Universidad del País Vasco Euskal Herriko Unibertsitatea

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

Donostia: https://www.ehu.eus/en/web/gipuzkoako-ingeniaritza-eskola/visiting-students-donostia
Contact: gie-coord.international@ehu.eus

Eibar: https://www.ehu.eus/en/web/gipuzkoako-ingeniaritza-eskola/visiting-students-eibar
Contact: gie-eibar.international@ehu.eus

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

English Friendly Courses taught in SPANISH:

FACULTY OF ENGINEERING – GIPUZKOA. DONOSTIA (263)

	COURSE	SEMESTER[1]	CREDITS	SCHEDULE[2]	LINK TO SYLLABUS
Bachelor´s Degree in Mechanical Engineering					
25984	Mecánica Aplicada	Annual	9	A	➡
26053	Sistemas Neumáticos y Oleohidráulicos	2nd	6	A	
Bachelor´s Degree in Industrial Electronics and Automated Engineering					
25999	Industria Informática	1st	6	M	
Bachelor´s Degree in Civil Engineering					
26569	Geología	2nd	7,5	M	

FACULTY OF ENGINEERING – GIPUZKOA. EIBAR DEPARTMENT (264)

	COURSE	SEMESTER	CREDITS	SCHEDULE	LINK TO SYLLABUS
Bachelor's Degree In Renewable Energy Engineering					
25986	Sistemas de Gestión Integrada	1st	6	M	
27650	Informática	1st	6	M	
27850	Cálculo	1st	6	M	
27859	Estática y Resistencia de Materiales	1st	6	M/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 ENGINEERING – GIPUZKOA. EIBAR DEPARTMENT (264)					
	COURSE	SEMESTER	CREDITS	SCHEDULE	LINK TO SYLLABUS
27866	Energía Geotérmica y Solar Térmica	1st	6	M	
27871	Regulación Automática y Control	1st	6	M	
27875	Eficiencia Energética	1st	6	M	
25989	Organización, Gestión y Administración de Empresas	2nd	6	M	
27861	Matemática Estadística	2nd	6	M	
27862	Transferencia de Calor	2nd	6	M	
27869	Instalaciones Eléctricas en Energías Renovables	2nd	6	M	
27857	Circuitos Eléctricos	1st	6	M/A	
27877	Energía Solar Termoeléctrica	2nd	6	M	

Universidad del País Vasco Euskal Herriko Unibertsitatea

English Friendly Courses taught in BASQUE:

FACULTY OF ENGINEERING – GIPUZKOA. DONOSTIA (263)					
	COURSE	SEMESTER[3]	CREDITS	SCHEDULE[4]	LINK TO SYLLABUS
Bachelor´s Degree in Mechanical Engineering					
25984	Mecánica Aplicada	Annual	9	A	
25985	Ekoizpen eta Fabrikazio Sistemak	2nd	6	A	
Bachelor´s Degree in Civil Engineering					
26569	Geologia	2nd	7,5	M	
26534	Fisika Aplikatua	1st	9	M	

FACULTY OF ENGINEERING – GIPUZKOA. EIBAR DEPARTMENT (264)					
	COURSE	SEMESTER	CREDITS	SCHEDULE	LINK TO SYLLABUS
Bachelor's Degree In Renewable Energy Engineering					
25986	Kudeaketa Osorako Sistemak	1st	6	M	
26509	Aljebra	1st	6	M	
27650	Informatika	1st	6	M	
27850	Kalkulua	1st	6	M	
27859	Estatika eta Materialen Erresistentzia	1st	6	M/A	
27866	Energia Geotermikoa eta Eguzki Energia Termikoa	1st	6	M	
27871	Erregulazio Automatikoa eta Kontrola	1st	6	M	
27875	Eraginkortasun Energetikoa	1st	6	M	
25989	Enpresen Antolakuntza, Kudeaketa eta Administrazioa	2nd	6	M	
27849	Analisi Matematikoa eta Numerikoa	2nd	6	M	
27857	Zirkuitu Elektrikoak	1st	6	M/A	
27861	Matematika Estatistikoa	2nd	6	M	
27862	Bero Transferentzia	2nd	6	M/A	

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

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

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 263 - Faculty of Engineering - Gipuzkoa **Cycle** .

Degree GMECAN20 - Bachelor`s Degree in Mechanical Engineering **Year** Second year

COURSE

25984 - Applied Mechanics **Credits, ECTS:** 9

COURSE DESCRIPTION

Applied Mechanics aims to study Statics, Kinematics and Dynamics of rigid solids. This knowledge is the scientific and technical bases of industrial engineering, essential for any engineer to carry out his work with confidence and reliability. On the other hand, within the Degree in Mechanical Engineering, this subject is the basis for other subjects in the following courses such as: Resistance and Elasticity of Materials, Kinematics and Dynamics of Machines, Machine Design, Industrial Structures and Buildings, among others.

The concepts of Applied Mechanics will be developed from Vector Calculus and Matrix Algebra, analyzing mechanical systems, which are described graphically. In this way, a good level is required in the knowledge and use of Calculus and Algebra (1st course).

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The main result of the course is to know the behavior of rigid solids based on different types of applied actions. For this, the knowledge of solid statics, kinematics and dynamics must be guaranteed. At the same time, students will develop the capability of solving exercises based on theoretical concepts.

Applied Mechanics will allow the student to obtain the following specific knowledge and skills:

- To understand how to obtain resultant and moment in sliding vector systems, as well as to obtain the equivalent system.

- To calculate the geometric features of a mass distribution.

- To master the statics of a rigid-body or a rigid-body system. To understand the conditions that actions and constraints must meet in a mechanical system to be in equilibrium.

- To analyze the equilibrium of mechanical systems by graphically posing the Free Solid Diagram.

- To calculate the forces transmitted by isostatic articulated structures.

- Ability to analyze mechanical systems including, when necessary, friction forces.

- Ability to relate the forces exerted on a cable with its geometry and internal forces.

- Ability to calculate internal forces and moments in beams.

- Ability to analyze the stresses generated by axial, shear, bending and torsion forces in simple structural elements.

- Ability to perform a kinematic analysis of a rigid body using fields of velocity and acceleration or relative motion.

- To carry out the graphical resolution of kinematic systems with plane movement.

- Ability to solve dynamic exercises with different methods: Linear and Angular Momentum Theorems or Mechanical Energy Theorem.

- Ability to perform dynamic analysis of rigid-bodies with fixed axes.

- Ability to perform dynamic analysis of rigid-bodies with plane movement (mechanisms).

