject.

12.2. article. In the continuous evaluation, in case the written exam value is over 40% of the total value, and the student does not take part in the exam, the final calification is "not presented". By the contrary, if the written exam value is under 40% of the total value, the student may present the withdrawal from the examination up to one month before the classes finish, by means of a writing form to the head-teacher of the subject.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Extraordinary examination. BOPV 2017-III-3 norm.

9th article
9.1. If the student cannot pass the exam in the continuous evaluation, an extraordinary written exam can be done in order to test the skills and knowledge.

9.3. Results obtained in the continuous evaluation are kept (%35) and added up to those obtained in the written exam (%65).

MANDATORY MATERIALS

Field-trip tools (sledgehammer, compass, metric scale, bags, magnifying glass, notebook...).
Security material (adequate shoes and garments, reflective vest, safety googles).

BIBLIOGRAPHY

Basic bibliography

Allen, P.A., Allen, J.R. (2005). Basin analysis: principles and applications. 2nd edition. Blackwell, Oxford, 549 pp.
Allen, P.A., Allen, J.R. (2013). Basin analysis: principles and applications to petroleum assessment. 3rd edition. Blackwell, Oxford, 619 pp.
Anguita, F. (2011, edición revisada). Biografía de la Tierra. Historia de un planeta singular. https://eprints.ucm.es/13263/1/Biograf%C3%ADa_de_la_Tierra_revisada_por_Francisco_Anguita_-_2011.pdf
Apraiz, A. (2005). Plaka Tektonika: Lurraren funtzionamendua ulertzeko teoria. UEU, Bilbao, 425 pp.
Benedetto, J.L. (2010, tercera edición), El continente de Gondwana a través del tiempo: una introducción a la Geología Histórica. http://www.librogondwana.com.ar
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Keary, P., Klepeis, K.A., Vine, F.J. (2009). Global Tectonics. 3rd edition. Wiley-Blackwell, 496 pp.
Macdougall, J.D. (1996). A short history of planet Earth. John Wiley and sons, New York, 266 pp.
Miall, A.D. (2000). Principles of sedimentary basin analysis. 3rd edition. Springer, Heidelberg, 490 pp.
Miall, A.D. (2016). STRATIGRAPHY A modern Synthesis. Springer, Heidelberg, 454 pp. https://link.springer.com/book/10.1007%2F978-3-319-24304-7
Schettino, A. (2015). Quantitative Plate Tectonics. Physics of the Earth – Plate Kinematics –Geodynamics. https://link.springer.com/content/pdf/10.1007/978-3-319-09135-8.pdf

Detailed bibliography

Gluyas, J. y Swarbrick, R. (2003). Petroleum Geoscience. Blackwell, Oxford, 359 pp.
Lunine, J. I. (1998). Earth: Evolution of a habitable world. Cambridge, 344 pp.
Watts, A. B. (2001). Isostasy and Flexure of the Lithosphere. Cambridge, 480 pp.

Journals

Sedimentology
The Depositional Record
AAPG Bulletin
Basin Research.
Sedimentary Geology
Marine and Petroleum Geology
Palaeogeography, Palaeoclimatology, Palaeoecology

Web sites of interest

http://www.sedimentologists.org
http://www.aapg.org
http://www.sepm.org

http://www.sciencedirect.com
https://www.springer.com/gp

OBSERVATIONS

During the examination the "Protocol on academic ethics and prevention of dishonest or fraudulent practices in assessment tests and in academic work at the UPV / EHU" will be applied.

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GMATEM31 - Bachelor's Degree in Mathematics	**Year**	Fourth year

COURSE

26668 - Probability and Stochastic Processes	**Credits, ECTS:**	6

COURSE DESCRIPTION

In this course, the Probability Theory is presented in the context of Measurement Theory and the principles of the Stochastic Processes Theory. In this way, the basic training acquired by the student in the second year of the degree with the Probabilty Calculus course is completed by carrying out a solid and systematic development of the principles, results and applications of the Probability Theory.

This course, together with the subjects Mathematical Programming and Multivariate Analysis, form the Module M14 of the Degree in Mathematics which is called Extension of Statistics and Operations Research. The objective of this module is to provide knowledge and techniques of probability, statistics and operations research so that the student acquires a basic and horizontal training of these courses that allows them to understand and apply such knowledge and skills in multiple interrelated directions. These three subjects can be followed independently.

