Course guide
270003 - F - Physics

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Unit in charge: Barcelona School of Informatics
Teaching unit: 748 - FIS - Department of Physics.

Degree: BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 7.5 **Languages:** Catalan

LECTURER

Coordinating lecturer: ELVIRA GUARDIA MANUEL

Others:

Primer quadrimestre:
EDGAR ALVAREZ GALERA - 51, 61
GRIGORI ASTRAKHARCHIK - 11, 34
JOAQUIN CASULLERAS AMBROS - 23, 24, 62, 63, 71, 72, 73
ELVIRA GUARDIA MANUEL - 72
ARNAU JURADO ROMERO - 42
DAVID MARCH PONS - 12, 22, 54
JORDI MARTÍ RABASSA - 11, 12, 13, 14
FERNANDO PABLO MAZZANTI CASTRILLEJO - 21, 61, 62, 63
GERARD PASCUAL LÓPEZ - 32, 44, 52, 53
ROMUALDO PASTOR SATORRAS - 31, 33, 41, 43, 51, 52, 53, 54
ROSENDO REY ORIOL - 31, 32, 33, 34
GEMMA SESE CASTEL - 41, 42, 43, 44
MICHELE STARNINI - 71, 73
JOAQUIM TRULLAS SIMO - 21, 22, 23, 24

Segon quadrimestre:
EDGAR ALVAREZ GALERA - 12
GRIGORI ASTRAKHARCHIK - 21
ELVIRA GUARDIA MANUEL - 11, 12
ROMUALDO PASTOR SATORRAS - 21

PRIOR SKILLS

Students are expected to have taken physics at upper secondary level and have basic notions of mathematical analysis. As far as skills are concerned, they should know how to learn, solve problems, search for information, make abstractions and use mathematical language.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CT1.2B. To interpret, select and value concepts, theories, uses and technological developments related to computer science and its application derived from the needed fundamentals of mathematics, statistics and physics. Capacity to understand and dominate the physical and technological fundamentals of computer science: electromagnetism, waves, circuit theory, electronics and photonics and its application to solve engineering problems.
CT8.4. To elaborate the list of technical conditions for a computers installation fulfilling all the current standards and normative.

Generical:
G4. EFFECTIVE ORAL AND WRITTEN communication: To communicate with other people knowledge, procedures, results and ideas orally and in a written way. To participate in discussions about topics related to the activity of a technical informatics engineer.

TEACHING METHODOLOGY

Theoretical concepts will be covered in either theory classes followed up with problem-solving sessions or theory/problem-solving classes (at the lecturer's discretion).

Practical exercises will be completed in the laboratory sessions, preferably in pairs.

At the end of each topic there will be an additional face-to-face session of two-hours to support learning (Directed Activity).

LEARNING OBJECTIVES OF THE SUBJECT

1.Students should be able to apply Kirchhoff's laws to the calculation of intensity and voltage in a direct current circuit in one or more grids.
2.Students should be able to calculate the Thévenin-equivalent voltage between two points in a given direct current circuit.
3.Students should be able to calculate the power in any component in a direct current circuit.
4.Students should be able to identify the amplitude, frequency, phase and effective value of a sine wave.
5.Students should be able to determine the response of the different passive elements affected by the action of periodic signals.
6.Students should be able to apply the phasor concept and determine the steady state response of an alternating current circuit
7.Students should be able to calculate the power of different elements in an alternating current circuit and to correct the power factor for a given circuit.
8.Students should be able to calculate the effect of different types of filters on signals composed of superimposed frequencies.
9.Students should be able to define waves and classify them according to different criteria.
10.Students should be able to determine the function of a one-dimensional harmonic wave and a harmonic electromagnetic plane wave.
11.Students should be able to describe the basic characteristics of the electromagnetic spectrum.
12.Students should be able to calculate the intensity of the energy carried by a beam of light and the energy of its photons.
13.Students should be able to determine the interference patterns for two coherent waves.
14.Students should be able to determine the directions of light beams reflected and refracted in a changing environment.
15.Students should be able to describe the fundamentals of conduction theory, particularly for semiconductors.
16.Students should be able to determine the intensities and voltages of simple circuits containing diodes.
17.Students should be able to describe basic current rectifiers.
18.Students should be able to determine the intensities and voltages of simple circuits containing transistors.
19.Students should be able to describe how digital information is represented and manipulated in electronic circuits.
20.Students should be able to determine the logic gates that implement given basic circuits.
21.Students should be able to properly and safely use the laboratory's electrical equipment.
22.Students should be able to properly and safely use the laboratory's basic electronic equipment: multimeter, oscilloscope, voltage sources, function generators.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	8.00
Guided activities	7,5	4.00
Hours medium group	30,0	16.00
Self study	105,0	56.00
Hours large group	30,0	16.00

Total learning time: 187.5 h

CONTENTS

Direct Current

Description:
1.1 Electrical load. 1.2 Electrical current. 1.3 Voltage. 1.4 Power. 1.5 Resistance. Ohm's law. Joule effect. 1.6 Voltage sources. 1.7 Kirchhoff's laws. 1.8 Series and parallel resistors. 1.9 Measurement devices. 1.10 Thévenin's theorem. 1.11 Capacitors.

