Teaching Guide				
Identifying Data				2018/19
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	SpanishGalician			
Teaching method	Face-to-face			
Prerequisites				
Department	Enxeñaría de Computadores			
Coordinador	Novo Vidal, Maria Elena	E-mail	e.novo@udc.es	
Lecturers	Bregains Rodriguez, Julio Claudio Novo Vidal, Maria Elena Porta Trinidad, Juan	E-mail	julio.bregains@udc.es e.novo@udc.es juan.porta@udc.es	
Web	moodle.udc.es			
General description	Nesta materia búscase que o alumno adquira os coñecementos básicos de compoñentes e circuítos que conforman os sistemas eléctricos e electrónicos do buque. Devanditos coñecementos permitiranlle evaluar o funcionamento dos sistemas de potencia, control y comunicacións do barco, ademais de adquirir xuízo crítico para detectar fallos e resolvelos.			

Study programme competences / results	
Code	Study programme competences / results
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 / results

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**
THEME 1: INTRODUCTION AND CONCEPTS OF CIRCUITS.	1.1. Electrical magnitudes and units. 1.2. Force, work and power. 1.3. Charge and electric current. 1.4. Electric potential. 1.5. Electric energy and power. 1.6. Constant and variable functions. 1.7. Active and passive elements. 1.8. Relations between the voltage and the current intensity. 1.9. Resistance. Inductance. Capacitance. 1.10. Circuit diagrams.
THEME 2: LAWS OF CIRCUITS AND METHODS OF ANALYSIS.	2.1. Kirchhoff's laws. 2.2. Elements in series and in parallel. 2.3. Division of tension and division of current. 2.4. Input resistance. 2.5. Superposition theorem. 2.6. Theorems of Thévenin and Norton. 2.7. Maximum power transfer theorem. 2.8. Circuit analysis.
THEME 3: ANALYSIS OF SINUSOIDAL CIRCUITS.	3.1. Periodic functions. Sinusoidal functions. 3.2. Average and effective values. 3.3. Response of the elements R, L, C. 3.4. Phasors. 3.5. Impedance and admittance. 3.6. Division of voltage and current. 3.7. Theorems of Thévenin and Norton. 3.8. Circuit analysis. 3.9. Transients in the circuits. 3.10. Power in permanent sinusoidal regime. Active power. Reactive power. Apparent power. Triangle of powers. 3.11. Transformers.

THEME 4: SEMICONDUCTORS. THE DIODE.	4.1. The Intrinsic Semiconductor. 4.2. Extrinsic Semiconductors. 4.3. Currents in a semiconductor. 4.5.The PN junction. 4.6. V-I characteristic of a diode. 4.7. Zener diodes. 4.8. LED diodes.
THEME 5. CIRCUITS WITH DIODES: RECTIFIERS.	5.1. Linear model of the diode. 5.2. Analysis of circuits with diodes. 5.3. Half-wave rectifier. 5.4. Full-wave rectifier. 5.5. Bridge rectifier.
THEME 6. THE BIPOLAR TRANSISTOR. CIRCUITS WITH BJT TRANSISTORS.	6.1. Basic structure and operation of a Bipolar Transistor. 6.2. Analysis of common-emitter (CE) circuits. 6.3.The V-I common-emitter (CE) characteristics. 6.4. Regions of operation and limit values. 6.5. Analysis of circuits.
THEME 7. UNIPOLAR TRANSISTOR. UNIPOLAR TRANSISTOR CIRCUITS.	7.1. Field-effect transistors. 7.2. The field-effect transistors V-I characteristics. 7.3. Analysis of circuits with field-effect transistors.
THEME 8. GENERAL CONCEPS OF AMPLIFIERS. THE OPERATIONAL AMPLIFIER.	8.1. Basics of amplificacion. 8.2. The Operational Amplifier. 8.3. Linear and nonlinear applications. 8.4. Analysis of circuits.
THEME 9. LOGIC GATES. APPLICATIONS.	9.1. Digital circuits. 9.2. Logic gates. 9.3. Logic families: DTL, TTL and CMOS. 9.4. Analysis of circuits. 9.5. Applications.
THEME 10. FOUNDATIONS OF ENERGY DISTRIBUTION.	10.1. Fundamentals of three-phase systems. 10.2. Basic elements of protection of facilities. 10.3. General fundamentals of alternators. 10.4. Electrical installations. Examples of electrical drawings.
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: Analysis of circuits with Diodes and Rectifiers. SESSION 6: Analysis of circuits with Bipolar Transistors. SESSION 7: Analysis of circuits with Bipolar Transistors. SESSION 8: Analysis of circuits with Unipolar Transistors. SESSION 6: Analysis of circuits with power devices. SESSION 7: Analysis of circuits with power devices. SESSION 9: Analysis of circuits with Operational Amplifiers. SESSION 10: Resolution of problems of fundamentals of energy distribution.