Theoretical and Practical Contents

1. BLOCK: STATICS

1. Chapter: FUNDAMENTALS OF VECTOR CALCULUS
2. Chapter: GEOMETRY OF MASSES AND PLANE SURFACES
3. Chapter: STATICS OF THE RIGID-BODY
4. Chapter: FRICTION
5. Chapter: CABLES
6. Chapter: FUNDAMENTALS OF STRENGTH OF MATERIALS

2. BLOCK: KINEMATICS AND DYNAMICS

7. Chapter: KINEMATICS OF THE RIGID-BODY
8. Chapter: STUDY OF PLANE MOTION
9. Chapter: MAGNITUDES AND FUNDAMENTAL THEOREMS OF DYNAMICS
10. Chapter: DYNAMICS OF THE RIGID-BODY
11. Chapter: DYNAMICS OF THE SOLID WITH FIXED AXIS
12. Chapter: DYNAMICS OF THE SOLID WITH PLANE MOTION

TEACHING METHODS

---ENGLISH---

Training and learning will be organized as follows:

- The master class and classroom practice are 3 hours a week. Basic theoretical concepts will be explained, developing theorems, demonstrating the statements used and giving examples. Classroom doubts will be clarified and class-based tasks will be proposed. In addition, to apply the theory, students will be asked to do the exercises in class, they will be given time to practice the exercise and the teacher will be able to clarify any doubts. It is strongly recommended to go to these classes to learn the fundamental theory which is necessary for the practical exercises.

- Outside of the classroom, students are encouraged to do additional work on their own with a minimum of 3-4 hours per week. Students must review the theoretical concepts taught in class and understand the developments. In addition, students will also have to work on the collections of exercises that are published in eGela. It is recommended to make use of teacher's tutorials to clarify doubts throughout the course.

- During the exam periods, students are recommended to make additional efforts (around +45 h) to review the whole content during the course.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	60		30						
Horas de Actividad No Presencial del Alumno/a	90		45						

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

---ENGLISH---

To pass Applied Mechanics in the ordinary call, it is necessary to pass the exam of the two blocks previously defined in the theoretical-practical contents. To pass each block, students must get at least 5/10 on the exam (both).

Theory and exercises will be examined in independent parts in the exam of each block. In the theoretical part, developments, explanations, and theoretical-practical issues are raised. The weight of this part will be between 20-40% of the exam.

There will be an opportunity to pass the first block during the exam period in January. In this way, students can reach the ordinary call with half of the subject approved. It is not imperative to take this exam in January.

The January exam is part of the evaluation system of the ordinary call. Therefore, following the ethical guidelines is mandatory for the student. Cheating during the exam or other types of fraud will be penalized with a 0 in the ordinary call. In this case, the student will be considered to have taken the exam.

The ordinary call exam will allow all students to take one or two blocks at a time. In both cases, the student will be considered to have taken (fully) the exam.

The student who does not show up for the final exam will get the grade of Not Presented. That student will not keep the note obtained in January for the extraordinary call, even if he/she had approved it.

The marks of the exams carried out for the students who have taken the final exam will be saved for the extraordinary call, so if one of the blocks has already been passed, it will be saved.

The final mark will be the average of the two blocks, with the weight of each block being 50%. To make the average, the highest grade of the exams taken will be used for each block.

If at the end of the ordinary call, both blocks are failed with a final mark of more than 4.0, the mark will be settled to 4.0.

If health circumstances do recommend it, the evaluation of the student may alternatively be carried out remotely through telematic means offered by the e-gela platform: tasks, questionnaires, etc.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

To pass Applied Mechanics in the ordinary call, it is necessary to pass the exam of the two blocks previously defined in the theoretical-practical contents. To pass each block, students must get at least 5/10 on the exam (both).

Theory and exercises will be examined in independent parts in the exam of each block. In the theoretical part, developments, explanations, and theoretical-practical issues are raised. The weight of this part will be between 20-40% of the exam.

Students will have again the option of taking one or both blocks. In both cases, it will be considered that the student has taken (fully) the exam.

The marks of students who have taken the ordinary call will be saved. If the student did not take the exam in the ordinary call, the mark will not be saved, even if he had passed it.

The student who does not take the exam in the extraordinary call will be set as Not Presented.

The final mark will be the average of the two blocks, with the weight of each block being 50%. To make the average, the highest grade of the exams taken will be used for each block.

If at the end of the ordinary call, both blocks are failed with a final mark of more than 4.0, the mark will be settled to 4.0.

If health circumstances do recommend it, the evaluation of the student may alternatively be carried out remotely through telematic means offered by the e-gela platform: tasks, questionnaires, etc.

MANDATORY MATERIALS

Theory and problems developed and solved in the classroom.

Besides, additional material to support self-study.

Special (high-level) problems for in-depth analysis of concepts taught and for self-study.

BIBLIOGRAPHY

Basic bibliography

Applied Mechanics is fundamental for every engineer so there is a hige variety of books. For that students interest please refer to the teacher. Many of them are spanish versions of english/american books.

Mecánica vectorial para ingenieros, Estática. Beer, Johnston. Mc Graw Hill
Mecánica vectorial para ingenieros, Dinámica. Beer, Johnston. Mc Graw Hill
Mecánica para ingenieros, Estática. Shames. Prentice Hall
Mecánica para ingenieros, Dinámica. Shames. Prentice Hall
Mecánica aplicada, estática y cinemática. Bilbao, Amezua. Síntesis
Mecánica aplicada, dinámica. Bilbao, Amezua, Altuzarra. Síntesis
Mecánica para ingenieros, Estática. Meriam, Kraige. Reverté
Mecánica para ingenieros, Dinámica, Kraige. Meriam. Reverté
Curso de Mecánica. Bastero, Casellas. EUNSA

Detailed bibliography

Journals

Web sites of interest

https://www.journals.elsevier.com/international-journal-of-mechanical-sciences
https://www.asme.org/
http://ocw.upm.es/course/mecanica

OBSERVATIONS

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 263 - Faculty of Engineering - Gipuzkoa **Cycle** .

Degree GMECAN20 - Bachelor`s Degree in Mechanical Engineering **Year** Second year

COURSE

25985 - Production and Manufacturing Systems **Credits, ECTS:** 6

COURSE DESCRIPTION

EKOIZPEN ETA FABRIKAZIO SISTEMAK izeneko ikasgaia Mecanica Graduaren 2. Kurtsoan irakasten da. Fabrikazio arloari buruzko sarrerako ikasgaia da. Ikasgai honen helburu nagusia fabrikazio prozesuen hastapenak ikustekoa da. Kurtsoan zehar, fabrikazio prozesu nagusiak (galdaketa, konformazio plastikoa, mekanizazio prozesuak, etb.) eta hauetan erabiltzen diren tresneri eta makinak ikasten dira. Honetaz gain, eta fabrikazio arloan garrantzia handia duenez, osagaien neurketarako erabiltzen diren teknologiak eta instrumentuak ere ikasten dira, metrologia dimentsionala dena, hain zuzen. Testuinguru honen barruan, fabrikazio teknologia ikasgaian, ikasleak osagai konkretu bat fabrikatzeko prozesu egokienak zeintzuk diren justifikatzeko gai izateko, behar besteko konpetentziak hartuko ditu. Aldi berean, fabrikazio prozesu baterako tresneria, ekipamendua eta funtsezko parametroak (bere magnitude ordenan) proposatzeko gaitasuna izan behar du ikasleak.
Azkenik, ikasleak piezak fabrikatzeko erabiltzen diren makina-erremintetan erabiltzen diren kontrol eta eragingailu sistemak, piezen egiaztapen geometrikoa egiteko tresneria eta metodoak deskribatzeko gai izatea bilatzen da.
Guzti hau, testuinguru orokor bezala gure inguruan (Euskal Autonomia Erkidegoan) ditugun osagarri eta makina-erreminta industriaren garrantzia hartuz.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Principios y posibilidades de los procesos de producción y fabricación.

