Università degli Studi di Brescia

Corso di Studio	05751 - INDUSTRIAL AUTOMATION ENGINEERING
Insegnamento	A003787 - FUNDAMENTALS OF ELECTRONICS AND INSTRUMENTATION
Anno Offerta	2023/2024
Responsabile	FERRARI VITTORIO
Periodo	Secondo Semestre
Modalità didattica	Convenzionale
Lingua	ita

ATTIVITÀ FORMATIVA DI RIFERIMENTO

Corso di Studio	05751 - INDUSTRIAL AUTOMATION ENGINEERING
Insegnamento	A003787 - FUNDAMENTALS OF ELECTRONICS AND INSTRUMENTATION
Titolare	FERRARI VITTORIO

CAMPI

LINGUA INSEGNAMENTO

Italian

CONTENUTI

Analog and digital signals, signal elaboration and the analog-to-digital conversion process.
Operating principles of electronic measuring instruments and analysis of the characteristics of basic instrumentation.
Semiconductor electronic devices: diodes, bipolar and field-effect transistors.
Analog circuits and systems: amplification and feedback, operational amplifiers, filters, oscillators, comparators, instrumentation amplifiers.
Short summary of electronic circuit fabrication technologies.

Digital combinatorial and sequential circuits.
Mixed-signal circuits for analog-to-digital (AD) and digital-to-analog (DA) conversion.

LIBRI DI TESTO/LIBRI CONSIGLIATI

Lecture short-notes and support material prepared by the instructor and made available on line.
Reference textbooks:
- C. K. Alexander, M. N. O. Sadiku, “Circuiti elettrici” 3rd ed., McGraw-Hill, 2008.
- P. Horowitz, W. Hill, "L'arte dell'elettronica Analisi e progettazione di circuiti", Zanichelli, 2018.

OBIETTIVI FORMATIVI

The course is intended to provide skills on the basics of electronic circuits and systems and electronic instrumentation. Fundamental concepts and theory will be integrated by exercises and laboratory activity. At the end of the course the students will be able to analyze the operating principles of most common electronic devices, circuits and systems, and to operate basic electronic instrumentation.

PREREQUISITI

The acquaintance with the contents of the following courses is necessary, though it is not strictly required that the respective tests are passed before that of the present course:
Calculus. Physics. Electric circuits.

METODI DIDATTICI

Lectures and training classes, complemented by practical laboratory experiences.

ALTRE INFORMAZIONI

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MODALITÀ DI VERIFICA DELL'APPRENDIMENTO

Written test possibly complemented by an oral exam. The test is made of: - Seven multiple-choice questions (total points up to 21/30) - One open question on theory (points up to 4/30) - One exercise (points up to 5/30).
Test passed for points of written test>21. Test failed for points of written test<18.
Oral exam for 18<=points of written test<=21.

PROGRAMMA ESTESO

1. Signals and signal elaboration: Analog signals: time and frequency domain, Fourier analysis, discrete and continuous spectra. Analog signal elaboration: linear and non-linear functions, amplifiers, filters. Digital signals: fundamental characteristics and binary coding. Analog-to-digital conversion (A/D): sampling, aliasing, quantization, resolution and number of bits. Digital signal elaboration: algorithms,

memory storage.
2. Instrumentation: Measuring techniques for static and dynamic electrical
quantities. General characteristics of electronic measurement instruments. Main metrological characteristics: sensitivity, resolution, measurement accuracy and uncertainty, influencing quantities. General characteristics of sensors and transducers. Laboratory instrumentation: multimeter, analog oscilloscope, digital oscilloscope, signal generator.
3. Devices: Basic concepts on semiconductors. PN-junction diodes. Bipolar junction transistors (BJT) and field-effect transistors (FET).
4. Analog circuit and systems: Structure and characteristics of operational amplifiers (OA). Feedback amplifiers. Linear applications of OAs: non-inverting, inverting, summing, differential amplifiers, configurations with impedances, filters and oscillators. Brief notes on non-linear applications of OAs. Nonidealities of OAs. Comparators, example of on/off regulation circuit. Instrumentation amplifiers. Examples of measurement systems comprising sensors, signal conditioning, elaboration and output blocks.
5. Short summary of electronic circuit technologies: Overview on the fabrication technologies of integrated circuits (IC) and printed-circuit boards (PCB); the role of software in simulation and design of electronic circuits.
6. Digital blocks and logic gates: Binary coding and logic operators. Logic functions and logic gates. Ideal logic inverter. Noise margins. Static and dynamic power dissipation. Rise, fall and propagation times. Logic families. CMOS inverter and dynamic power dissipation.
7. Combinational circuits: Combinatorial logic. Adder, subtractor, ALU. Parity check generator and detector. Multiplexer and demultiplexer. Gates with 3-state output. Coders and decoders. ROM, PROM, EPROM, EEPROM memories.
8. Sequential circuits: Sequential logic. Set-Reset bistable cell and applications. Timing and clock. Flip flop types: SR, JK, D, T. Flip flop applications. Dividers. Shift registers. Synchronous and asynchronous counters. RAM memories. Brief notes on programmable logic devices, microcontrollers, microprocessors.
9. Analog-to-digital converters (ADC) and digital-to-analog converters (DAC): Counting ADC. Tracking ADC. Successive approximation ADC. Flash ADC flash. Single and double-ramp ADC. Binary weight DAC. R/2R DAC. Pulse width modulation DAC.

DOCENTI ASSOCIATI

NASTRO ALESSANDRO
NESSUN DOCENTE
NESSUN DOCENTE