Teaching Guide				
Identifying Data				2020/21
Subject (*)	Electricity and Electronics		Code	631G01206
Study programme	Grao en Náutica e Transporte Marítimo			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Second	Obligatory	6
Language	Spanish			
Teaching method	Hybrid			
Prerequisites				
Department	Enxeñaría de Computadores			
Coordinador	Bregains Rodriguez, Julio Claudio	E-mail	julio.bregains@udc.es	
Lecturers	Andión Fernández, José Manuel Bregains Rodriguez, Julio Claudio	E-mail	jose.manuel.andion@udc.es julio.bregains@udc.es	
Web	campusvirtual.udc.es			
General description	In this course the student will acquire the basic knowledge of components and circuits that constitute the electrical and electronic systems of the ship. This knowledge will allow them to evaluate the operation of the power, control and communication systems of the ships, as well as to acquire critical judgment to detect failures and solve them.			
Contingency plan	1. Modifications of the contents There are no changes in the contents. 2. Methodologies *Teaching methodologies that are maintained Master sessions, problem solving and practices through ICTs. *Teaching methodologies that are modified If the teaching was to become totally non-presential, the use of slides and blackboard would be changed to explanations with slides on Teams (given during class time) and/or copy of slides with detailed explanations on Moodle (in pdf format). The students would have at their disposal on Stream the non-presential classes given by Teams and/or the pdfs on Moodle (campusvirtual.udc.es). The laboratory practices would be adapted to be carried out in a non-presential way with the support of ICT through videos, interactive text/video tasks, etc. 3. Mechanisms for personalized attention to students Tutorials will be done through Teams. 4. Modifications in the evaluation The duration of the assessments and the number of questions in the tests could be changed. *Evaluation observations: The mixed test and/or the short answer test and/or the tests could be non-attendance, according to the circumstances. 5. Modifications to the bibliography or webgraphy They would have at their disposal on Stream the non-presential classes given by Teams and/or the pdfs in Moodle (campusvirtual.udc.es). The materials of the practices will be already in a digital way on Moodle (campusvirtual.udc.es).			

Study programme competences	
Code	Study programme competences
A6	Localizar avarías sistematicamente nun equipo electrónico.
A8	Modelizar situacións e resolver problemas con técnicas ou ferramentas físico-matemáticas.
A9	Avaliación cualitativa e cuantitativa de datos e resultados, así como representación e interpretación matemática de resultados obtidos experimentalmente.
A10	Redactar e interpretar documentación técnica e publicacións náuticas.
B2	Resolver problemas de xeito efectivo.
B5	Traballar de forma autónoma con iniciativa.
B6	Traballar de forma colaboradora.

B8	Aprender en ámbitos de teleformación.
B10	Versatilidade.
B11	Capacidade de adaptación a novas situacións.
B12	Uso das novas tecnoloxías TIC, e de Internet como medio de comunicación e como fonte de información.
B13	Comunicar por escrito e oralmente os coñecementos procedentes da linguaxe científica.
B14	Capacidade de análise e síntese.
B15	Capacidade para adquirir e aplicar coñecementos.
B16	Organizar, planificar e resolver problemas.
B19	Utilizar as ferramentas básicas das tecnoloxías da información e as comunicacións (TIC) necesarias para o exercicio da súa profesión e para a aprendizaxe ao longo da súa vida.
B22	Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.
C10	Que os estudantes saiban aplicar os coñecementos adquiridos e a súa capacidade de resolución de problemas en contornas novas ou pouco coñecidas dentro de contextos máis amplas (ou multidisciplinares) relacionados coa súa área de estudo
C13	Que os estudantes posúan as habilidades de aprendizaxe que lles permitan continuar estudando dun modo que haberá de ser en grande medida autodirixido ou autónomo.