Theoretical and Practical Contents

CHAPTER 1: Introduction to manufacturing and form processes.
CHAPTER 2: Metrology.
CHAPTER 3: Introduction to machining processes.
CHAPTER 4: Modeling of machining and cutting processes.
CHAPTER 5: Numerical control.
CHAPTER 6: Special machining processes.
CHAPTER 7: Sheet metal cutting and bending.
CHAPTER 8: Drawing, rolling and extrusion.
CHAPTER 9: Forging.
CHAPTER 10: Casting.
CHAPTER 11: Welding processes.

TEACHING METHODS

Ikasgaiaren irakasletza hurrengo instrumentuen bidez gertatzen da:
- Eskola teoriko-praktikoa (M eta AP): Gelan egindakoak, non irakasleak ikasgaiaren kontzeptu nagusiak azalduko dituen gardenkiak, ariketak, fabrikazio kasu errealak, eta abarren bidez.
- Tailer Industrialeko Praktikak (ITP): Talde txikietan emango dira, non pieza eta osagai erreal desberdinen fabrikazio prozesuak aztertzeko, arazo errealen kalkulua egiteko, fabrikazio tailer baten aurkitu ahal ditugun makinak zein tresneriak erabiltzeko aukera izango duten.

TYPES OF TEACHING

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

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

Evaluation methods

- 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

- Bukaerako notan, azterketaren pisua %70 izango da.
- Praktika eta ondoren egin beharreko lan eta informen pisua %30 izango da.
- Azterketara aurkeztu ahal izateko, praktika guztiak (%100) eta egin behar diren lanak/informeak eginda eta gainditua edukitzea derrigorrezkoa izango da.
- Irakasgaia gainditzeko, azterketaren nota minimoa 5.0 izan beharko da.
- Graduko eta Lehenengo eta Bigarren Zikloko Ikasketen Gestiorako Arautegiaren 39 artikuluaren arabera, aurreikusita dagoen bukaerako probara ez aurkezteak ebaluazioaren deialdiari uko egitea suposatuko du eta Ez Aurkeztuta gisa agertuko da.
- Graduko eta Lehenengo eta Bigarren Zikloko Ikasketen Gestiorako Arautegiaren 43 artikuluaren arabera, ikasleari, justifikatutako arrazoiengatik ezin bazaio egin etengabeko ebaluazioa, bukaerako proba bakarra egingo zaio, irakasgaiko jakintzak eta gaitasunak bereganatu dituela egiazta dezan.Horretarako, eskaera bat egin beharko du Eskolako web orrialdean (Idazkaritza eta Izapideak atalean) agertzen diren prozedura eta epea errespetatuz.
-Egoera sanitarioak horrela gomendatzen badu, ebaluazio ez presentziala burutuko da, e-gela plataforma bitartez.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

There will be a single written exam. All the content given in the subject can be included.

In order to pass the subject, it is mandatory to complete all the practice sessions.
Students who have not done these practices will have to take a written exam to pass this part. This practical exam will be done after the official exam. All the content given in the practices will be evaluated.

To pass the subject, a minimum mark of 5.0 is necessary.

If necessaary, do to sanitary constraints, online evaluation could be carried out using e-Gela platform or similar.

MANDATORY MATERIALS

Notes and documentation provided by the teaching staff.

BIBLIOGRAPHY

Basic bibliography

1 - Echepare Zugasti, Ricardo, Mecanizado por arranque de viruta: máquinas-herramienta.
2 - Weck, Manfred. Handbook of machine tools. ISSN/ISBN: 0471262242. Biblioteca: 621.7/.9.
3 - López de Lacalle, Norberto, Sánchez Galíndez, José Antonio, Lamikiz Mentxaka, Aitzol. Mecanizado de alto rendimiento: procesos de arranque. ISSN/ISBN: 8460913805. Biblioteca: 621.9 LOP.
4 - Jesús del Río. Conformación plástica de materiales metálicos (en frío y en caliente).ISBN 84-96437-09-4. Biblioteca: 621.7 RIO.
5 - Hernández Riesco, Germán. Manual del soldador. ISBN: 84-931444-5-2. Biblioteca: 621.791 HER.
-5-2. Biblioteca: 621.791 HER.

Detailed bibliography

1- G. Boothroyd. Fundamentos del corte de metales y las máquinas-herramienta. Editoral McGraw-Hill. ISBN/ISSN 0-07-090935-0 (968-6046-58-5). Biblioteca: 621.9.02.
2- M. C. Shaw. Metal cutting principles. Oxford Science Publications.ISBN 0-19-859002-4. Biblioteca 621.9.
3- G. F. Micheletti. Mecanizado por arranque de viruta. Editorial Blume. ISBN/ISSN 84-7031-250-2. Biblioteca 621.9.
4- I. V. Sanz Glaria. Metrología dimensional . Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos, Santander. ISBN/ISSN 84-86928-92-3. Biblioteca 681.2.
5- M. Reina Gómez. Soldadura de los aceros : aplicaciones. Editor M. Reina Gómez, Madrid. ISBN/ISSN 84-605-1475-7. Biblioteca 621.791.
6- José MªLasheras. Tecnología mecánica y metrotecnia. Donostiarra. 84-7063-087-3.
7- P. Coca Rebollero, J. Rosique Jiménez. Tecnología mecánica y metrotecnia. Pirámide. 84-368-0247-0.
8- E.P. DeGarmo, J.T. Black, R.A.Kohser. Materiales y procesos de fabricación. Reverte, S.A. 84-291-4822-1
9- A.Kucher. Tecnología de metales. Mir Moscu. 5-03-000683-4
10- John E. Neely. Materiales y procesos de Manufactura. Limusa, S.A.. 968-18-4381-9
11- Jesús del Río. Deformación plástica de los metales. Gustavo Gili, S.A. 84-252-0995-1
12- J.Billigmann, H.D. Feldmann. Estampado y prensado a maquina. Reverte, S.A.. 84-291-6034-5
13- Mario Rossi. Estampado en frío de la chapa. Dossat, S.A.. 84-237-0384-3
14- Oehler-Kaiser. Herramientas de troquelar, estampar y embutir. Gustavo Gili, S.A.. 84-252-20640-5
15- Oscar Schü Alonso. Tratado Practico de moldeo y fundición. Gustavo Gili, S.A.
16- J.M. De La Poza Lleida. Hornos para fundir metales y sus aleaciones. OIKOS-TAU. 84-281-0819-6.
17- Avner. Introducción a la metalurgia física. Mc. Graw Hill.
18- Coca Rosique Rebolledo. Ciencia de Materiales. Cosmos.

