COURSE DESCRIPTION – ACADEMIC YEAR 2023/2024

Course title	Electronic Circuit Design
Course code	42410
Scientific sector	Ing-inf/01
Degree	L-8, Bsc in Electronics and Cyber-Physical Systems Engineering
Semester	II
Year	II
Credits	6
Modular	no

Total lecturing hours	36
Total lab hours	12 ex + 12 lab
Attendance	Strongly recommended. Non attending students should contact the lecturer at the start of the course to agree on the modalities of the independent study.
Prerequisites	Basics of Electronics, Electronic Devices, Fundamentals of Systems and Control
Course page	

Specific educational objectives	Electronic Circuit Design is an introductory course on the design and analysis of both analog and digital electronic circuits. The course covers diode-based circuits, such as rectifiers and supplies; Operational amplifier based circuits, addressing Op-Amp non-idealities; discrete and integrated-circuit amplifiers in CMOS and BJT technologies; and digital logic circuits, with an emphasis on CMOS logic circuits.

Lecturer	Dr. Alessandro Torrisi
Contact	Alessandro.Torrisi@unibz.it
Scientific sector of lecturer	Ing-inf/01
Teaching language	English
Office hours	tbd
Lecturing assistant (if any)	Dr. Giuseppe Ciccone; Dott. Moritz Ploner
Contact LA	giuseppe.ciccone@unibz.it; moritz.ploner@unibz.it
Office hours LA	tbd
List of topics	• Diodes: models, rectifier circuits, linear power supplies, diode-based voltage regulators, limiting and clamping circuits. • Operational amplifiers: the ideal Op-Amp, the inverting and non-inverting configurations, difference amplifiers, integrators and differentiators, Op-Amp filters and non-idealities. • MOSFET and BJT models: physical structure, I-V model, C-V model, parasitic capacitances and resistances, small-signal models, p-channel MOSFET, pnp BJT. • Transistor amplifiers: basic principles, basic configurations, biasing networks, discrete-circuit and IC amplifiers. Differential amplifiers: differential pair. • Frequency response: low- and high-frequency responses, approximate analysis methodologies, high-frequency response of MOSFET amplifiers.

	• Digital logic circuits: binary representation of information, elements of Boolean algebra, combinatorial logic. CMOS logic circuit topologies, dynamic operation, and power dissipation.
Teaching format	Frontal lectures, exercises, and laboratories

Learning outcomes	A student who successfully completes the course will be able to: • recognize and draw the schematics of basic circuit configurations introduced in the course, including rectifiers, operational amplifiers,, and the CMOS logic; • list, explain and design the basic circuit configurations covered during the course, considering the most appropriate device models and being able to address design trade-offs and limitations of the models; • analyze and design basic analog circuits featuring diodes, Op Amps, MOSFETs and BJTs; • analyze and design basic CMOS logic circuits, considering the relevant design trade-offs; • perform bias-point, DC, AC and transient analyses using an industry-grade electronic design automation software, such as LTspice; • measure DC voltages and currents with a multimeter, measure the transient behavior of discrete circuits with an oscilloscope, generate test signals with a waveform generator, and apply the required DC voltages using a power supply.

Learning outcomes (ILOs)	<u>Knowledge and understanding in the field of:</u> Thanks to training in Electronic Engineering, graduates in Electronic and Cyber-Physical Systems Engineering will be able to: know and understand the fundamental principles, techniques and methods of designing, prototyping and testing basic analog and digital electronic circuits; <u>Applying knowledge and understanding Ability</u> Thanks to training in Electronic Engineering, graduates in Electronic and Cyber-Physical Systems Engineering will be able to: • apply the knowledge of Electronics to analyze and understand the behavior of analog and digital circuits, using the most appropriate approximations; • carry out simple experimental activities on electronic systems, acquiring measurements relating to the system and its behavior. <u>Making judgements</u>

	The graduate has the ability to judge and discern between different solutions to problems, evaluating the alternatives and methodologies to be applied, regarding fundamental analog and digital electronic circuits. The graduate has the ability to participate in data collection, analysis and the formulation of critical judgments and project proposals. Communication skills The graduate is able to communicate, understand and process texts on technical issues. In this case, not only the contents of the essay will be evaluated, but also the candidate's synthesis, communication and presentation skills. Ability to learn The graduate acquires the methodological tools for study and in-depth study, even individual, and possesses the knowledge necessary to deal with subsequent levels of university education (master's degree or first level master's degree).

Assessment	Written and oral
Assessment language	Italian
Assessment Typology	Written exam (2 hours; permitted aid: a non-programmable scientific calculator) + oral exam 30 mins.
Evaluation criteria and criteria for awarding marks	The assessment criteria will be: - the accuracy of the answers given in the written examination, with particular attention to the resolution procedure adopted and the formal correctness of the same; - the accuracy of the answers given in the oral examination, with particular attention to the terminology used; - the ability to solve design issues presented during the course and exam.

Required readings	Tbd
Supplementary readings	Tbd
Software used	LTspice