Learning outcomes			
Learning outcomes	Study programme competences		
Be able to interpret electrical diagrams.	A6 A8 A9 A10	B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22	C10 C13
Be able to analyze electrical installations.	A6 A8 A9 A10	B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22	C10 C13

Practical applications of analog and digital integrated circuits, and solid state devices.	A6 A8 A9 A10	B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22	C10 C13
Know the electrical alternators.	A6 A8 A9 A10	B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22	C10 C13
Evaluate powers.	A6 A8 A9 A10	B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22	C10 C13

Know the operation of electronic instrumentation.	A6 A8 A9 A10	B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22	C10 C13
Knowledge of the characteristics of basic semiconductor devices	A6 A8 A9 A10	B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22	C10 C13

Contents	
Topic	**Sub-topic**
CHAPTER 1: INTRODUCTION. DIRECT CURRENT CIRCUITS.	1.1. The atom. Electric charge and force. Electrical conductors and insulators. 1.2. Mechanical and electrical quantities: work, energy, voltage, current, power. 1.3. Electrical resistance. Ideal sources. 1.4. Ohm's law. Joule's law. Series and parallel circuits. Kirchhoff's Laws. 1.5. Real sources. Circuit theorems: superposition, Thévenin, Norton. 1.6. Circuit analysis.
CHAPTER 2: ALTERNATING CURRENT CIRCUITS. TRANSFORMERS.	2.1. Time-dependent functions. Fundamental values. 2.2. Sine regime, and behavior of R, L and C. 2.3. Impedance and admittance. Resonance. 2.4. The ideal transformer. 2.5. Circuit theorems: superposition, Thévenin, Norton. 2.6. Circuits analysis.
CHAPTER 3: MANOEUVRING AND CIRCUIT BREAKERS. GENERATION AND DISTRIBUTION OF ENERGY. ELECTROMECHANICAL SYSTEMS.	3.1. Fundamentals of three-phase systems 3.2. Control and protection elements for installations. 3.3. Fundamentals of generators and motors. 3.4. Electric propulsion for ships. 3.5. Analysis of circuits and drawings of installations.

CHAPTER 4: SEMICONDUCTORS. DIODES. APPLICATIONS.	4.1. Fundamentals: intrinsic and extrinsic semiconductor 4.2. Currents in a semiconductor. Polarized PN junction. 4.3. Basic structure and operation of PN diodes and LEDs. 4.4. Diode equivalent models. 4.5. Applications. Rectifier circuits. 4.6. Other diodes.
CHAPTER 5: BIPOLAR JUNCTION TRANSISTOR.	5.1. Basic structure and operation of a bipolar transistor 5.2. Circuit analysis in common emitter configuration. 5.3. Input and output characteristics. 5.4. Switching circuits.
CHAPTER 6: UNIPOLAR MOSFET TRANSISTOR.	6.1. Basic structure and operation of a MOSFET. 6.2. Circuit analysis in common source configuration. 6.3. Input and output characteristics. 6.4. Switching circuits.
CHAPTER 7: AMPLIFIERS GENERAL CONCEPTS. THE OPERATIONAL AMPLIFIER.	7.1. Characteristics of the amplifiers. 7.2. Concept of negative feedback. 7.3. The operational amplifier. Linear and non-linear applications. 7.4. Circuit analysis.
CHAPTER 8: DIGITAL CIRCUITS. APPLICATIONS.	8.1. Fundamentals of digital circuits. 8.2. Analogical-digital conversion. 8.3. Applications: communications, fundamentals of a digital communications system. 8.4. Introduction to Radar systems.
PROBLEM SOLVING SESSIONS.	SESSION 1:Introduction and concepts of circuits. SESSION 2: Laws of circuits and methods of analysis. SESSION 3: Analysis of sinusoidal circuits. SESSION 4: Analysis of sinusoidal circuits. SESSION 5: Resolution of problems of fundamentals of energy distribution. SESSION 6: Analysis of circuits with Diodes and Rectifiers. SESSION 7: Analysis of circuits with Bipolar Transistors. SESSION 8: Analysis of circuits with Bipolar Transistors. SESSION 9: Analysis of circuits with Unipolar Transistors. SESSION 10: Analysis of circuits with Operational Amplifiers.
LABORATORY PRACTICES.	PRACTICE 1: EQUIPMENT HANDLING (I). 1.1. Feeding source and multimeter. 1.2. Measurement of resistances. 1.3. Measurement of DC voltages and currents with multimeter. PRACTICE 2: EQUIPMENT HANDLING (II). 2.1. Signals generator and oscilloscope. 2.2. Measurement of AC voltages with multimeter and oscilloscope.
ITC PRACTICALS.	Circuit design and measurement practices will be carried out with the LTSpice software according to the theory syllabus.