Journals

- International Journal of Machine Tools and Manufacture. Editor: Elsevier
- CIRP Annals: manufacturing technology. International Institution for Production Engineering Research. Editor: Elsevier
- Precision. Editor: Elsevier
- International Journal of Advanced Manufacutirng Technologies, JAMT. Editor: Springer.
- IMHE Información de máquinas-herramienta, equipos y accesorios. Editor: Ediciones Técnicas Izaro.
- Interempresas: Metalmecánica
- Soldadura y tecnologías de unión. Editor: Asociación Española de Soldadura y Tecnologías de Unión CESOL.
- Deformación metálica. (Técnicas de fabricación, acabado y transformación del fleje, chapa, tubos y alambre). Editor: Elsevier Prensa.
- Moldes. Editor: Metal Spain.
- Fundidores. (Fundiciones férreas y no férreas en arena, coquilla y fundición a presión). Editor: Metal Spain.

Web sites of interest

https://egela.ehu.eus/

OBSERVATIONS

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty	264 - Faculty of Engineering - Gipuzkoa. Eibar Department	**Cycle**	.
Degree	GRENOV20 - Bachelor's Degree In Renewable Energy Engineering	**Year**	Second year

COURSE

27859 - Statics & Strength of Materials — **Credits, ECTS:** 6

COURSE DESCRIPTION

The subject offers an overview of the mechanical design of parts. It presents the basis of the design of mechanical elements: the safety degree is assessed according to the loads, dimensions and material of the mechanical element. The subject consists of two differentiated parts: 'Statics' and 'Mechanics of Materials'. In Statics, the mechanical element is isolated and the external forces are analysed to obtain a free solid diagram. In Mechanics of Materials, the solid is considered deformable. This allows the study of internal forces (stresses) created by the external forces. Comparing the magnitude of these stresses with the mechanical properties of the material, it the safety coefficient is calculated and, thus, the design of the part is validated. An optimal mechanical design saves materials and resuces, enlarges the usable life cycle and improves social and environmental sustainability.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Competences:
CRI04 - Learn about and use the principles of materials resistance.
G011 - Develop the necessary learning skills to carry out ongoing training with a high level of autonomy.
G012 - Apply strategies found in scientific methodology.
G013 - Work efficiently in groups.

Learning outcomes:
Knows and uses the basic principles of particle statics and rigid solids.
Knows and uses beam and cable elements, the calculation of their main parameters for different types of loads.
Design structures in 2 and 3 dimensions.
Knows and uses the tensile and compression loads.
Knows and uses the bending loads in beams.
Knows and uses the torque loads in axes.
Knows and uses the buckling loads in columns

Theoretical and Practical Contents

Unit 1. Statics of the particle and the rigid solid.
Unit 2. Beams and cables.
Unit 3. Structures.
Unit 4. Stress and deformation. Material properties characterisation tests.
Unit 5. Axial loads: tensile and compression.
Unit 6. Bending.
Unit 7. Torque.
Unit 8. Buckling.

TEACHING METHODS

In this subject different teaching methodologies are used, being the most common the problem-solving. The participation in the programmed activities ensures the development of the right skills by the students.
The following activities take place over the year:
- Lectures: the conceptual content of the subject is explained, with student participation in occasional debates.
- Seminars: cooperative work is done, using the puzzle of problems in groups. Debate based learning (DBL) is used to understand the influence of mechanical properties of materials on the mechanical behaviour and sustainability of mechanical elements.
- Also in seminars, a guided debate will be prepared and carried out. In this debate, the groups shall prepare the two sides regarding the mechanical design of the elements from the point view of mechanics, materials, and sustainability.
- Practical work in the laboratory: the mechanical properties of a material are measured and the results shared among the groups so reach agreement on conclusions.

«If the sanitary conditions does not allow regular academic activities or/and evaluation in the classroom, the on-line teaching will activate, of which the students will be informed promptly.»

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	45		7	8					
Horas de Actividad No Presencial del Alumno/a	60		20	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 60%
- Exercises, cases or problem sets 15%
- Teamwork assignments (problem solving, Project design) 25%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Assessment in this subject is combined. The exam must be passed with a minimum mark of 5/10 to pass the subject. It is also necessary to complete satisfactorily the practical work to pass the subject. Aptitude and participation during the year also has an impact on the final grade.
A student who, for justified reasons, cannot participate in the combined assessment system (or, as the case may be, the continuous assessment system) may take a final exam in which the practical part will also be assessed. To do this, he/she will notify the professor responsible for the subject in writing within one month of the data set for the assessment of the subject. In this case, the student will be assessed in a single final exam, which will include the practical part and will account for 100% of the grade.
A student who wishes to withdraw from continuous assessment may do so in writing to the professor who teaches the subject, at least one month before the completion of the teaching period for the subject.
If the student does not present him/herself for the written exam, in any of the calls, she/she will be considered to have withdrawn from said call and will appear as "Not Presented".

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

9th article.
In the extraordinary exam call, a single final exam is the only evaluation system.
The final exam includes both, theoretical and practical parts, it accounts for 100% of the grade.

MANDATORY MATERIALS

Basic references:
Vector Mechanics for Engineers: statics, F. Beer, E. R. Johnston Jr., D. Mazurek McGraw-Hill, 2008
Mechanics of Materials, F. Beer, E. R. Johnston Jr., McGraw-Hill, 2009
Mechanics of Materials (Timoshenko), J. Gere, McGraw-Hill, 2006
Fundamentals of Materials Science and Engineering: An Integrated Approach, W. D. Callister D.G. Rethwisch, 3rd edition, Wiley 2007.

BIBLIOGRAPHY

Basic bibliography

In-depth bibliography:
Mechanics of Materiales, R.C. Hibbeler, Pearson, 2006
Foundations of Materials Science and Engineering, W. J. Smith, J. Hashemi, McGraw-Hill, 2014
Introduction to the Mechanics of Solids, S.H. Crandall, N.C. Dahl, T.J. Lardner, McGraw-Hill, 1978

Detailed bibliography

Resistencia de Materiales, Timoshenko, James Gere, Editorial ITES, PARANINFO
Mecánica de Sólidos. TJ Lardner - Rarcher, Editorial McGraw-Hill
Mecanica de Materiales, William F. Riley, Wiley
Materials and Sustainable Development, M. F. Ashby, Butterworth-Heinemann, 2015

Journals

Web sites of interest

Ansolaren liburua UEUn:
http://www.buruxkak.org/liburuak_ikusi/205/elastikotasunaren_teoria_eta_materialen_erresistentzia.html
Deformaziogatiko gogortzearen eta tenplearen adibidea:

http://www.roadandtrack.com/car-culture/videos/a31369/heres-how-automotive-coil-springs-are-made/
Elementu finituen metodoa:
https://knowledge.autodesk.com/support/nastran-in-cad/learn-explore/caas/CloudHelp/cloudhelp/2017/ENU/NINCAD-SelfTraining/files/GUID-B63CD966-5467-45A2-BACA-1408418997D0-htm.html
Espagetien haustura-moduak:
https://www.youtube.com/watch?v=ADD7QlQoFFI
http://ocw.mit.edu/OcwWeb/Mechanical-Engineering/index.htm
http://imechanica.org/
http://www.mip.berkeley.edu/physics/bookadx.html
http://memagazine.asme.org/
https://en.unesco.org/sustainabledevelopmentgoals
https://www.datemats.eu/blog/

OBSERVATIONS

Universidad del País Vasco Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 264 - Faculty of Engineering - Gipuzkoa. Eibar Department **Cycle** .

