UCLouvain

lphys2101

2022

Analog and digital electronics

10.00 credits	45.0 h + 45.0 h	Q1

Teacher(s)	Cortina Gil Eduardo ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	LPHYS1221 for the students enrolled in the Bachelor in physics who wish to follow this teaching unit within the additional module in physics. Having followed LPHYS1201 is an asset. No prerequisites for students who have obtained a Bachelor's degree in physics and who therefore already have a basic knowledge of : - circuit theory, - the complex algebra and Laplace transform.
Main themes	This teaching unitis designed to familiarize the student with the basic aspects of electronic equipment in modern metrology. It is divided into two parts. The first part deals with the essential points of linear electronics in semiconductors and small signals. The second part is dedicated to an introduction to digital electronics and data acquisition systems. Both parts should be followed in parallel and the links between these two parts will be done during practical work and during a personal project.
Learning outcomes	**At the end of this learning unit, the student is able to :** **a. Contribution of the teaching unit to the learning outcomes of the programme (PHYS2M and PHYS2M1)** AA1: A1.1, A1.5 AA2: A2.5 **b. Specific learning outcomes of the teaching unit** At the end of this teaching unit, the student will be able to : 1 1. describe the operating mode of the basic electronic, analog and digital components and its limitations ; 2. simulate with LTSPICE software the response of the basic electronic circuits ; 3. analyze and calculate the basic assemblies commonly used in physics in the reading of sensors / detectors ; 4. analyze and draw a finite state machine ; 5. link an electronic data acquisition system to the computer using a simple communication protocol.
Evaluation methods	The evaluation is based on : • Written exam: 12 questions on analog and digital electronics (45%) • Project: oral examination + report (45%) • Grading on selected exercises. (10%) Continuous assessment Depending on the sanitary conditions the evaluation methods would be adapted to non-presential examinations.
Teaching methods	Traditional lectures and exercise sessions: • Lecture in the auditorium ; • problem solving in the auditorium; • homework execises (weekly). Practical work (mandatory): - experimental study of basic circuits; - simulation of circuits in LTSPICE; - development of a project combining analog and digital electronics. The list of projects is presented at the beginning of the lecture's period
Content	Analogue electronic part. 1. Electronic simulation tools LTSpice-IV. 2. Analysis of passive circuits composed of linear and permanent elements. 3. The semiconductor diode.

	4. The bipolar transistor. 5. Unipolar transistor or FET with field effect. 6. Differential amplifier. Operational amplifier. 7. Transmission lines. 8. The noises. Part dedicated to numerical electronics and data acquisition. 1. Digital and analog signals and systems. 2. Number systems, operations and codes. 3. Logic gates and gate combinations. 4. Combinational logic : adders, decoders, comparators, multiplexers, … 5. Sequential logic : flip-flops, timers, shift registers, counters, … 6. Counters : finite state machines. 7. Programmable logic : VHDL. 8. Data transmission. 9. Signal conversion : ADC, DAC, … 10. Buses and interfaces : serial and parallel buses, USB, I2C, ethernet.
Bibliography	1. Electronic Principles, A. Malvino & D.J. Bates, McGraw Hill (2007). 2. Microelectronic circuits, Sedra & Smith, Oxford University Press (2004). 3. Digital Fundamentals, 11th Edition (http://www.pearsonglobaleditions.com/Sitemap/Floyd/), Thomas Floyd, Ed. Pearson. 4. Acquisition de Données. Du Capteur à l'Ordinateur, Georges Asch et collaborateurs, Ed. Dunod.
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Additionnal module in Physics	APPHYS	10		🔍
Master [60] in Physics	PHYS2M1	10		🔍
Master [120] in Physics	PHYS2M	10		🔍