O desenvolvemento e superación destes contidos, xunto cos correspondentes a outras materias que inclúan a adquisición de competencias específicas da titulación, garanten o coñecemento, comprensión e suficiencia das competencias recollidas no cadro AII/2, do Convenio STCW, relacionadas co nivel de xestión de Primeiro Oficial de Ponte da Mariña Mercante, sen limitación de arqueo bruto e Capitán da Mariña Mercante ata o máximo de 3000 GT.Cadro A-II/2 do Convenio STCW.	Especificación das normas mínimas de competencia aplicables a Capitáns e primeiros oficiais de ponte de buques de arqueo bruto igual ou superior a 500 GT.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C13 C10	30	39	69
Problem solving	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	10	20	30
Mixed objective/subjective test	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	3	0	3
Laboratory practice	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	10	10	20
ICT practicals	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	10	10	20
Supervised projects	A8 A9 A10 B2 B5 B10 B11 B12 B13 B14 B15 B16 B19 B22	1	4	5
Short answer questions	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	1	1	2
Personalized attention		1	0	1
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	Description
Guest lecture / keynote speech	Didactic exposition, using slides and blackboard of the theoretical content of the subject.
Problem solving	Approach and resolution of problems related to the contents of the subject.

Mixed objective/subjective test	Mixed exam written by the theory Professor about the contents of the course.
Laboratory practice	Students will work on a series of practices in the Electronics Laboratory working with an electronic practice board and the available measurement materials. The students will have to answer corresponding sets of questions related to the themes to be developed in each practice.
ICT practicals	Students will work on a series of practices on a PC using the electronic circuits simulator LTspice. The students will have to answer corresponding sets of questions related to the themes to be developed in each practical.
Supervised projects	The students could carry out autonomously a work proposed by the practice teacher using the software tool (ICT) of simulation of electronic circuits LTSpice. Additionally, at the end of the course and for all students who pass the course, it may be requested to do additional work to qualify for a raise in grade (see assessment section). The subject of this additional work will be proposed by the teacher and will be related to some of the contents of the course.
Short answer questions	Os alumnos deberán responder a un conxunto de preguntas relacionadas cos temas a desenvolverse en cada sesión de prácticas.

Personalized attention	
Methodologies	**Description**
Supervised projects Laboratory practice Guest lecture / keynote speech ICT practicals Problem solving	Teaching session: To attend and solve the student's inquiries in relation to the theoretical subject exposed in the teaching sessions. Problem solving: To attend and solve the student's inquiries related to the problems solved in class. Laboratory practices: To attend and solve the student's inquiries related to the practices proposed or carried out in the laboratory. Practices through ICT: To attend and solve student's inquiries related to the practices proposed or carried out through ICT. Personalized attention: In relation to the theory and problem solving classes, tutorial hours will be preferably used in an individualized way. Tutorials will be non-presential, through Teams. In relation to the practical classes, the tutorial hours will be used preferably in an individualized way, being also possible the use of the electronic mail. The tutorials will be non-presential, through Teams.