Degree GRENOV20 - Bachelor's Degree In Renewable Energy Engineering **Year** Second year

COURSE

27861 - Statistical Mathematics **Credits, ECTS:** 6

COURSE DESCRIPTION

The subject of STATISTICAL MATHEMATICS is a subject of the second semester of the second year and it has 6 ECTS. Classroom lessons are divided into three types: lectures (30 hours), classroom practices (15 hours) and computer practices (15 hours). In addition to the lessons, students will have to work 45 hours of lectures, 22.5 hours of classroom practice and 22.5 hours of computer practice.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Knowledge or Content:
RCO1: The graduate will be capable of identifying concepts and techniques from basic and specific subjects that allow the learning of new methods, theories, and modern engineering tools, providing sufficient versatility to adapt to new situations in their professional practice.
RCO5: The graduate will be able to identify concepts and methods related to mathematics that are applicable in the field of engineering.

Competencies:
RC4: The graduate will be capable of applying the strategies inherent to the scientific methodology: analyzing problematic situations both qualitatively and quantitatively, formulating hypotheses and solutions using models specific to renewable energy engineering.

Skills or Abilities:
HE1: The graduate will be capable of solving problems with initiative, decision-making, creativity, and critical reasoning.
HE5: The graduate will be capable of working effectively in a team constructively, integrating skills and knowledge to make decisions.
HE6: The graduate will be capable of acquiring new knowledge and skills for continuous learning, as well as pursuing further studies, with a high degree of autonomy.

Learning outcomes of the subject:
- Analyze and express ideas correctly using mathematical terminology.
- Statistically describe a sample by means of tables, graphs and measurements.
- Knows the concepts and applications of probability.
- Analyzes situations and models engineering problems of stochastic nature by means of variables randomly.
- Correctly applies sampling and parameter estimation techniques.
- Applies basic regression models to engineering problems.

Theoretical and Practical Contents

Unit 1 : Descriptive statistics.
Population and sample. Frequency distributions. Graphical representations and measurements.

Unit 2 : Combinatorial. Basic ideas of probability.
Variations, combinations and permutations. Random experiments. Algebra of events. Absolute and relative frequency of an event. Concept of probability. Axioms. Conditioned probability. Compound probability theorem. Dependent and independent events. Probability of the union of compatible events. Total probability theorem. Bayes' theorem.

Unit 3 : Discrete random variables.
Random variable. Classification. Discrete probability distributions. Probability function and distribution function. Mean and variance. Hypergeometric, binomial, geometric, negative binomial, Poisson and polynomial distribution.

Unit 4 : Continuous random variables.
Density function and distribution function. Mean and variance. Normal Gaussian distribution. Moivre's theorem. Pearson's chi-square distribution, Student's t and F by Fisher-Snedecor. Weibull distribution. Other distributions.

Unit 5 : Sampling and estimation theory.
Introduction. Means and variance of a linear combination of random variables. Central boundary theorem. Population and statistical sampling parameters. Parameter estimation. Fisher's theorem. Confidence interval of the mean and variance of

a normal population. Confidence interval for the difference of means of two normal and independent populations. Confidence interval for the difference in means of two normal populations, paired samples. Variance ratio.

Unit 6 : Hypothesis contrast.
Introduction. Types of hypotheses. Type of contrasts. Type I and type II error. Critical region and region of acceptance. Contrasts on the mean and variance of a normal population. Contrasts on the difference of means of two normal and independent populations. Contrasts on the difference of means of two normal populations, paired samples.

Unit 7 : Analysis of variance.
Analysis of variance with one factor of variation and with two independent factors of variation Tables ANOVA and ANOVA II.

Unit 8: Regression and correlation.
Two-dimensional statistical variable. Scatter diagrams. Linear regression. Method of the least squares of Gauss. Correlation. Standard error of the estimation. Non-linear regression: Adjustment of exponential, potential and parabolic curves.

TEACHING METHODS

- Final exam: 75%. (It could be possible advance up to 15% throughout the course through activities)
- Computer training: 25%

A minimum score of 4 marks are required for both the computer training and the final exam.

TYPES OF TEACHING

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

Legend:

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

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

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

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In continuous evaluation the practices will be carried out throughout the four-month period and the written test on the day of the exam.

In the final evaluation the practices and the written test will be done on the day of the exam.

If classroom teaching should be replaced by virtual teaching, and above all, if it is not possible to take the exam in person, the assessment systems will be adapted to the situation. The tests taken so far (if any) will be kept. From then on, all the contents to be assessed will be evaluated by means of different tests and/or written and/or oral activities (papers, tests, exams, interviews...). As far as possible, the selected evaluation system will be maintained but continuous evaluation against the final will be encouraged.

Article 8.
In any case, students will have the right to be evaluated through the final assessment system, regardless of whether or not they have participated in the continuous or mixed assessment system. To do so, students must present a written waiver of continuous or mixed assessment to the teaching staff in charge of the subject, for which they will have a period of 9 weeks, counting from the beginning of the four-month period, in accordance with the school's academic calendar. In this case, the student will be evaluated with a single final exam, which will include a theoretical and practical part, and which will comprise 100% of the mark.

Article 12. Waiver of the call
12.2.- In the case of continuous evaluation, if the weight of the final test is higher than 40% of the grade of the course, it will be enough not to take the final test for the final grade of the course to be not submitted or presented. Otherwise, if the weight of the final test is equal to or less than 40% of the qualification of the subject, the students may waive the call within a period of at least one month before the end of the teaching period of the corresponding subject. This resignation

must be presented in writing to the teaching staff responsible for the subject.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Article 9
The evaluation of the subjects in the extraordinary calls will be carried out exclusively through the final evaluation system.

The final assessment test of the extraordinary call will consist of as many tests and assessment activities as necessary to be able to assess and measure the defined learning outcomes, in a way that is comparable to how they were assessed in the ordinary call. The positive results obtained in each part by the students during the course may be kept.

MANDATORY MATERIALS

Exercises notebook.

In the written test, a calculator and statistical tables may be used.

BIBLIOGRAPHY

Basic bibliography

Probability and Statistics for Engineering and the Sciences. Jay L. Devore.
- NOVO SANJURJO V. Estadística Teórica y Aplicada. Ed. Sanz y Torres.
- NOVO SANJURJO V. Problemas de cálculo de probabilidades y estadística. Ed. Sanz y Torres

Detailed bibliography

GEORGE C. CANAVOS. Probabilidad y estadística. Aplicaciones y métodos. MacGraw -Hill

JOSE M. CASAS SANCHEZ. Inferencia estadística para economía y administración de empresas.
Ed. Centro de estudios Ramón Areces, S.A.

SIXTO RIOS. Análisis estadístico aplicado. Paraninfo.

KARMELE FERNANDEZ ETA BESTEAK. Estatistika-ariketak. Udako Euskal Unibertsitatea.