The following subjects that are taken in the first, second and third year of the degree are desirable requirements when taking this subject: Calculation of probabilities, Measurement and integration, Complex analysis and Differential and Integral Calculus I and II.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIES:
M14CM01- Deep knowledge of the concepts and results of probability calculation, statistics and mathematical programming.
M14CM03- Correct use of terminology related to random phenomena, data analysis and optimization of linear functions.
M14CM04- Correct modeling of common situations related to random phenomena and data processing.
M14CM06- Correct selection of the appropriate analysis technique, according to the goal achieved in the analysis of these situations.
M14CM07- Correct calculations or graphic displays, when required by such situations, using appropriate theoretical and/or computational resources.
M14CM08- Critically interpret the results of the analysis carried out.

LEARNING RESULTS:
To know how to formulate, solve and interpret calculation problems of probabilities and stochastic processes.

Theoretical and Practical Contents

1. PROBABILITY SPACES: probability and measure, probability spaces, conditional probability, independence of events and collection of events.
2. RANDOM VARIABLES: measurable functions, probability distribution, independence of random variables.
3. EXPECTATION: expectation as integral, properties, moments, main inequalities.
4. CHARACTERISTIC FUNCTIONS: concept and main properties, derivatives and moments, inverse functions, identification of characteristic functions.
5. CONVERGENCE: modes of convergence of random variables, mutual relations, strong and weak laws of large numbers, convergence of random series, the central limit theorem and its generalizations.
6. CONDITIONAL EXPECTATION: concept and main properties, martingales, convergence of martingales.
7. STOCHASTIC PROCESSES: Markov chains, other stochastic processes, fundamentals of process theory.

TEACHING METHODS

In theory classes, basic theoretical concepts and results are explained, developed and illustrated. The problem classes show the practical aspects of the theory presented in the lectures. They can also be used to assign tasks to be done, to show instructions for doing them or to explain certain tasks. In the seminars, the student will take a more active role and will have to demonstrate the skills acquired up to that point in the skills studied. Depending on the session, different activities will be carried out, such as the theoretical and/or practical tasks assigned to them will be presented, individual or group work will be done, problem solving,...

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	36	6	18						
Horas de Actividad No Presencial del Alumno/a	54	9	27						

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- See orientations 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS EVALUATION GUIDELINES:
The evaluation of the subject will consists of presentations of problem-solving works, as well as some written tests. Exactly:
Partial writen exam: %25.
Solving problems in class, delivering and presenting proposed problems and/or theoretical works, participating in seminars and tutorials: % 20.
Final writen examen: % 55

The partial written test and the final written test are compulsory. It is necessary to obtain 4 out of 10 in both exams.

The 20% assessment of problem solving in class, delivery and presentation of proposed problems and/or theory assignments, participation in seminars and tutorials will be optional, always taking into account that, if continuous assessment has been chosen, the non-delivery / realization / presentation will imply the automatic loss of this percentage in the note.

The student who does not appear for the final written test that is carried out on the date of the ordinary call will be evaluated as "Not presented".

The student who does not want to participate in the continuous evaluation may officially renounce it by means of a letter addressed to the responsible teacher that must be delivered within a maximum period of 15 weeks from the beginning of the semester.

GUIDELINES FOR THE FINAL EVALUATION:
A written exam will be carried out on the date of the ordinary call whose qualification will be 100% of the note.

CONSIDERATIONS TO TAKE INTO ACCOUNT:
When evaluating, the following will be taken into account:
In the written tests: the precision and rigor in the definitions, properties and reasoning, the correctness of the results and developments, the correct use of mathematical language and the correct method of reasoning (clear, orderly and reasoned explanations of the steps followed and arguments used).
In the presentations and delivery of works: the precision and rigor in the definitions, properties and reasoning, the correction in the results and in the developments, the adequate use of mathematical language both in written and oral form and the clear, orderly and reasoned justifications of the arguments used.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

There will be a written exam and the obtained mark will be 100% of the note.

MANDATORY MATERIALS

Lists of material and problems taught in class and available in the subject's virtual classroom.

BIBLIOGRAPHY

Basic bibliography

G.R. GRIMMETT, D.R. STIRZAKER, Probability and Random processes, Oxford Science Publications, 1992
A.F. KARR, Probability, Springer Verlag, 1993.
S.I. RESNICK, A Probability Path, Birkhäuser, 1999.

Detailed bibliography

P. BILLINGSLEY, Probability and Measure, Wiley, New York, 1986.
J. NEVEU, Martingales a temps discret, Dunod, 1972.
A. N. SHIRYAYEV, Probability, Springer-Verlag, New York, 1996.