Assessment			
Methodologies	**Competencies**	**Description**	**Qualification**
Supervised projects	A8 A9 A10 B2 B5 B10 B11 B12 B13 B14 B15 B16 B19 B22	It will consist of the evaluation of the proposed work on the subject and tutored by the teacher. The student who passed the course (see "Assessment comments"), may request an additional tutored work (see "Step 5: Methodologies"), whose maximum grade will be 1 point.	0
Laboratory practice	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	The work done by the student in each of the sessions will be valued. Students with part-time dedication or with academic dispensation from teaching exemption will have the option of taking a laboratory practice test at the end of the course.	4
Guest lecture / keynote speech	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C13 C10	It will be possible to value the attendance to class and the participation of the student in the works proposed by the professor throughout the course in the magisterial sessions, of resolution of problems and tutorships.	0

ICT practicals	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	The work done by the student in each of the sessions will be valued. Students with part-time dedication or with academic dispensation from teaching exemption will have the option of taking an ICT practice test at the end of the course.	4
Mixed objective/subjective test	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	It will consist of two theoretical exams and problem solving on the contents exposed throughout the course during the lectures sessions, evaluating the understanding of such contents, and its application to problem solving.	60
Problem solving	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	It will consist of problem-solving assessment through a set of tests. On dates indicated by the teacher, the student will have to answer a test consisting of 2 short problems and a question whose answer must be reasoned. In order to pass the test, students must correctly answer at least two of these three simple points. To pass the course, the student cannot fail more than three of these tests.	30
Short answer questions	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	At the beginning of each of the practices, the student should answer a set of 3 short questions related to the theoretical concepts corresponding to the session.	2
Others			

Assessment comments

The evaluation of the contents taught in the lecture classes and problem solving of the subject represents 90% of the overall mark. The evaluation of the laboratory practices and through ICT, together with the short answer test, is the remaining 10%. To pass the subject will be required:
a) UP TO 6 POINTS OBTAINED IN THE MIXED TEST, WITH A MINIMUM OF 3 (IN THIS SECTION) TO PASS THE ASSIGNMENT, THE MAXIMUM DURATION OF EACH MIDTERM (SEE TEXT BELOW) WILL BE 2 HOURS. THE MAXIMUM DURATION OF THE FINAL EXAM WILL BE 3 HOURS. The mixed test will consist of two exams of theory and problems related to the contents of Electricity and Electronics of the subject, given throughout the four-month period. The student will have two options: to pass the mixed test by midterms (a midterm one with problems related to the contents of the first four subjects, and another one with problems related to the remaining contents) or to take both exams in the final mixed test. In order to pass the subject, a minimum of 3 points out of 6 in each of the two relative exams that make up the mixed test will be required. The final grade will be computed as the average of the grades obtained in each of the partial exams. The maximum duration of each of the midterms will be 2 hours. The maximum duration of the final exam (that is, including both parts) will be 3 hours. The student who passes one of the two partial exams will only have to take the exam of the part not passed in the final exam (first opportunity). It will be possible to evaluate the participation of the student throughout the course in the lectures and problem-solving sessions.
B) UP TO 3 POINTS OBTAINED IN THE CONTINUOUS EVALUATION OF PROBLEM SOLVING, WITH A MINIMUM OF 1.5 (IN THIS SECTION) TO PASS THE COURSE. IF THE STUDENT DOES NOT PASS THE PROBLEM-SOLVING (SEE DETAILS BELOW), THE STUDENT MUST PASS AN ADDITIONAL FINAL PROBLEM-SOLVING EXAM (TO BE TAKEN AT THE SAME TIME AS THE FINAL EXAM, AND WITHOUT AN INCREASE IN THE TIME AVAILABLE TO COMPLETE THIS ADDITIONAL PART).
Attendance at problem solving classes is not mandatory. The continuous evaluation will consist in the resolution of problems grouped in tests (consisting of 2 problems to be solved and a reasoned question), which must be solved on previously stipulated dates. The maximum duration of each test will be 10 minutes. Those students who fail more than three of these tests, or who do not reach at least 1.5 points in the final grade of this section, will have to take a final (additional) problem test on the dates indicated by the center for the mixed test (final exam). This additional exam will consist of three problems whose difficulty will be maximum, although always within the level of the problems solved in group tutoring classes. In this case, the passing of the problem part will be obtained with a score of at least 1.5 out of 3.
C) UP TO 1 POINT OBTAINED IN THE CONTINUOUS EVALUATION OF LABORATORY AND ICT PRACTICES, TOGETHER WITH THE TUTORED WORK (WHOSE MAXIMUM SCORE IS 0.5), WITH A MINIMUM OF 0.5 POINTS TO PASS THE ASSIGNMENT. IF THE STUDENT DOES NOT PASS THE PRACTICES (SEE DETAILS BELOW), A FINAL THEORETICAL-PRACTICAL LABORATORY AND ICT EXAM (TO BE TAKEN AT THE END OF THE FINAL EXAM TIME, AND WHICH MAXIMUM DURATION IS 1 HOUR) MUST BE TAKEN.
In the evaluation of the work it will be required to have a minimum of 0.5 points out of 1 in the sum of the laboratory practices, practices through ICT and supervised work, delivered through laboratory guides accordingly completed by each student. Prior to each laboratory practice, students must complete a test (duration: 10 minutes) consisting of 3 simple questions, or simple calculations, related to the laboratory practice that will follow. They will have a maximum total score of 0.2 points, while the guides will complete the remaining 0.8 points. Students who do not pass the practical part of the subject through continuous assessment will have to take a final theoretical and practical exam on the dates indicated by the center for the mixed test. This exam will consist of questions related to the work done in class, along with questions related to the handling of equipment. In this case, the pass of the practical part will be obtained with a score of at least 0.25 over 0.5.
The evaluation criteria contemplated in Table A-II/1 of the STCW Code, and included in the Quality Assurance System, will be taken into account when designing and carrying out the evaluation.