Journals

LA GACETA DE LA REAL SOCIEDAD MATEMATICA ESPAÑOLA

Web sites of interest

http://www.divulgamat.net
http://www.hiru.com
http://aulafacil.com/CursoEstadistica/CursoEstadistica.htm

OBSERVATIONS

La asignatura está dentro del siguiente proyecto, IKDi3 -23-40.

Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 264 - Faculty of Engineering - Gipuzkoa. Eibar Department **Cycle** .

Degree GRENOV20 - Bachelor's Degree In Renewable Energy Engineering **Year** Second year

COURSE

27862 - Heat Transfer **Credits, ECTS:** 6

COURSE DESCRIPTION

In the practice of engineering, have some understanding of the mechanisms of heat transfer is increasingly important. It plays a critical role in the design of renewable energy systems.
The subject develops the fundamental knowledge of the heat and mass transfer. This is a basic science that studies the ratio of thermal energy transfer.
For this subject, students have get solid calculation base (calculation of 1st course and extension of mathematics of 2nd course) and physics (physics and physical expansion of 1º course). Equally, it is convenient to have passed thermodynamics, mechanics of fluids and differential equations (all 2nd year). Although the concepts that belong to these themes are presented and reviewed as they will need.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Knowledge of heat transmission is acquired as the basic principles and applied to the resolution of engineering problems.

The transversal competence G012 is worked on. Thus, the strategies of scientific methodology are applied: the problematic situation is analysed qualitatively and quantitatively. Hypotheses and solutions that will be used in the models of Renewable Energy engineering are proposed.

KNOWLEDGE OR CONTENTS

- RCO1: The graduate will be able to identify concepts and techniques from basic and specific subjects, enabling the learning of new methods, theories and modern engineering tools, providing sufficient versatility to be able to adapt to new situations in the exercise of his/her profession.

- RCO7: The graduate will identify the laws of applied thermodynamics and heat transfer, as well as the basic principles of fluid mechanics, which are applicable in the field of engineering.

COMPETENCIES

- RC4: The graduate will be able to apply the strategies of scientific methodology: analyse the problematic situation qualitatively and quantitatively, propose hypotheses and solutions using the models of renewable energy engineering.

SKILLS OR ABILITIES

- HE1: The graduate will be able to solve problems with initiative, decision-making, creativity and critical reasoning.

- HE5: The graduate will be able to work effectively in a constructive team, integrating skills and knowledge to make decisions.

- HE6: The graduate will be able to acquire new knowledge and skills in order to carry out continuous training, as well as to undertake further studies, with a high degree of autonomy.

Theoretical and Practical Contents

CHAPTER 1.- INTRODUCTION AND BASIC CONCEPTS
CHAPTER 2.- HEAT CONDUCTION EQUATION
CHAPTER 3.- STEADY HEAT CONDUCTION
CHAPTER 4.- TRANSIENT HEAT CONDUCTION
CHAPTER 5.- NUMERICAL METHODS IN HEAT CONDUCTION
CHAPTER 6.- FUNDAMENTALS OF CONVECTION
CHAPTER 7.- EXTERNAL FORCED CONVECTION
CHAPTER 8.- INTERNAL FORCED CONVECTION
CHAPTER 9.- NATURAL CONVECTION
CHAPTER 10.- BOILING AND CONDENSATION
CHAPTER 11.- HEAT EXCHANGERS
CHAPTER 12.- FUNDAMENTALS OF THERMAL RADIATION
CHAPTER 13.- RADIATION HEAT TRANSFER
CHAPTER 14.- MASS TRANSFER

TEACHING METHODS

M (Lecture): a 2 h duration PowerPoint will be exposed every week, one presentation for each chapter. The students must take notes.

GA (Problems): 1 h of problems will be done, every week, on the board for each chapter. The students must take notes and will be asked randomly about how they would do some parts of the problems.

GO (Computer Problems): 7 computer classes will be done (1.5 h each one) using the ESS software to solve different problems. During the first hour of each class the teacher will lead some exercises and in the last half hour the student will have to solve a problem by his own, which will be evaluated. Schedule:

COMPUTER CLASS 1 (week 5): fundamentals of EES software and problems for chapters 3 and 4. This one will not be evaluated.

COMPUTER CLASS 2 (week 6): problems for chapter 5.
COMPUTER CLASS 3 (week 7): problems for chapter 5.
COMPUTER CLASS 4 (week 8): problems for chapter 5.
COMPUTER CLASS 5 (week 9): problems for chapters 6, 7 and 8.
COMPUTER CLASS 6 (week 12): problems for chapters 9, 10 and 11.
COMPUTER CLASS 7 (week 15): problems for chapters 12 and 13.

GL (Laboratory practices): the students must do two laboratory practices, 2.5 h each one: convection and heat exchangers. The student will do a report for each of the laboratory practices and those reports will be evaluated.

NOTE: The semester is 15 weeks long but there are just 14 chapters because probably one week will be lost because of some free days.

TYPES OF TEACHING

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

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

Evaluation methods

- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions 55%
- Multiple choice test 15%
- Exercises, cases or problem sets 30%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

1 - WRITTEN EXAM*:

1st exercise: heat transfer
2nd exercise: heat transfer
3rd exercise: heat transfer

Written exam grade = [(1st exercise)x(2nd exercise)x(3rd exercise)]^1/3 .

Also, three written test, using Socrative tool will be done during the course. In each test, all the class must participate and 80% of the answers will be correct in order to get 5% of the final grade, otherwise will get nothing.

2 - COMPUTER PROBLEMS**: 7 computer problem classes (1.5 h duration each one) will be done using the EES software. In the last three computer classes problems on the
theory exposed on lectures will be solved. In those 3 computer classes the pattern will be the same, in the first hour the teacher will lead the exercises and in the last half hour the student will be evaluated. The exam type will be passed or failed. The student will be given one problem, similar to those made during the first hour, and if the student gets the correct solution will get a 5% of the final grade, otherwise will get nothing. Since there are 3 evaluated computer classes the total weight of them is a 15% of the final grade.

3 - REPORTS FROM LABORATORY PRACTICES**: Two written test from laboratory practices will be done: convection

and heat transfer. The value of each of the reports will be the 7.5% of the final grade.

FINAL GRADE:
WRITTEN EXAM (55%) + COMPUTER PROBLEMS (15%) + REPORTS FROM LABORATORY PRACTICES (15%) + WRITTEN TEST WITH SOCRATIVE (15%)
* To pass the subject in the written exam a minimum of 35% must be obtained. The proceedings will show the written exam grade in case the minimum is not obtained.
** If, because of holiday days, any computer class or any laboratory practice is not carried out, their total percentage on the final grade will be the same. This means that the value of the ones carried out will be adjusted in order to maintain the total percentage.

