



## Teaching Guide

Identifying Data					2023/24
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	Face-to-face				
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 Lobeiras Blanco, Jacobo	E-mail	jose.manuel.andion@udc.es julio.bregains@udc.es jacobolobeiras@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.				

## Study programme competences / results

Code	Study programme competences / results
A54	RA1C-Write, explain and transmit the theoretical knowledge acquired both orally and in writing using scientific-technical language.
A57	RA4C-Collecting and interpreting relevant data
A59	RA6C-Identify critical situations and use available means in order to resolve them effectively.
B31	RA9H-Effectively solve practical problems associated with the subject by applying the knowledge acquired.
B32	RA10H-Know, analyse, synthesise and apply the contents, fundamental concepts and applications of the subject.
B33	RA11H-Develop both individual and group work
B34	RA12H-Handle bibliographic material and computer resources.
B35	RA13H-Handle with ease the tools, techniques, equipment and/or material/instrumental of each subject.
B36	RA14H-Use information and communication technology (ICT) tools necessary for the exercise of their profession and for lifelong learning.

## Learning outcomes

Learning outcomes	Study programme competences / results
A54 RA1C-Write, explain and transmit the theoretical knowledge acquired both orally and in writing through the use of scientific-technical language.	A54
A57 RA4C-Collecting and interpreting relevant data	A57
A59 RA6C-Identify critical situations and use the available means in order to solve them effectively.	A59
B31 RA9H-Effectively solve practical problems associated with the subject by applying the knowledge acquired.	B31
B32 RA10H-Know, analyze, synthesize and apply the contents, fundamental concepts and applications of the subject.	B32
B33 RA11H-Develop both individual and group work.	B33
B34 RA12H-Handle bibliographic material and IT resources	B34
B35 RA13H-Handle with fluency the tools, techniques, equipment and/or material/instrumental of each subject.	B35
B36 RA14H-Use information and communication technology (ICT) tools necessary for professional practice and lifelong learning.	B36

## Contents



Topic	Sub-topic
CHAPTER 1: INTRODUCTION. DIRECT CURRENT CIRCUITS.	<ul style="list-style-type: none"><li>1.1. The atom. Electric charge and force. Electrical conductors and insulators.</li><li>1.2. Mechanical and electrical quantities: work, energy, voltage, current, power.</li><li>1.3. Electrical resistance. Ideal sources.</li><li>1.4. Ohm's law. Joule's law. Series and parallel circuits. Kirchoff's Laws.</li><li>1.5. Real sources. Circuit theorems: Thévenin, Norton.</li><li>1.6. Circuit analysis.</li></ul>
CHAPTER 2: ALTERNATING CURRENT CIRCUITS. TRANSFORMERS.	<ul style="list-style-type: none"><li>2.1. Time-dependent functions. Fundamental values.</li><li>2.2. Sine regime, and behavior of R, L and C.</li><li>2.3. Impedance and admittance. Resonance.</li><li>2.4. The ideal transformer.</li><li>2.5. Circuit theorems: Thévenin, Norton.</li><li>2.6. Circuits analysis.</li><li>2.7. General information about electrical safety.</li></ul>
CHAPTER 3: MANOEUVRING AND CIRCUIT BREAKERS. GENERATION AND DISTRIBUTION OF ENERGY. ELECTROMECHANICAL SYSTEMS.	<ul style="list-style-type: none"><li>3.1. Fundamentals of three-phase systems</li><li>3.2. Control and protection elements for installations.</li><li>3.3. Fundamentals of generators and motors.</li><li>3.4. Electric propulsion for ships.</li><li>3.5. Analysis of circuits and drawings of installations.</li></ul>
CHAPTER 4: SEMICONDUCTORS. DIODES. APPLICATIONS.	<ul style="list-style-type: none"><li>4.1. Fundamentals: intrinsic and extrinsic semiconductor</li><li>4.2. Currents in a semiconductor. Polarized PN junction.</li><li>4.3. Basic structure and operation of PN diodes and LEDs.</li><li>4.4. Diode equivalent models.</li><li>4.5. Applications. Rectifier circuits.</li><li>4.6. Other diodes.</li></ul>
CHAPTER 5: BIPOLAR JUNCTION TRANSISTOR.	<ul style="list-style-type: none"><li>5.1. Basic structure and operation of a bipolar transistor</li><li>5.2. Circuit analysis in common emitter configuration.</li><li>5.3. Input and output characteristics.</li><li>5.4. Switching circuits.</li></ul>
CHAPTER 6: UNIPOLAR MOSFET TRANSISTOR.	<ul style="list-style-type: none"><li>6.1. Basic structure and operation of a MOSFET.</li><li>6.2. Circuit analysis in common source configuration.</li><li>6.3. Input and output characteristics.</li><li>6.4. Switching circuits.</li></ul>
CHAPTER 7: AMPLIFIERS GENERAL CONCEPTS. THE OPERATIONAL AMPLIFIER.	<ul style="list-style-type: none"><li>7.1. Characteristics of the amplifiers.</li><li>7.2. Concept of negative feedback.</li><li>7.3. The operational amplifier. Linear and non-linear applications.</li><li>7.4. Circuit analysis.</li></ul>
CHAPTER 8: DIGITAL CIRCUITS. APPLICATIONS.	<ul style="list-style-type: none"><li>8.1. Fundamentals of digital circuits.</li><li>8.2. Analogical-digital conversion.</li><li>8.3. Applications.</li></ul>
PROBLEM SOLVING SESSIONS.	Problem sessions corresponding to the theory content, with the exception of chapter 5 (bipolar junction transistor).