Alternating Current (AC)

Description:
2.1 Transients: RC and RL circuits. 2.2 RLC circuits: steady state response. 2.3 Complex numbers. 2.4 Impedance. Ohm's law. 2.5 Alternating current circuits. 2.6 Power. 2.7 Signal superposition. Bandwidth. 2.8 Resonance. 2.9 Filters.

Electronics and logic gates

Description:
3.1 Electronic structure of atoms. 3.2 Conduction theory: metals, insulators, semiconductors. 3.3 The p-n junction diode: current rectifier and logic gates. 3.4 Light-emitting diodes (LED). 3.5 Zener diode: voltage regulators. 3.6 Enhancement MOSFET. Logic gates. 3.7 CMOS inversor. 3.8 Power and delay in digital circuits. 3.9 CMOS logic.

Waves

Description:
4.1 Wave types. Wave functions. 4.2 Harmonic waves. 4.3 Electromagnetic waves Energy density. Intensity. 4.4 Electromagnetic spectrum. 4.5 Polarisation. Liquid crystal displays. 4.6 Reflection and refraction. Optical fibres. 4.7 Interference. 4.8 Lasers.

ACTIVITIES

SUBJECT 1

Description:
Topic 1 development

Specific objectives:
1, 2, 3

Related competencies :
G4. EFFECTIVE ORAL AND WRITTEN communication: To communicate with other people knowledge, procedures, results and ideas orally and in a written way. To participate in discussions about topics related to the activity of a technical informatics engineer.

Full-or-part-time: 40h 30m
Theory classes: 6h
Practical classes: 7h
Laboratory classes: 3h
Guided activities: 2h
Self study: 22h 30m

SUBJECT 2

Description:
Topic 2 development

Specific objectives:
15, 16, 17, 18, 19, 20

Related competencies :
G4. EFFECTIVE ORAL AND WRITTEN communication: To communicate with other people knowledge, procedures, results and ideas orally and in a written way. To participate in discussions about topics related to the activity of a technical informatics engineer.

Full-or-part-time: 41h 30m
Theory classes: 6h
Practical classes: 8h
Laboratory classes: 2h 30m
Guided activities: 2h
Self study: 23h

P1

Description:
Theory/problem-solving test to assess topics 1 and 2.

Specific objectives:
1, 2, 3, 4, 5, 6, 7, 8

Related competencies :
G4. EFFECTIVE ORAL AND WRITTEN communication: To communicate with other people knowledge, procedures, results and ideas orally and in a written way. To participate in discussions about topics related to the activity of a technical informatics engineer.

Full-or-part-time: 5h 30m
Guided activities: 2h
Self study: 3h 30m

SUBJECT 3

Description:
Topic 3 development

Specific objectives:
4, 5, 6, 7, 8

Related competencies :
G4. EFFECTIVE ORAL AND WRITTEN communication: To communicate with other people knowledge, procedures, results and ideas orally and in a written way. To participate in discussions about topics related to the activity of a technical informatics engineer.

Full-or-part-time: 41h 30m
Theory classes: 6h
Practical classes: 8h
Laboratory classes: 2h 30m
Guided activities: 2h
Self study: 23h

SUBJECT 4

Description:
Topic 4 development

Specific objectives:
9, 10, 11, 12, 13, 14

Related competencies :
G4. EFFECTIVE ORAL AND WRITTEN communication: To communicate with other people knowledge, procedures, results and ideas orally and in a written way. To participate in discussions about topics related to the activity of a technical informatics engineer.

Full-or-part-time: 38h
Theory classes: 5h
Practical classes: 7h
Laboratory classes: 2h 30m
Guided activities: 1h 30m
Self study: 22h

P2

Description:
Theory/problem-solving test to assess topics 3 and 4.

Specific objectives:
9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22

Related competencies :
G4. EFFECTIVE ORAL AND WRITTEN communication: To communicate with other people knowledge, procedures, results and ideas orally and in a written way. To participate in discussions about topics related to the activity of a technical informatics engineer.

Full-or-part-time: 5h 30m
Guided activities: 2h
Self study: 3h 30m

F

Description:
Final theory/problem-solving test for students who failed continuous assessment or who wish to improve their mark (students should apply to sit the test 10 days previously). All four topics and their associated content will be assessed.

Specific objectives:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Related competencies :
G4. EFFECTIVE ORAL AND WRITTEN communication: To communicate with other people knowledge, procedures, results and ideas orally and in a written way. To participate in discussions about topics related to the activity of a technical informatics engineer.

Full-or-part-time: 3h
Guided activities: 3h

L1

Description:
Assessment of laboratory Practice 1 by means of a pre-delivery exercise at the beginning of the session and a report at the end.

Specific objectives:
21, 22

Full-or-part-time: 1h 30m
Guided activities: 0h 30m
Self study: 1h

L2

Description:
Assessment of laboratory Practice 2 by means of a pre-delivery exercise at the beginning of the session and a report at the end.