Note: Students than for cause (Art.43 management regulations for the teachings of degree. UPV/EHU) may not participate in joint evaluation system will have access to a final exam which will be also evaluated the practical part. For this purpose, it shall his desire, as written and justified to the teacher in charge of the subject, within a period that, at a minimum, will be one month before the date set for the evaluation of the subject. In this case, the / the student to be evaluated / a with a single final exam, which will include a practical part, and that shall cover 100% of the note.Article 39 of the same regulation states that the / the student at that desired, may submit his resignation to the call for evaluation, by means of a letter sent to the professor who taught the course, within a period that, at a minimum, will be one month prior to the date of completion of the teaching period of the course.In the event that the / the student that is submitted to the test written in any of the calls, will mean the renunciation of such call for evaluation and will consist as not submitted.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The extraordinary call is governed under the same criteria that ordinary call.

MANDATORY MATERIALS

ÇENGEL, Y. A. HEAT AND MASS TRANSFER, A Practical Approach. McGraw-Hill. 3rd Edition (2007).

BIBLIOGRAPHY

Basic bibliography

INCROPERA, F. P. & DE WITT, D. P. Introduction to Heat Transfer. John Wiley & Sons. New York. (1990).
Carnahan B., Luther H.A., Wilkes J.O., Applied Numerical Methods.

Detailed bibliography

CHAPMAN, A. J. Transmisión del Calor. Ed. Interciencia. Madrid. (1974).
KREITH, F. & BOHN, M. Principios de transferencia de Calor. Thomson. Madrid. (2002).
Ishachenko V., Osipova V., Sukomel A.,Transmisión del calor
ASHRAE. Handbook of Fundamentals.
ASHRAE. Handbook of System and Applications
Eckert, E.R.G., Drake, R.M.- Análisis of Heat and Mass Transfer. Mc Graw-Hill. (1972).
Hotel, H.C., Sarofim, A.F.- Radiative Transfer. Mc Graw-Hill Company (1976).
Jacob, M.- Heat Transfer, Vol. I y II. JohnWiley and Sons. (1957).
Kays, W.m., London, A.L.- Compact Heat Exchangers. Mc Graw-Hill. (1964).

Journals

Heat Transfer Engineering. USA.
International Journal of Heat and Mass Transfer, Elsevier.
Applied Thermal Engineering, Elsevier.
ASHRAE Journal. USA.
Energy, Pergamon.

Web sites of interest

http://www.ashrae.org/
https://www.jove.com/es/

OBSERVATIONS

Universidad del País Vasco Euskal Herriko Unibertsitatea

COURSE GUIDE 2024/25

Faculty 264 - Faculty of Engineering - Gipuzkoa. Eibar Department **Cycle** .

Degree GRENOV20 - Bachelor's Degree In Renewable Energy Engineering **Year** Second year

COURSE

27857 - Electrical Circuits **Credits, ECTS:** 6

COURSE DESCRIPTION

The subject Electrical Circuits is part of the Degree in Renewable Energy Engineering, within the module that the industrial branch has in common, which includes a group of subjects shared in the field of Industrial Engineering. It is one of the compulsory second-year subjects, taught in the first semester, with the aim of supporting subsequent electrical and electronic subjects. It is taught by faculty members of the Department of Electrical Engineering.

Electrical Circuits is a subject that serves as an introduction to electrical and electronic systems. Its main objective is to provide a general overview of the fundamental principles and most important aspects of electrical technology. Fundamental concepts of electricity are covered, and the basic tools for analysing electrical circuits are developed. Subsequently, the characteristics of modelling with dependent sources and the generalised use of the most relevant theorems in electrical network analysis are addressed. Additionally, the foundations for the analysis and design of three-phase networks are laid, highlighting the assemblies, measuring instruments, and devices associated with this type of networks.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

KNOWLEDGE OR CONTENT:
-RCO1: Undergraduates will be able to identify concepts and techniques from core and specific subjects that enable them to learn new methods, theories, and modern engineering tools, providing sufficient versatility to adapt to new situations in their professional work.
-RCO2: Undergraduates will be able to describe the fundamentals of electrical circuits, electrical machines, low and medium voltage electrical installations, as well as energy generation and storage technologies.

COMPETENCIES:
-RC4: Undergraduates will be able to apply strategies specific to the scientific methodology: analyse the problematic situation both qualitatively and quantitatively, and propose hypotheses and solutions using models specific to renewable energy engineering.

SKILLS OR BROAD-SPECTRUM ABILITIES:
-HE1: Undergraduates will be able to solve problems with initiative, decision-making, creativity, and critical reasoning.
-HE5: Undergraduates will be able to work effectively in a team in a constructive manner, integrating abilities and knowledge to make decisions.
-HE6: Undergraduates will be able to acquire new knowledge and skills for continuous learning, as well as to undertake further studies with a high degree of autonomy.

Theoretical and Practical Contents

CHAPTER 1: INTRODUCTION TO ELECTRICAL CIRCUITS.
An introductory chapter that describes basic electrical devices, as well as the fundamental laws of electrical circuits, nodal analysis, mesh current method, and the behaviour of inductors and capacitors in direct current (DC).
1.1: Fundamental Laws of Electrical Circuits.
1.2: Mesh Current Method.
1.3: Resistive Circuits.
1.4: Circuits with Inductances.
1.5: Behaviour of Inductors in DC.
1.6: Behaviour of Capacitors in DC.
1.7: Charging and Discharging of a Capacitor.
1.8: Equivalent Capacitance of Different Configurations.
1.9: DC Analysis of Networks with Resistors and Capacitors.
1.10: Thévenin and Norton Theorems.

CHAPTER 2: PERIODIC WAVEFORMS.
This chapter covers the fundamental concepts of waveforms, the average and root mean square (RMS) values of functions, the peak factor, and the form factor or ripple factor.
2.1: Fundamental Concepts of Periodic Waveforms.
2.2: Average Value of Periodic Functions.
2.3: RMS Value of Periodic Functions.
2.4: Peak Factor.
2.5: Form Factor or Ripple Factor.
2.6: RMS Value of Functions with Sine and Cosine Waves.

CHAPTER 3: AC CIRCUIT ANALYSIS.

This chapter addresses the fundamental concepts of impedances, circuits excited by sinusoidal generators, the concept of phasors and their applications, active, reactive, and apparent power, power factor, power factor correction, and circuits with dependent sources.

3.1: Fundamental Concepts of Impedances.
3.2: Circuits Excited by Sinusoidal Generators.
3.3: Concept of Phasor and Applications.
3.4: Power in the General Case.
3.5: Active, Reactive, and Apparent Power.
3.6: Complex Power.
3.7: Boucherot Theorem.
3.8: Power Factor Correction.
3.9: Types of Dependent Sources.
3.10: Modelling of Devices with Dependent Sources.
3.11: Thévenin and Norton Equivalent Circuits with Dependent Sources.
3.12: Methodology for the Analysis of Networks with Dependent Sources.

CHAPTER 4: FUNDAMENTAL THEOREMS.

This chapter deals with circuit analysis techniques that involve the use of fundamental theorems of circuit theory.

4.1: Analysis of Linear Networks.
4.2: Superposition Theorem.
4.3: Maximum Power Transfer Theorem.
4.4: Other Theorems.

CHAPTER 5: BALANCED POLYPHASE SYSTEMS.

This chapter covers three-phase electrical systems in the most common configurations used in such networks.