LABORATORY PRACTICES.	<p>PRACTICE 1: EQUIPMENT HANDLING (I).</p> <p>1.1. Feeding source and multimeter.</p> <p>1.2. Measurement of resistances.</p> <p>1.3. Measurement of DC voltages and currents with multimeter.</p> <p>PRACTICE 2: EQUIPMENT HANDLING (II).</p> <p>2.1. Signals generator and oscilloscope.</p> <p>2.2. Measurement of AC voltages with multimeter and oscilloscope.</p>
ICT PRACTICES.	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 arqueado 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 arqueado bruto igual ou superior a 500 GT.

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student's personal work hours	Total hours
Guest lecture / keynote speech	A57 B31 B32 B34	30	39	69
Problem solving	A59 B31	8	28	36
Mixed objective/subjective test	A59 B31 B32	3	0	3
Laboratory practice	A54 A57 A59 B31 B33 B35	8	12	20
ICT practicals	A57 A54 B31 B32 B33 B36	8	12	20
Short answer questions	A57 A59 B32	1	0	1
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/or blackboard- of the theoretical contents of the subject.
Problem solving	Formulation and resolution of problems related to the contents of the course, using slides and/or blackboard.
Mixed objective/subjective test	Theory and problem-solving test on the contents exposed during the lectures and problem-solving sessions throughout the course.
Laboratory practice	The students will solve a series of practices in the Electronics Laboratory, on measurement equipment and use of components. Along with these practices, they will also have to answer questions related to the topics to be developed in them.
ICT practicals	The students will solve a series of practical exercises on PC, using electronic circuit simulation software. Along with these practices, they will also have to answer questions related to the topics to be developed in them.
Short answer questions	Students will have to answer a series of questions related to the topics to be developed in each practice session.

<b>Personalized attention</b>
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Methodologies	Description
Laboratory practice ICT practicals Problem solving Guest lecture / keynote speech	<p>Lecture session: To attend and solve inquiries of the students in relation to the theoretical contents exposed in the lecture sessions.</p> <p>Laboratory practices: To attend and solve inquiries of the students in relation to the proposed or carried out practices.</p> <p>Practices through ICT: Attend and solve inquiries of the students in relation to the practices proposed or carried out through ICT.</p> <p>Problem solving: Attending and solving student's inquiries related to the problems solved in class.</p> <p>Personalized attention: In cases of individualized attention will be used preferably face-to-face tutoring sessions, or through Teams.</p>

Assessment			
Methodologies	Competencies / Results	Description	Qualification
Laboratory practice	A54 A57 A59 B31 B33 B35	The work done by the student in each of the sessions will be assessed. Part-time students or students with academic dispensation of exemption from teaching will have the option of taking a laboratory practice exam at the end of the course.	4
Short answer questions	A57 A59 B32	At the beginning of each of the practicals, the student will have to answer a set of short questions related to the theoretical concepts corresponding to the session.	2
ICT practicals	A57 A54 B31 B32 B33 B36	The work done by the student in each of the sessions will be assessed. Part-time students or students with academic dispensation for exemption from teaching will have the option of taking an ICT practice exam at the end of the course.	4
Mixed objective/subjective test	A59 B31 B32	It will consist of two parts of theoretical examination and problem solving on the contents exposed throughout the course during the lectures, assessing the understanding of such contents and their application to problem solving.	60
Problem solving	A59 B31	It will consist of the evaluation of problem solving through a set of tests.	30
Others			

### Assessment comments



The mixed test and the problem-solving tests constitute 90% of the grade. The evaluation of the laboratory practices and through ICT, together with the short answer test, constitute the remaining 10%.

Description of the evaluation and distribution of points.

**FIRST OPPORTUNITY A) MIXED TEST:**

It will consist of two midterm exams of 6 points (maximum) each. In order to pass the course, a minimum of 3 points must be obtained in each one. Once obtained, the grade of the mixed exam will be the average of the grades of both midterm exams. If any of the midterm exams are not passed, the student will have the opportunity to pass them in the final exam (1st opportunity).

