SUBJECT TEACHING GUIDE

G269 - PHYSICAL FUNDAMENTALS OF COMPUTING

Degree in Computer Systems Engineering

Academic year 2022-2023

1. IDENTIFYING DATA					
Degree	Degree in Computer Systems Engineering			Type and Year	Core. Year 1
Faculty	Faculty of Sciences				
Discipline	Subject Area: Physical Foundations of Computer Science Basic Training Module				
Course unit title and code	G269 - PHYSICAL FUNDAMENTALS OF COMPUTING				
Number of ECTS credits allocated	6	Term		Semester based (1)	
Web					
Language of instruction	Spanish	English Friendly	No	Mode of delivery	Face-to-face

Department	DPTO. INGENIERIA DE COMUNICACIONES
Name of lecturer	ALVARO GOMEZ GOMEZ
E-mail	alvaro.gomez@unican.es
Office	Edificio Ing. de Telecomunicación Prof. José Luis García García. Planta: - 2. DESPACHO S276 (S276)
Other lecturers	JUAN ANTONIO SAIZ IPIÑA OSCAR FERNANDEZ FERNANDEZ JOSE ANGEL MIER MAZA

3.1 LEARNING OUTCOMES
- Know the basic laws of electrostatics, capacitors and dielectrics and their applications in computer science devices: computer keyboard, cathode ray tube (monitor), laser printers.
- Manage properly resolution techniques for solving DC circuits and simulation tools for analyzing circuits.
- Assimilate basics concepts of electronics: solid state, diodes (Junction and Zener) and transistors (bipolar and MOSFET).
- Know fundamental aspects of the magnetic field (creation and action), magnetic materials and electromagnetic induction. Applications: magnetic memories, transformers, filtering circuits.
- Acquire basic concepts about electromagnetic waves and their applications to IT (optical fibers, optical and magneto-optical memories, liquid crystal displays, wireless communications).
- Know and handle basic elements of a "hardware" laboratory: oscilloscope, digital multimeter, function generator and DC and AC sources.

4. OBJECTIVES
Achieve the student knows the concepts of physics more directly related to the operation of computers and their peripherals, i.e., the basic principles of Electromagnetism, Optics and Quantum Physics explaining the operation of monitors, printers, magnetic and optical memories, electronic circuits and optical fibers, among others.
Introduce students to the modeling of electrical and electronic devices from the concept of lumped parameters model. The main objective is to familiarize students in the management of the most common techniques in circuit analysis.
Provide practical knowledge on the use of basic material in "hardware" Laboratories.

6. COURSE ORGANIZATION

CONTENTS	
1	Thematic Block 1: Electric field and electrical properties of matter
1.1	- Load, insulators and conductors. Coulomb's law. Electric field. Electric field of a charge distribution. Electric field lines. Electric flux. Gauss' Law. Applications of Gauss's Law. - Electric Potential. Field calculation from the Electric Potential. Electric Potential due to continuous charge distributions. Electric Potential due to a charged conductor. APPLICATIONS of the electrostatics. - Capacity and Dielectrics. Capacity calculation. Combination of Capacitors. Stored energy in a charged Capacitor. Capacitors with Dielectrics. Types of Capacitors.
1.2	Resolution of problems and questions proposed by the teacher at the beginning of the development of the thematic block.
2	Thematic Block 2: Electrokinetic
2.1	- Electric Current and Current Density. Drift speed. Resistance. Resistance and Temperature. Electric Energy and Power. Power in an electric heater. - DC circuits.Thevenin and Norton Equivalents. Power transference. Nodal and Mesh Analysis techniques.
2.2	Resolution of problems and questions proposed by the teacher at the beginning of the development of the thematic block.
3	Thematic Block 3: Magnetic field and electromagnetic induction. Maxwell equations
3.1	- Force exerted by a magnetic field. Force on current conductor. Motion of a charged particle. Lorentz Force. APPLICATIONS. - Magnetic Field sources. Magnetic force between two parallel conductors. Ampere's law. Magnetic field of a solenoid. Magnetic flux. Magnetism of Matter. - Electromagnetic induction and self-induction. Induction current. Faraday and Lenz Laws. Self-inductance and inductance. Energy of a magnetic field associated to an inductor. - Maxwell equations. Propagation of electromagnetic waves.
3.2	Resolution of problems and questions proposed by the teacher at the beginning of the development of the thematic block.
4	Thematic Block 4: Electrical circuits in transient regime
4.1	- Temporal evolution of the circuit state. First and second order circuits. Equations of energy storage elements. First order circuit analysis in transient regime. Circuits without excitation sources and non-zero initial conditions. Circuits with excitation sources and zero initial conditions. Circuits with excitation sources and non-zero initial conditions.
4.2	Resolution of problems and questions proposed by the teacher at the beginning of the development of the thematic block.
5	Thematic Block 5: Introduction to Electronics
5.1	- Solid state physics. Bonds between atoms and molecules. Band theory in solids. Metals, semiconductors and insulators. Classification of Semiconductors. Concentration of charge carriers. Currents in Semiconductors. Manufacture of devices. - Semiconductor Devices I - Diodes. semiconductor diode - pn junction. Rectifier diode. (APPLICATIONS). - Semiconductor Devices II - Transistors. The Bipolar transistor BJT. Field Effect Transistors FET. The JFET transistor. The MOSFET transistor. Bipolar and CMOS technologies. Logic circuits. (APPLICATIONS).
5.2	Resolution of problems and questions proposed by the teacher at the beginning of the development of the thematic block.
6	GROUP WORK, ON PROBLEMS RELATING TO DIFFERENT THEMATIC BLOCKS (PA). Approach of problems to be solved by groups, to practice with the material presented in class. Grouping: groups of 2-4 students according to availability.