5.1: Balanced Three-Phase Systems.
5.2: Concepts in Balanced Three-Phase Systems.
5.3: Balanced Star Connection with Positive and Negative Sequences.
5.4: Balanced Delta Connection with Positive and Negative Sequences.
5.5: Star-Delta and Delta-Star Transformations.
5.6: Single-Phase Equivalent Circuit.
5.7: Power in Balanced Three-Phase Systems.
5.8: Methods of Power Measurement.

LABORATORY PRACTICALS.

Students will undertake 7 practicals, each lasting 2 hours. The practicals will cover the concepts explained in the theoretical syllabus:

-Measurements in DC Circuits.
-Measurement of Parameters in Capacitors and Inductors.
-Verification of Fundamental Theorems.
-Measurements in AC Circuits.
-Measurement of Power in AC Circuits.
-Measurements in Three-Phase Circuits.
-Measurement of Power in Three-Phase Circuits.

TEACHING METHODS

The course is organized into theory lectures (M), classroom practicals (GA), laboratory practicals (GL), and individualized tutorials, which are held in the professor's office.

The theoretical classes are conducted using a combination of conventional and IT means. Students have access to exercises to solve via the eGela platform, which are introduced as the necessary theoretical knowledge is taught. Additionally, students are provided with course notes containing solved exercises, exercises proposed in exams, unsolved exercises, and the set of laboratory practicals that will be carried out during the semester. In this regard, the format of the practicals includes the theoretical resolution of exercises and a set of tables that record the individual readings that students must perform through the setup of the experiments.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	30		15	15					
Horas de Actividad No Presencial del Alumno/a	40		30	20					

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 10%
- Individual assignments 20%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

SISTEMA DE EVALUACIÓN CONTINUA
Para poder ser evaluado mediante el sistema de evaluación continua, se requiere de una asistencia a clase con regularidad.

Grading tools:
-Written Exam: This will account for 70% of the final mark. A minimum score of 4 out of 10 must be achieved in the Written Exam. The Written Exam will be held during the official examination period.

-Laboratory Practicals: This will account for 10% of the final mark. Attendance and completion of all laboratory practicals are mandatory to qualify for the continuous assessment system. In the laboratory test, a minimum score of 5 out of 10 is required. The laboratory practicals mark will not be saved from year to year.

-Individual and/or Group Projects: Projects will be completed throughout the semester, accounting for 20% of the final mark. The non-submission of any Project does not, by itself, imply a rejection of the continuous assessment system. However, not submitting any project will result in a 0 for that project when calculating the final mark.

If the laboratory practicals are not passed, the student may still take the written exam. If the written exam is passed, the course will not be considered passed, but the exam mark may be saved for the extraordinary exam. Similarly, if the laboratory practicals are passed but the written exam is not, the course will not be considered passed, but the laboratory practicals mark may be saved for the extraordinary exam.

If any of the minimum scores are not achieved, the final mark will be capped at 4 out of 10.

FINAL SYSTEM EVALUATION
According to Article 8 of the Regulations governing the assessment of students in official Bachelor's degree programs, students have the right to be evaluated through the final evaluation system. To do this, students must submit a letter/email to the course instructor asking for this evaluation system within the first 9 weeks from the beginning of the semester. The final evaluation system assesses learning outcomes through a test conducted during the official examination period. The test consists of a written exam (90% of the mark) and evaluation activities related to Laboratory Practical sessions (10% of the mark). A minimum score of 4 out of 10 is required on the exam, and a minimum score of 5 out of 10 is required on the Laboratory Practical evaluation activity. If any of the minimum scores are not achieved, the final mark will be capped at 4 out of 10.

OPTING OUT
According to Article 12 of the Regulations governing the assessment of students in official Bachelor's degree programs, in the case of continuous assessment, where the weight of the final exam is over 40% of the mark for the course, simply not attending the final exam will be marked as "no show". When it comes to the final evaluation system, not attending the test scheduled during the official examination period will automatically as an opt out of the exam session. Opting out of the exam session will be marked as "No show".

INFORMATION REGARDING THE USE OF MATERIALS, MEDIA, AND RESOURCES:
In general, and unless otherwise indicated, the use of books, notes, or any other material, as well as electronic, computer, or other devices, is prohibited during assessments at UPV/EHU. If necessary, during the assessment, places may be designated for students to deposit unauthorized materials, ensuring they are out of reach.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

According to Article 9 of the Regulations governing the assessment of students in official Bachelor's degree programs, assessments in the extraordinary examination session will be conducted exclusively through the final evaluation system. The final evaluation system assesses learning outcomes through a test conducted during the official examination period. The test consists of a written exam (90% of the mark) and evaluation activities related to laboratory practicals (10% of the mark). It is necessary to obtain a minimum of 4 out of 10 points in the exam, and a minimum of 5 out of 10 points in the laboratory practicals evaluation activity. If any of the minimum scores is not achieved, the final mark will be capped at 4 out of 10.

Not attending the test, scheduled during the official examination period, will automatically be considered as an opt out of the examination session. Opting out of the examination session will be marked as "no show".

MANDATORY MATERIALS

Provided notes.

BIBLIOGRAPHY

Basic bibliography

-Análisis de Circuitos Lineales I y II. A. J. Álvarez, P. Amo, M. Labrador, F. López, J. Palmero
-Teoría y Problemas de Circuitos Eléctricos. J.A. Edminister

Detailed bibliography

-Network Analysis. Van Valkenburg. Ed. Limusa
-Electric Circuits. J.W. Nilsson, S.A. Riedel. Ed. Prentice Hall
-Fundamentals of Electric Circuits. C.K. Alexander, M.N. Sadiku. Ed. McGraw-Hill
-Electric Technology. J.R. Folch, M.R. Guasp, C.R. Porta. Ed. Síntesis

Journals

-Cuadernos de energía
-Anales de Mecánica y Electricidad
-Ingeniería Energética

Web sites of interest

-https://egela.ehu.es/
-http://www.ingeniaritza-elektrikoa.ehu.es
-http://www.ree.es/es/
-http://www.unesa.es/
-http://www.iberdrola.es/

OBSERVATIONS

The subject Electrical Circuits is fundamental in the Renewable Energy Engineering Degree, as it introduces students to various methods of electrical circuit analysis and the fundamental characteristics of their response and simulation. Aspects such as Ohm's, Kirchhoff's laws, and theorems like Thévenin's, Norton's, superposition, maximum power transfer, among others, are treated with special attention, addressing both direct current and alternating current approaches. These aspects are of particular importance in various disciplines taught in the areas of Electrical Engineering and Electronic Technology included in this Engineering Degree.

In this context, a set of subjects requires the concepts associated with Electrical Circuits. Among them, subjects such as Electric Machines, Electronics, Distributed Generation Technologies, Electrical Installations for Renewable Energies, Power Conditioning, Electronic Energy Conversion Systems, Instrumentation, Monitoring, and Communications in Energy Systems, etc., stand out. These subjects complement and apply the knowledge acquired in Electrical Circuits, providing students with a solid foundation for their training in the field of renewable energies and electrical engineering.