Journals

Web sites of interest

Virtual classroom to support face-to-face teaching: https://egela.ehu.eus/
Probability Web: https://www.stat.berkeley.edu/~jpopen/probweb/

OBSERVATIONS

Universidad del País Vasco · Euskal Herriko Unibertsitatea

COURSE GUIDE	2024/25		
Faculty	310 - Faculty of Science and Technology	**Cycle**	.
Degree	GMATEM31 - Bachelor's Degree in Mathematics	**Year**	Third year

COURSE

26690 - Differential Equations	**Credits, ECTS:**	12

COURSE DESCRIPTION

DESCRIPTION
This course presents the elementary methods (both analytic and qualitative) to solve ordinary differential equations (ODE) of first order. An extensive study of linear differential equations of higher order and linear differential systems is carried out. Existence and uniqueness of solutions of the Cauchy problem are covered. Autonomous systems are studied. Sturm-Liouville boundary value problems are analysed. First and second order partial differential equations (PDE) are also covered, by means of the methods of characteristics and separation of variables.

CONTEXTUALISATION
The course "Differential equations" (third year of the degree) is linked with the course "Partial differential equations" (fourth year). In the first part of the course "Differential equations" the focus is on the results and techniques for the studying of ordinary differential equations. In the second part and in the course "Partial differential equations" the goal is to develop concepts and techniques to solve partial differential equations, as well as the most important applications in geometry and physics.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

SPECIFIC SKILLS
M04CM01: Applying the main methods to solve ordinary differential equations.
M04CM02: Understanding and precisely stating the main concepts and results of the theory of existence and uniqueness of solutions of differential equations, using results of Mathematical Analysis previously studied. Also results regarding the dependence with respect to initial conditions.
M04CM03: Knowing rigorous proofs of the results concerning differential equations and devising new proofs of proposed results.
M04CM04: Using analytic, graphic and computational methods to solve certain differential equations.
M04CM05: Solving linear systems of ordinary differential equations.
M04CM06: Relating problems from Geometry, Physics and the real world to differential equations.
M04CM07: Extracting qualitative information about the solutions of ordinary differential equations, without having to solve them.
M04CM08: Solving differential equations and explaining the process, orally or in written form, using the appropriate mathematical language.
M04CM10: Translating real world problems in terms of ordinary differential equations or partial differential equations.
M04CM11: Understanding the behaviour of differential equations around regular or singular points, and the concept of stability of equilibrium.

LEARNING OUTCOMES
Applying the main methods to solve differential equations, either ordinary or partial differential equations.
Solving linear systems of ordinary differential equations.
Understanding real world problems in terms of differential equations.
Obtaining qualitative information about solutions of differential equations.

Theoretical and Practical Contents

1. DIFFERENTIAL EQUATIONS: Classification of differential equations. The concept of solution of a differential equation. Families of curves and orthogonal trajectories. Science and technology problems.
2. ELEMENTARY METHODS OF SOLUTION: Analytic methods to solve first order differential equations: equations of separable variables, homogeneous equations, exact equations and integrating factors, linear differential equations, Bernoulli equations, Ricatti equations, implicit equations. Methods to solve some second order differential equations. Qualitative methods to solve first order differential equations.
3. LINEAR DIFFERENTIAL EQUATIONS: Basic definitions. Homogeneous linear differential equations: Liouville formula, order reduction. Non-homogeneous linear differential equations: order reduction and the method of variation of constants or Lagrange method. Linear differential equations with constant coefficients, Euler differential equations. Second order linear differential equations: qualitative properties of the solutions.
4. POWER SERIES SOLUTIONS OF DIFFERENTIAL EQUATIONS: Power series and analytic functions. Power series solution of first order differential equations. Second order differential equations: regular points and regular singular points. Indicial equation and Frobenius series. Bessel equation. Expansions in a neighbourhood of infinity.

