



## COURSE DETAILS

"ELETTRONICA I"

SSD ING-INF/01

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2023-2024

## GENERAL INFORMATION – TEACHER REFERENCES

TEACHER:

PHONE:

EMAIL:

[SEE THE STUDY COURSE WEBSITE](#)

## GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.

MODULE (IF APPLICABLE): N.A.

CHANNEL (IF APPLICABLE): N.A.

YEAR OF THE DEGREE PROGRAMME (I, II, III): II

SEMESTER (I, II): II

CFU: 9



## REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Analisi matematica II, Fisica Generale II.

## PREREQUISITES (IF APPLICABLE)

None.

## LEARNING GOALS

The course of Electronics I aims to learn some fundamental concepts related to the operation and use of semiconductor electronic devices for the processing of analog and digital signals. Students are able to analyze the behavior of simple circuits, even at various levels of abstraction, such as diodes, transistors, operational amplifiers. Theoretical tools are provided for the analysis of small signal sinusoidal circuits. The analysis of circuits operating in the presence of large signals is mainly carried out graphically. The course also includes a part of circuit synthesis with the aim of providing students with the basic elements necessary for the design of digital circuits based on logic gates made with MOSFETs.

## EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

### Knowledge and understanding

After passing the exam, the student has essential concepts on the physical principles that underlie the operation of simple solid-state electronic devices. He knows the fundamental characteristics of the most used solid-state devices in electronics (diodes, MOSFET and BJT transistors), and is able to highlight them, from the point of view of the characteristics at the terminals, similarities and differences. He knows the classification of amplifiers from the point of view of input-output characteristics, and the main circuit configurations of amplifiers based on BJT and MOSFET. He knows some fundamental applications of MOSFETs in the field of circuits for processing and storing logic signals. He knows the properties of Operational Amplifiers and some fundamental circuits based on them.

### Applying knowledge and understanding

In order to pass the exam, the student must be able to illustrate the theoretical and technical motivations that underlie the properties of analog and digital fundamental circuits. In particular, it must demonstrate that it is able to analyse simple electronic circuits using MOSFET or BJT diodes and transistors, using the most appropriate models of such devices depending on the intended circuit application. It must also be able to predict the electrical behavior of simple circuit configurations, whether for digital or analog applications, known in the literature, resorting, where necessary, to the study in direct current, in the presence of small signals in sinusoidal regime, or for large signals.

The student must also be able to analyze some fundamental circuits based on Operational Amplifiers, single stage or multi-stage, or, starting from them, appropriately size the passive components to obtain specific assignments in terms of amplification or input and output resistance.

## COURSE CONTENT/SYLLABUS

Analog signals and digital signals, amplification of analog signals, general models of amplifiers and characteristic parameters. The Operational Amplifier (OpAmp): simplified model and fundamental circuits to OpAmp (inverting, non-inverting, adding, integrator, shunt).

Semiconductor materials, charge transport in semiconductors, doping. The p-n junction: barrier potential, junction capacity. Diode polarization, rectifiers, small diode signal model.

Diode switching . Circuit simulators: SPICE.

Principles of operation of the MOSFET, wide signal model, the MOSFET as a controlled switch.

Characteristic parameters of real logic circuits, noise margins, performance, power dissipation. Circuitry logical based on MOSFETs, CMOS technology, synthesis of static CMOS logic networks. Semiconductor



memories. Small signal models of the MOSFET, the MOSFET as an amplifier, MOSFET amplifier stages. Principle of operation of the BJT, wide signal model, small signal models. The BJT as an amplifier characteristics of BJT amplifiers.

Introduction to signal acquisition and processing using simple programmable systems.

**READINGS/BIBLIOGRAPHY**

A. Sedra, K. Smith, *“Circuiti per la microelettronica”*.

S. Daliento, A. Irace, *“Elettronica generale”*.

A. Agarwal, J. H. Lang, *“Foundations of analog and digital electronic circuits”*.

Slides used during lessons, video recordings of lessons and exercise solutions.

**TEACHING METHODS**

The teacher will use: a) lectures for about 70% of the total hours, b) exercises for the application and the deepening of the theoretical aspects, both numerical and based on the use of circuit simulators or simple programmable systems.

There will also be short seminars held by experts in the field of analog or digital circuit design.

**EXAMINATION/EVALUATION CRITERIA**

a) Exam type:

Exam type	
written and oral	
only written	
only oral	X
project discussion	
other	

In case of a written exam, questions refer to:	Multiple choice answers	
	Open answers	
	Numerical exercises	

b) Evaluation pattern: N.A.

