UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

Course guide
280647 - 280647 - Naval Electronics

Last modified: 27/05/2024

Unit in charge: Barcelona School of Nautical Studies
Teaching unit: 710 - EEL - Department of Electronic Engineering.

Degree: BACHELOR'S DEGREE IN MARINE TECHNOLOGIES (Syllabus 2010). (Compulsory subject).
BACHELOR'S DEGREE IN NAVAL SYSTEMS AND TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: JOSEP MARIA TORRENTS DOLZ

Others: Segon quadrimestre:
JUAN DE DIOS CASTILLO MACHICADO - GTSD5, GTSD6
ROMÀ MACARIO CHIB - GTSD0, GTSD1, GTSD2, GTSD7, GTSD8, GTSD9
MAHTAB MOHAMMADPOOR FASKHODI - GTSD3, GTSD4
JOSEP MARIA TORRENTS DOLZ - GTSD0, GTSD1, GTSD2, GTSD3, GTSD4, GTSD5, GTSD6, GTSD7, GTSD8, GTSD9

PRIOR SKILLS

Concepts of electric current, electrical voltage, power and energy, their relation in electrical circuits and the use of their units in the SI. Basic circuit analysis (Kirchoff and Ohm laws). Concept of numbering bases (binary, octal and hexadecimal).

REQUIREMENTS

Pass 280641.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
GTM.CE8. Knowledge of electronics applied to the ship and offshore installations and their application to board.
GESTN.CE11. Knowledge of the characteristics of electronic components and systems and its application on board.

STCW:
ME.1. A-III/1-2. Function: Electrical, electronic and control engineering at the operational level
ME.2. A-III/1-2.1 Operate electrical, electronic and control systems
ME.3. A-III/1-KUP 2.1.1.2 Basic configuration and operation principles of the following electrical, electronic and control equipment: .2 electronic equipment: .a) characteristics of basic electronic circuit elements, .b) flowchart for automatic and control systems, .c) functions, characteristics and features of control systems for machinery items, including main propulsion plant operation control and steam boiler automatic controls
ME.4. A-III/1-2.2 Maintenance and repair of electrical and electronic equipment
ME.5. A-III/1-KUP 2.2.6 The interpretation of electrical and simple electronic diagrams
ETO.1. A-III/6-1. Function: Electrical, electronic and control engineering at the operational level
ETO.2. A-III/6-1.1 Monitor the operation of electrical, electronic and control systems
ETO.3. A-III/6-KUP 1.1.4 Knowledge of Fundamentals of electronics and power electronics

TEACHING METHODOLOGY

Various methodologies are combined: Lercture, participatory class of problems, flipped classroom, electronic lab practical duties.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course the student will be able to:
- Analyze electronic circuits.
- Use the most common instruments in an electronics laboratory (DMM, FG, PS and Oscilloscope)
- Assemble circuits with devices (such as diodes and transistors) and measure electrical variables.

STUDY LOAD

Type	Hours	Percentage
Hours small group	18,0	12.00
Hours large group	42,0	28.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Topic 1. Introduction to electronics. Basic instrumentation and measurements

Description:
Review of basic laws and theorems: Ohm, Kichhoff (KCL for analyzing nodes of an electrical circuit and KVL for analyzing meshes of an electrical circuit), maximum power transfer, Thévenin / Norton. Passive component circuits (RCL). Parasitic elements, example with marine batteries. Basic measuring tools: DMM or multimeter, FG (function generator), PS (power supply), Oscilloscope. Review of the International System of Weights and Measures (SI). Tolerances and uncertainties.

Full-or-part-time: 28h
Theory classes: 6h
Practical classes: 2h
Laboratory classes: 4h
Guided activities: 2h
Self study : 14h

Topic 2. Semiconductors, the PN junction

Description:
Electronics physics. Intrinsic and extrinsic semiconductors. Operation of the PN union. The diode. Types of diodes. Interpretation of diode characteristics sheets. Circuits with diodes. Example of direct current blocking in the return of power supply in the dock.

Full-or-part-time: 24h
Theory classes: 6h
Practical classes: 2h
Laboratory classes: 2h
Guided activities: 2h
Self study : 12h

Topic 3. Union transistors (BJT) and thyristors (SCR)

Description:
Principles of operation of a transistor. BJT transistors (NPN and PNP). Interpretation of BJT feature sheets. Polarization of a BJT. Self-polarized circuit. Alternating model of a BJT (in small signal). Amplifier circuits with BJT (in common transmitter), operation in linear zone. Effects of signal frequency. Interpretation of the data sheets of a BC547 (which is a BJT-NPN). Circuits with thyristors. Example of "dimmers".