7	SIMULATION PRACTICES (PS). Introduction to Circuit Simulators (EWB). Grouping: individual.
8	BASIC ELECTRONIC PRACTICES (PEB). Grouping: by pairs or, if not, individual.
8.1	PRACTICAL WORK 1 - Study of Resistive Elements.
8.2	PRACTICAL WORK 2. Checking Thévenin and Norton equivalents.
8.3	PRACTICAL WORK 3 - Oscilloscope and Function Generator usage.
8.4	PRACTICAL WORK 4 - Study of the transient response of a series RC circuit.
8.5	PRACTICAL WORK 5 - Study of Diodes

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Questions and/or problems relating to Theme block 1 and 2.	Written exam	No	Yes	30,00
Questions and/or problems relating to Theme blocks 3, 4 and 5.	Written exam	No	Yes	30,00
Group work, on problems relating to different thematic blocks.	Work	No	No	10,00
Final Exam	Written exam	Yes	Yes	0,00
Laboratoy Practices.	Laboratory evaluation	No	Yes	30,00
Extraordinary Exam	Written exam	Yes	No	0,00
TOTAL				100,00

Observations

If for sanitary reasons:
(a) The minimum safety distance between students must be maintained, individual work should be made in the classroom and/or in the laboratories intended for this purpose. In addition, in this case, the number of practices to be performed will be reduced and the number of groups to do the PEB practices in the laboratory will be doubled.
(b) If In-person activity is suspended, practical sessions shall be conducted remotely, synchronously, at the usual time. Under these conditions, the number of PEB practices will be reduced and carried out from a series of experimental data that can be provided by teachers or, alternatively, obtained with the help of a circuit simulator. In this case, the remaining sessions not taught will be replaced by hours of tutoring and/or resolution of exercises by telematics.

- In order to pass the subject in continuous or regular evaluation, it will be necessary, on the one hand, (i) that the weighted average of the notes of the 2 written examinations (evaluations of Thematic Blocks 1-5) be equal to or greater than 5 and, on the other hand, (ii) that the weighted average of the notes corresponding to laboratory practices and the proposed work is equal to or greater than 5. Otherwise, the student must take the final exam and/or the extraordinary exam.
- In the final exam, the student may choose to improve the score of (i) the partial assessments he deems appropriate so that the weighted average of the written examinations is greater than or equal to 5 and/or (ii) to carry out a laboratory internship examination so that the weighted average of laboratory practices and the proposed work is equal to or greater than 5. In this case, the final grade of the subject will correspond to the grade obtained in the final exam.
- In the extraordinary assessment the student will be examined of the whole subject. Only the note of the practical part shall be saved if it is equal to or greater than 5. In this case, to pass the subject, the minimum grade required in each of the tests (written exams and laboratory internship exam) is 5.
- If the number of laboratory sessions to be carried out during this course is less than or equal to that of the previous year, repeating students who have passed the practical part of the subject during the continuous evaluation period of the previous academic year will have the option of not having to carry out the practices again. To do this, they must talk to the teacher at the beginning of the course. On the other hand, if the number of practical sessions to be carried out in the current academic year is greater than that of the previous year, the repeating student who has approved the practices during the continuous evaluation period will have to carry out all the sessions corresponding to that batch of practices (classroom practices, simulation practices and / or basic electronics practices) regardless of whether any of the sessions had been carried out in the previous year.

* The tests are conducted without notes or books.

Observations for part-time students

- The obligation to attend and carry out all practices includes part-time students. As far as possible, and according to the teacher, it will be attempted to facilitate the follow-up of the rest of the subject.
- Part-time students must take the assessment tests at the end of the semester and, where appropriate, the extraordinary exam, which will constitute 60% of the Total Note. On the other hand, students who are unable to attend and carry out laboratory practices throughout the course, must take the examination corresponding to laboratory practices, which constitutes 30% of the Total Note. In addition, they will deliver throughout the course and in any case before the final evaluation, individual work proposed by the teacher whose evaluation will constitute 10% of the Total Note.

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

Serway - Jewett, "Física para Ciencias e Ingeniería", 7ª Edición, Vol. 2. CENGAGE Learning, 2010.

Alexander - Sadiku, “Fundamentos de Circuitos Eléctricos”. 3ª Edición en español. McGraw-Hill, 2013.

P. Gómez Vilda, V. N. Nieto ... , "Fundamentos Físicos y Tecnológicos de la Informática". Pearson - Prentice Hall, 2007.