5. LINEAR DIFFERENTIAL SYSTEMS: Homogeneous linear differential systems: fundamental matrix and the Jacobi formula. Non-homogeneous linear differential systems. Homogeneous linear systems with constant coefficients: the method of eigenvectors and the matrix exponential function.
6. INITIAL VALUE PROBLEM. EXISTENCE THEORY: the Cauchy problem: the differential problem and the integral problem. The Lipschitz condition, Picard approximations. Global solutions of the Cauchy problem. Local solutions of the Cauchy problem. Extension of solutions and maximal solutions. Dependence of the solutions on initial conditions.
7. AUTONOMOUS SYSTEMS: Plane autonomous systems: the phase plane, orbits. Critical points of autonomous systems and their stability. Stability and classification of critical points of linear autonomous systems. Nonlinear systems: linearization and the direct Liapunov method.
8. STURM-LIOUVILLE PROBLEMS: Fourier series. Regular homogeneous Sturm-Liouville problems: eigenvalues, eigenfunctions and their properties. Orthogonality of eigenfunctions and Fourier series with respect to eigenfunctions of Sturm-Liouville problems. Periodic Sturm-Liouville problems. Regular non-homogeneous Sturm-Liouville problems; solution by means of eigenfunctions, Green's function.
9. INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS: Partial differential equations: definitions and examples. First order partial differential equations with constant coefficients. First order PDE with variable coefficients: the method of characteristics. Second order PDE with constant coefficients: classification. Second order PDE with variable coefficients: reduction to the canonical form. Solution of the wave equation in the half-plane and in a quadrant.
10. SEPARATION OF VARIABLES: The heat equation in one dimension. The wave equation in one dimension. The two-dimensional Laplace's equation in a rectangle. The Laplace’s equation in polar coordinates.

TEACHING METHODS

METHODOLOGY
The theoretical contents of the course will be explained in the lectures, following the basic references and mandatory materials that appear in the bibliography. Lectures will be complemented by applied classroom-based lessons, in which students will be asked to apply the theoretical contents studied in the lectures to solve problems.
In the seminars students will present and explain, both orally and in written form, representative problems or examples related to the content of the course. Students will be organised in groups of four or five. One week before the day of the seminar, the lecturer will make the material to be worked on by the group available on the eGela platform. The written group work must be uploaded to eGela before the seminar. During the class session, the lecturer will choose students to explain on the blackboard some of the questions and problems solved in the group work. The seminar will end with the students being given a problem to be solved and handed in at the end of the class.
The professors will guide the students during their tutorial hours about any question or difficulty the students may have throughout the course.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	72	12	36						
Horas de Actividad No Presencial del Alumno/a	108	18	54						

Legend:

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- See orientations and disclaimer 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

ORDINARY EXAMINATION PERIOD:
Written exams, both theory and problems
Weight: 80%-100% (students are required to obtain at least 4 points out of 10 in the exam to take into account the seminars)
Criteria:
- Precision in the reasonings and definitions.
- Correctness of mathematical language.
- Clear and correctly ordered argumentation methods, explaining the steps.
- Accuracy in the results of the exercises.

Seminars (written and oral).
Peso: 0%-20% (students are required to obtain at least 4 points out of 10 in the exam to take into account the seminars)

Criteria:
-Correct answers and proper use of mathematical language.
-Clarity in reasoning.
-Order and precision in oral presentations.
-Order and precision in problem solving.
-Attendance.

Opting out of the continuous assessment may be requested up to week 18 of the academic year, in writing to the lectures of the subject.

The final assessmet is based on a final exam of the whole subject. Weight 100%.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Written exam. Weight %100.

MANDATORY MATERIALS

eGela platform, if available.

BIBLIOGRAPHY

Basic bibliography

BIBLIOGRAFÍA
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*BOYCE-DIPRIMA, Elementary Differential Equations and Boundary Value Problems, 10th edition, John Wiley&Sons, 2012
*O. CIAURRI, Instantáneas diferenciales, Servicio de Publicaciones de la Universidad de La Rioja, 2013.
*A. DOU, Ecuaciones en derivadas parciales, Dossat.
*KISELIOV, KRASNOV Y MAKARENKO, Problemas de ecuaciones diferenciales ordinarias, MIR.
*R. K. NAGGLE Y E. B. SAFF, Fundamentos de Ecuaciones Diferenciales, Addison-Wesley Iberoamericana, 1992.
*I. PERAL ALONSO, Primer curso de ecuaciones en derivadas parciales, Addison-Wesley/Universidad Autónoma de Madrid,1995.
*F. SIMMONS, Ecuaciones Diferenciales con Aplicaciones y Notas Históricas, McGraw Hill.
*D.G. ZILL, W.S. WRIGHT, Ecuaciones diferenciales con problemas de valores en la frontera, 8th edition, Cengage Learning, 2015.

Detailed bibliography

*M. BRAUN, Differential Equations and Their Applications, Springer Verlag, New York 1978.
*M. W. HIRSCH, S. SMALE, Ecuaciones diferenciales, sistemas dinámicos y álgebra lineal, Alianza Editorial, Alianza Universidad, Textos nº 61.

Journals

Web sites of interest

http://www.ehu.eus/izaballa/Ecu_Dif/ecu_dif.htm

OBSERVATIONS