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.	PRACTICE 3: RECTIFIER CIRCUITS (I). 3.1. Introduction to LTSPICE. 3.2. Half wave rectifiers. 3.3. Full wave rectifiers with capacitor filter. PRACTICE 4: BIPOLAR TRANSISTOR. 4.1. Circuit of transistor as an amplifier. 4.2. Switching operation. PRACTICE 5: MOSFET TRANSISTOR. 5.1. Switching operation. PRACTICE 6: OPERATIONAL AMPLIIFIER: LINEAR APPLICATIONS (I). 6.1. Inverting amplifier. 6.2. Non inverting amplifier. PRACTICE 7: OPERATIONAL AMPLIFIER: NON LINEAR APPLICATIONS (II). 7.1. Open loop comparator.
SUPERVISED PROJECTS.	AMPLIFIER: LINEAR APPLICATIONS. AL.1. Non inverting amplifier with controlled gain. AL.2. Non inverting summing amplifier.
By the development and passing of these contents together with those corresponding to other subjects that includes the acquisition of competences specific to the degree, the knowledge, comprehension and adequacy of the competences contained in Table A11/2 of the STCW Convention is guaranteed, in relation to the level of management of a Chief Mate of the merchant navy on ships without gross tonnage limitation, and a Master of the merchant navy for those of up to a maximum of 500 GT.	Table A-II / 2 of the STCW Convention. Specification of the mandatory minimum requirements of competence for the certification of masters and chief mates on ships of 500 gross tonnage or more.

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	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 C10 C13	30	45	75
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
Speaking test	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	0.25	0.75	1
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
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.
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.
Speaking test	Short answer objective test to evaluate the knowledge and skills acquired by students in the management of electronic instrumentation during laboratory practices.
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.

Personalized attention	
Methodologies	**Description**

Laboratory practice Guest lecture / keynote speech ICT practicals Problem solving Speaking test	Keynote session: assist and answer questions from the students in relation to the theoretical material exposed in the keynote sessions. Problems solving: addressing and solving concerns of students in relation to the problems solved or posed by the teacher in the problem solving sessions. Laboratory practice: attend and answer questions from students in relation to practices posed or carried out in the laboratory. Practices through ICT: addressing and solving concerns of students in relation to ICT practices posed or carried out. Personal attention: in relation to classes of theory and problem solving sessions, preferably use tutoring hours individually. In relation to practical classes, hours of tutoring will be used preferably individually, although e-mail will be possible.

Assessment			
Methodologies	Competencies / Results	Description	**Qualification**
Laboratory practice	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	Attending the practices and performing their corresponding projects will be deemed positive. At the beginning of each practice, the student will have to write the answers to a set of three (3) brief questions (tests) related to the above mentioned practice. If the student does not answer correctly at least two of those questions, the score obtained in the practice will be halved. The students registered part-time or with academic dispensation of attendance exemption will have the option of taking an exam regarding laboratory practices at the end of the course.	7.5
Guest lecture / keynote speech	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	Answers to the teacher during the course in the keynote sessions could be estimated positively. Works carried out independently by the student and posed by the Professor of theory can be presented optionally.	0
ICT practicals	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	Attending the practices and performing their corresponding projects will be deemed positive. At the beginning of each practice, the student will have to write the answers to a set of three (3) brief questions (tests) related to the abovementioned practice. If the student does not answer correctly at least two of those questions, the score obtained in the practice will be halved. The students registered part-time or with academic dispensation of attendance exemption will have the option of taking an exam regarding ITC practices at the end of the course.	7.5