Specific objectives:
1, 2, 3, 21, 22

Related competencies :
G4. EFFECTIVE ORAL AND WRITTEN communication: To communicate with other people knowledge, procedures, results and ideas orally and in a written way. To participate in discussions about topics related to the activity of a technical informatics engineer.

Full-or-part-time: 1h 30m
Guided activities: 0h 30m
Self study: 1h

L3

Description:
Assessment of laboratory Practice 3 by means of a pre-delivery exercise at the beginning of the session and a report at the end.

Specific objectives:
16, 17, 18, 19, 21, 22

Related competencies :
G4. EFFECTIVE ORAL AND WRITTEN communication: To communicate with other people knowledge, procedures, results and ideas orally and in a written way. To participate in discussions about topics related to the activity of a technical informatics engineer.

Full-or-part-time: 1h 30m
Guided activities: 0h 30m
Self study: 1h

L4

Description:
Assessment of laboratory Practice 4 by means of a pre-delivery exercise at the beginning of the session and a report at the end.

Specific objectives:
4, 5, 6, 7, 8, 21, 22

Related competencies :
G4. EFFECTIVE ORAL AND WRITTEN communication: To communicate with other people knowledge, procedures, results and ideas orally and in a written way. To participate in discussions about topics related to the activity of a technical informatics engineer.

Full-or-part-time: 1h 30m
Guided activities: 0h 30m
Self study: 1h

L5

Description:
Assessment of laboratory Practice 5 by means of a pre-delivery exercise at the beginning of the session and a report at the end.

Specific objectives:
9, 10, 11, 12, 13, 14, 21, 22

Related competencies :
G4. EFFECTIVE ORAL AND WRITTEN communication: To communicate with other people knowledge, procedures, results and ideas orally and in a written way. To participate in discussions about topics related to the activity of a technical informatics engineer.

Full-or-part-time: 1h 30m
Guided activities: 0h 30m
Self study: 1h

ExLab

Description:
Laboratory exam where the student will make an individual oral presentation describing the objectives, implementation and results of one of the practices. This presentation will be followed by questions related to the subject presented. The student will also deliver a handwritten summary of the chosen practice. The learning objectives for the topic to which the practice refers will be assessed, as well as the transverse competence "Effective oral and written communication".

Specific objectives:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22

Related competencies :
G4. EFFECTIVE ORAL AND WRITTEN communication: To communicate with other people knowledge, procedures, results and ideas orally and in a written way. To participate in discussions about topics related to the activity of a technical informatics engineer.

Full-or-part-time: 4h 30m
Guided activities: 2h
Self study: 2h 30m

GRADING SYSTEM

The technical competency mark will be based on two marks:
- A theory mark (90%).
- A laboratory or practical mark (10%).

There will be two partial tests, P1 and P2, corresponding respectively to topics 1 and 2 the first one and to topics 3 and 4 the second one, covering the four topics in which the course is structured.

Additionally, there will be six evaluable activities to be carried at the Physics Laboratory, which will include five evaluable practices and a final Lab exam, consisting of an oral presentation of one of the practices performed,
followed by a brief question session.

The grade of the course by continuous assessment will be computed by means of the expression:

NotaCursAC = 0.90 * (P1 + P2) / 2 + 0.10 * L

P1 and P2 being the marks of the partial exams and L the global note of the laboratory.
The latter will be obtained according to:

L = 0.75 * (average of practice notes) + 0.25 * ExLab

In case the student needs or wants to improve his / her mark, an optional final exam (EF) will be carried out.
In this case, the resulting grade of the course will be

NotaCursFinal = 0.90 * max (EF, (P1 + P2) / 2) + 0.10 * L

The grade of the competence on oral and written expression (CEOE) can be: A (excellence), B (optimal), C (sufficient), D (not passed).
The oral part will be evaluated on the basis of the Laboratory exam. The written part will be evaluated from a handwritten summary of the practice selected for its exposition.

The oral and written parts will have equal weigths on the final grade.

BIBLIOGRAPHY

Basic:
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- Tipler, P.A.; Mosca, G. Física para la ciencia y la tecnología: vol. 2. 6a ed. Barcelona: Reverté, 2010. ISBN 9788429144307.
- Gettys, W.E.; Keller, F.J.; Skove, M.J. Física clásica y moderna. McGraw-Hill, 1991. ISBN 8476156359.
- Cogdell, J.R. Foundations of electrical engineering. 2nd ed. Prentice Hall, 1996. ISBN 0130927015.

Complementary:
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- Alcaraz, O.; López, J.; López, V. Física: problemas y ejercicios resueltos. Pearson Educación, 2006. ISBN 8420544477.
- Nahvi, M.; Edminister, J.A. Circuitos eléctricos y electrónicos. 4a ed. McGraw-Hill, 2005. ISBN 8448145437.
- Míguez, J.V.; Mur, F.; Castro, M.A.; Carpio, J. Fundamentos físicos de la ingeniería: electricidad y electrónica. 2a ed. adaptada al EEES. McGraw-Hill, 2010. ISBN 9788448174989.
- Serway, R.A.; Jewett, J.W. Física : para ciencias e ingeniería. Vol.2. 7a ed. Cengage Learning, 2008. ISBN 9789706868374 (V. 2).