Sources of information	
Basic	- R. L. Boylestad (). Introducción al análisis de circuitos. Ed. Prentice Hall - R. L. Boylestad y L. Nashelsky (2009). Electrónica: teoría de circuitos y dispositivos electrónicos. Ed. Prentice Hall (10ª Edición) - Mª Elena Novo Vidal (2019). Copia de las diapositivas de la asignatura con problemas resueltos. Reprografía - Jacob Millman y Christos C. Halkias. (). Electrónica integrada: Circuitos y Sistemas Analógicos y Digitales. Editorial Hispano-Europea.- (6ª Edición). - J.A.Edminister (). Circuitos eléctricos . Ed. McGraw Hill (Serie Schaum). - J.A.Edminister y Mahmood Nahvi (). Circuitos eléctricos. Ed. McGraw Hill (Serie Schaum). - José Manuel Andión Fernández (2020). Prácticas de laboratorio y simulador. Moodle: https://moodle.udc.es/

Complementary	- Albert Malvino y David J. Bates (2.010.). Principios de electrónica. Mac Graw Hill. (7ª Edición). - Jacob Millman y Arvin Grabel. (). Microelectrónica. Editorial Hispano-Europea.(6ª edición). - Jacob Millman. (). Microelectrónica: Circuitos y Sistemas Analógicos y Digitales. Editorial Hispano-Europea. (3ª edición). - Jacob Millman y Christos C. Halkias (). Dispositivos y circuitos electrónicos. Editorial Pirámide. 10ª Edición. - Keysight Technologies (2012). Osciloscopios de la serie 1000B de Keysight. Guía del usuario. Keysight Technologies - Siglent Technologies (2017). SDG800 Series Function/Arbitrary Waveform Generator. User Manual.. Siglent Technologies - Linear Technology (2009). LTspice User Manual. Linear Technology - Varios Autores (2020). LTspice Users Group. https://groups.io/g/LTspice

Recommendations
Subjects that it is recommended to have taken before
Mathematics I/631G01101 Phisics/631G01103 Mathematics II/631G01106
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Ship's Energy and auxiliary systems/631G01204 Maritime Radiocommunications/631G01307 Navigation and communications systems/631G01311
Other comments