Full-or-part-time: 24h
Theory classes: 6h
Practical classes: 2h
Laboratory classes: 2h
Guided activities: 2h
Self study : 12h

Topic 4. Field effect transistors (JFET and MOSFET)

Description:
Principles of operation of a FET, enrichment and deplexion, N channel and P channel (low and high side transistors). Interpretation of the data sheets of the FET. Circuits with switching transistors (cut-off and saturation); transients, introduction to switched sources. Introduction to digital circuits from transients (LS and CMOS logic families), examples.

Full-or-part-time: 22h
Theory classes: 6h
Practical classes: 2h
Guided activities: 4h
Self study : 10h

Topic 5. Operational amplifiers (OpAmp)

Description:
Ideal OpAmp, operating principle. Inverter amplifier, adder, non-inverter amplifier, differential and instrumentation amplifier with ideal OpAmp. Real OpAmp, negative and positive feedback. Interpretation of OpAmp feature sheets.

Full-or-part-time: 20h
Theory classes: 6h
Practical classes: 2h
Guided activities: 4h
Self study : 8h

Topic 6. Special applications

Description:
Oscillators (phase shift, sinusoidal, Hartley and Colpitts). Timers / multivibrator (555). Interpretation of characteristics. Circuits with these special functions. Example of circuits in VHF transmitter.

Full-or-part-time: 12h
Theory classes: 3h
Practical classes: 1h
Guided activities: 4h
Self study : 4h

Topic 7. Introduction to power electronics

Description:
Devices for power electronics (MOS, IGBT, IGC, SiC). Features, thermal effects. Buck and Boost converters. Engine drivers, H-bridges of marine engines. Review problems.

Full-or-part-time: 20h
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 2h
Guided activities: 4h
Self study : 8h

ACTIVITIES

Access to the laboratory on the first day

Description:
Regulations for the use of the Electronics Laboratory

Sign the risk prevention sheet before entering the laboratory on the first day. Read and prepare practice and previous study and / or material before entering the laboratory. The assistant, always present during the lab session, assigns desk to each student enrolled in the group that performs the lab session. Coats and bags are not naughty or dangerous (e.g. tripped). No smoking or eating or drinking in the laboratory. Not on the balcony either. When finished, we clean and tidy the place. Tools and instruments are used only for the purpose of the lab session. It is forbidden to disarm them, if any damage is detected, please inform to the assistant.

Working in the laboratory presents health risks. Before starting, it is necessary to understand the General Standards of Safety and Hygiene in Laboratories prepared by the Occupational Risk Prevention Service of the UPC:
https://www.upc.edu/prevencio/ca/seguretat-higiene/arxius/safety-hygiene-regulations/shr-001-general-safety-hygiene-regulations-laboratories.pdf
In addition, it is necessary to understand additional risks when working with electricity or welding. Working with electricity:
https://www.upc.edu/prevencio/ca/seguretat-higiene/arxius/safety-hygiene-regulations/shr-504-electrical-work-the-5-basic-rules.pdf
https://www.upc.edu/prevencio/ca/seguretat-higiene/arxius/safety-hygiene-regulations/shr-505-electrical-work-the-5-additional-rules.pdf
Solder with tin wire:
https://www.upc.edu/prevencio/ca/seguretat-higiene/arxius/safety-hygiene-regulations/shr-218-soldering.pdf

Final comment: Reverse-polarized capacitors (electrolytic, or polarized) tend to explode within minutes. Always double-check their polarity before connecting them.

Delivery:
Signed document.

Full-or-part-time: 0h 20m
Laboratory classes: 0h 20m

Laboratories

Description:
Two-hour practices are held every two weeks in the FNB's electronics and electricity laboratory. In the first sessions, students learn how to use the usual instruments in an electronics laboratory (DMM, FG, PS and Oscilloscope). In later sessions, circuits are assembled with devices (such as diodes and transistors) and electrical variables are measured with the instruments. Students can simulate the circuits with EasyEDA and compare the simulated values with those measured.

Specific objectives:
Learn to work in a basic electronics lab.

Material:
Instruments, connection cables, protoboard, passive and active components.

Delivery:
Previous study and report of each practice.