**B) PROBLEM SOLVING:**

It will consist of a set of tests with a maximum combined score of 3 points, with a minimum of 1.5 to pass the course. If the tests are not passed, the student will have a problem-solving exam on the same date and time as the final exam (see section A). This exam must be passed in order to pass the course.

**C) LABORATORY/TIC PRACTICES:**

It will consist of a set of tests of questions about concepts, together with laboratory and computer simulation (ICT) tasks with a maximum combined evaluation of 1 point, with a minimum of 0.5 to pass the course. If the assignments are not passed, the student will have a laboratory exam at the date and time established by the center. This exam must be passed in order to pass the course.

**FINAL GRADE:** If all three parts (A, B and C) are passed, the final grade will be the sum of them. In case of failing, the final grade will be one half of such a sum. Academic fraud in the performance of tests or evaluation activities: The fraudulent performance of the evaluation tests or activities, once verified, will directly imply the qualification of failure in the call in which it is committed: the student will be qualified with "suspense" (numerical grade 0) in the corresponding call of the academic year, whether the commission of the fault occurs in the first opportunity or in the second. For this, the student's grade will be modified in the first opportunity report, if necessary.

**SECOND OPPORTUNITY** The grade obtained in the laboratory practices and problem solving will be maintained. The grades of the mid-term exams of the first opportunity will not be maintained. As in the case of the first opportunity, the mixed exam will consist of two midterm exams of 6 points (maximum) each. In order to pass the course, a minimum of 3 points must be obtained in each one. Once obtained, the grade of the mixed exam will be the average of the grades of both midterm exams. In case of not having passed the practices or problem solving, the student will have at his/her disposal the corresponding exams (similar and with the same conditions as those of the first opportunity).

Students enrolled part-time or who have been granted the academic waiver of exemption from attendance, as established in the "Norma que regula o réxime de dedicación ao estudo dos estudantes de grao na UDC" (Arts. 2.3; 3.b; 4.3 e 7.5) (04/05/2017), will take the same evaluation tests as students enrolled full-time. He/she will have the option to take a lab/ICT practicum exam at each opportunity.

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

<b>Basic</b>	<ul style="list-style-type: none"> <li>- J. C. Brégains (). Material de la asignatura en moodle. Moodle (campusvirtual.udc.es)</li> <li>- J. M. Andión (). Prácticas de laboratorio y simulador. Moodle (campusvirtual.udc.es)</li> <li>- J. C. Brégains / P. Castro (2012). Electricidad Básica. Problemas Resueltos. Ed. Starbook</li> <li>- J. C. Brégains / P. Castro (2013). Electrónica Básica. Problemas Resueltos. Ed. Starbook</li> <li>- R. L. Boylestad (). Introducción al análisis de circuitos. Ed. Prentice Hall</li> <li>- R. L. Boylestad / L. Nashelsky (2009). Electrónica: teoría de circuitos y dispositivos electrónicos. Ed. Prentice Hall (10ª Edición)</li> <li>- Jacob Millman / Christos C. Halkias. (). Electrónica integrada: Circuitos y Sistemas Analógicos y Digitales. Editorial Hispano-Europea.- (6ª Edición).</li> <li>- J.A.Edminister (). Circuitos eléctricos . Ed. McGraw Hill (Serie Schaum).</li> </ul>
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<b>Complementary</b>	<ul style="list-style-type: none"><li>- Albert Malvino y David J. Bates ( 2010). Principios de electrónica. Mac Graw Hill. (7ª Edición).</li><li>- Jacob Millman y Arvin Grabel. (). Microelectrónica. Editorial Hispano-Europea.(6ª edición).</li><li>- Jacob Millman. (). Microelectrónica: Circuitos y Sistemas Analógicos y Digitales. Editorial Hispano-Europea. (3ª edición).</li><li>- Jacob Millman y Christos C. Halkias (). Dispositivos y circuitos electrónicos. Editorial Pirámide. 10ª Edición.</li><li>- Siglent Technologies (2014). SPD3000C Series Programmable DC Power Supply. Quick Start. Siglent Technologies</li><li>- Keysight Technologies (2012). Osciloscopios de la serie 1000B de Keysight. Guía del usuario. Keysight Technologies</li><li>- Siglent Technologies (2017). SDG800 Series Function/Arbitrary Waveform Generator. User Manual.. Siglent Technologies</li><li>- Analog Devices (). Learn How to Use LTspice: Instructional Videos. Analog Devices</li></ul> <p>&lt;br /&gt;</p>
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### Recommendations

#### Subjects that it is recommended to have taken before

Mathematics I/631G01101  
Physics/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

(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.