Mixed objective/subjective test	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	Written exam about the content taught in masterclasses and problem solving sessions: have a minimum of 3.8 points out of 8. The student must demonstrate a basic knowledge of all the content of the subject in this exam. For students (matriculated full-time or part-time) who regularly attend class (minimum 80% attendance), a continuous assessment could be made throughout the course that could exempt part or all of the subject in the final mixed test. Works carried out independently by the student and posed by the Professor of theory can be presented optionally. The participation of the student in the exercises or works posed by the teacher during the course in the keynote and problem-solving sessions will be estimated positively. To pass the course 4 out of 8 must be reached in the final marks of theory and problems.	80
Problem solving	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	Answers to the teacher during the course in the keynote and problem-solving sessions could be estimated positively.	0
Speaking test	A6 A8 A9 A10 B2 B5 B6 B8 B10 B11 B12 B13 B14 B15 B16 B19 B22 C10 C13	At the date established by the professor, an evaluation of the defense of a supervised project of practices will be performed in an oral session. Mainly will be evaluated the clarity when presenting the results and the critical analysis of them.	5
Others			

Assessment comments

The evaluation of the content taught in masterclasses and problem solving sessions of the subject represents 80% of the total marks. The evaluation of laboratory and ICT practices by the short answer questions is the remaining 20%.
To pass the course will be required:
1)
Mixed exam: written exam about the content taught in masterclasses and problem solving sessions: have a minimum of 3.8 points out of 8. The student must demonstrate a basic knowledge of all the content of the subject in this exam.
For students (matriculated full-time or part-time) who regularly attend class (minimum 80% attendance), a continuous assessment could be made throughout the course that could exempt part or all of the subject in the final mixed test.
Works carried out independently by the student and posed by the Professor of theory can be presented optionally.
Answers to the teacher during the course in the keynote and problem-solving sessions could be estimated positively.
To pass the course, 4 out of 8 must be reached in the final marks of theory and problems.
2) Practices: To have a minimum of 1 point in the practices.
Attending the practices and performing their corresponding projects will be assessed positively. At the beginning of each practice, the student will have to write the answers to a set of three (3) brief questions (tests) related to the abovementioned practice. If the student does not answer correctly at least two of those questions, the score obtained in the practice will be halved.
The students registered part-time or with academic dispensation of attendance exemption will have the option of taking an exam about laboratory/ITC practices at the end of the course.
If a minimum of 4 out 8 is not obtained in the final marks of theory and problems, the practice marks will be divided by two to calculate the final marks. If in practice the minimum 1 was not obtained, to calculate the final grade the geometric mean weighted will be made.
The evaluation criteria considered in tables A-III/1 and A-III/3 of the STCW Code and its amendments related to this subject shall be taken into account when designing and evaluating.

Sources of information	
Basic	- R. L. Boylestad y L. Nashelsky (2009). Electrónica: teoría de circuitos y dispositivos electrónicos. Ed. Prentice Hall (10ª Edición) - R. L. Boylestad (). Introducción al análisis de circuitos. Ed. Prentice Hall - Mª Elena Novo Vidal (2018). Copia de las diapositivas de la asignatura con problemas resueltos. Reprografía - J.A.Edminister (). Circuitos eléctricos . Ed. McGraw Hill (Serie Schaum). - Jacob Millman y Christos C. Halkias. (). Electrónica integrada: Circuitos y Sistemas Analógicos y Digitales. Editorial Hispano-Europea.- (6ª Edición). - J.A.Edminister y Mahmood Nahvi (). Circuitos eléctricos. Ed. McGraw Hill (Serie Schaum).

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. - F. J. Martín Pérez y J. Martín Juan (). Apuntes de electricidad aplicada a los buques . Ed. ECU - Linear Technology (2008). LTSpice User's Guide. Linear Technology - Keysight Technologies (2012). Osciloscopios de la serie 1000B de Keysight. Guía del usuario. Keysight Technologies - Julio Brégains (2016). Tutoriales de medidas de circuitos eléctricos y electrónicos. Plataforma moodle (moodle.udc.es)

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