Related competencies :
A36-1.1.4. A-III/6-KUP 1.1.4 Knowledge of Fundamentals of electronics and power electronics
A31-2.1.1b. A-III/1-KUP 2.1.1.2 Basic configuration and operation principles of the following electrical, electronic and control equipment: .2 electronic equipment: .a) characteristics of basic electronic circuit elements, .b) flowchart for automatic and control systems, .c) functions, characteristics and features of control systems for machinery items, including main propulsion plant operation control and steam boiler automatic controls
A31-2.2.6. A-III/1-KUP 2.2.6 The interpretation of electrical and simple electronic diagrams

Full-or-part-time: 14h 40m
Laboratory classes: 14h 40m

GRADING SYSTEM

Continuous evaluation of class/Atenea or a partial test. Continuous evaluation of the laboratory. A final exam. The final grade is the weighted average with 40% laboratory + 30% class or test + 30% final exam. To pass the subject it is necessary to attend all the laboratory sessions.

The criterion for demonstrating STCW competence is approved training with the laboratory equipment

EXAMINATION RULES.

The tests are individual. Only pen (blue or black, non-red, non-pencil) and scientific calculator (non-programmable) are allowed. The mobile phone must be switched off completely.

BIBLIOGRAPHY

Basic:

- Malvino, Albert Paul. Principios de electrónica [on line]. Madrid: McGraw-Hill, 2007 [Consultation: 01/09/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4146. ISBN 9788448174644 .
- Closas Torrente, Lluís; Closas Gómez, Pau. Electrònica naval. 2a ed. Tarragona: Nautical Union Editorial, 2013. ISBN 9788494107023.
- Wolf, Stanley. Guide to electronic measurements and laboratory practice. 2nd ed. Englewood Cliffs, NJ: Prentice-Hall, 1983. ISBN 0133696529.
- Monk, Simon. Ejercicios prácticos con electrónica [on line]. Primera edición en español. [Barcelona]: Marcombo, 2018 [Consultation: 03/07/2023]. Available on: https://search-ebscohost-com.recursos.biblioteca.upc.edu/login.aspx?direct=true&AuthType=ip,uid&db=nlebk&AN=2749570&site=ehost-live&ebv=EK&ppid=Page-__-1. ISBN 9788426727671.
- Brégains, Julio C; Castro, Paula M. Electrónica básica problemas resueltos. Paracuellos de Jarama, Madrid: Starbook, [2013]. ISBN 9788415457602.
- Pallàs Areny, Ramon. Instruments electrònics bàsics. Barcelona: Marcombo, DL 2008. ISBN 9788426714848.

Complementary:

- Mohan, Ned; Undeland, Tore M.; Robbins, William P. Power electronics : converters, applications, and design. 3rd ed. New York: John Wiley & Sons, 2003. ISBN 0471226939.
- Sierra Pérez, Manuel, [et al.]. Electrónica de comunicaciones [on line]. Madrid: Prentice Hall, 2003 [Consultation: 01/09/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=2858. ISBN 8420536741.
- Erickson, Robert W.; Maksimovic, Dragan. Fundamentals of power electronics [on line]. Norwell: Kluwer Academic, 2011 [Consultation: 01/09/2022]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-3-030-43881-4. ISBN 0306480484.
- Pallás Areny, Ramon. Adquisición y distribución de señales. Barcelona: Marcombo, 1993. ISBN 8426709184.
- Manley, Pat. Essential boat electrics. Hoboken, NJ: John Wiley & Sons, 2006. ISBN 9781904475170.
- Floyd, Thomas L.. Fundamentos de sistemas digitales [on line]. 11a ed. Madrid: Pearson Education, 2016 [Consultation: 01/09/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=6120. ISBN 9788490353004.
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- Malvino, Albert Paul. Principios y aplicaciones digitales. Barcelona: Marcombo, 1988. ISBN 9788426707215.
- Tipler, Paul A.; Mosca, Gene. Física para la ciencia y la tecnología, Vol. 1 [on line]. 6a ed. Barcelona: Reverté, 2010 [Consultation: 02/09/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=10372. ISBN 9788429144291.
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- González de la Rosa, Juan José; Moreno Muñoz, Antonio. Circuitos electrónicos aplicados con amplificadores operacionales : teoría y problemas [on line]. Cádiz: Servicio de Publicaciones de la Universidad de Cádiz, 2009 [Consultation: 30/05/2022]. Available on: https://lectura-unebook-es.recursos.biblioteca.upc.edu/viewer/9788498284249. ISBN 9788498284249.
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RESOURCES

Hyperlink:
- http://www.batterystuff.com/tutorial_chargers.html- http://www.falstad.com/fourier/index.html

Other resources:
It would be interesting to have access to a simple DMM.