Università degli Studi di Brescia

Corso di Studio	05821 - ELECTRONICS ENGINEERING
Insegnamento	750603 - INSTRUMENTATION ELECTRONICS, SENSORS AND MICROSYSTEMS
Anno Offerta	2025/2026
Responsabile	FERRARI VITTORIO
Periodo	Secondo Semestre
Modalità didattica	Convenzionale
Lingua	ita

ATTIVITÀ FORMATIVA DI RIFERIMENTO

Corso di Studio	05821 - ELECTRONICS ENGINEERING
Insegnamento	750603 - INSTRUMENTATION ELECTRONICS, SENSORS AND MICROSYSTEMS
Titolare	FERRARI VITTORIO

CAMPI

LINGUA INSEGNAMENTO

Italian, with learning material mostly in English.

CONTENUTI

The first part of the course deals with techniques and circuits for the extraction and processing of measurement information in electronic instrumentation, with special focus on sensor interfacing. The two combined aspects of signal amplification, plus mitigation of disturbing effects due to noise, interference and influencing quantities are jointly considered, with the general goal of maximizing signal-to-noise ratio.
The second part of the course deals with sensors and micro-electromechanical systems (MEMS) based on silicon micromachining. The main aspects treated are transduction effects, fabrication technologies and interfacing to signal-

conditioning electronic circuits. Techniques, development methods and devices are presented and discussed with reference to up-to-date applications and recent research trends, such as energy-harvesting for powering wireless autonomous sensors and microsystems, sensors for Internet of Things, wearable systems for monitoring physiological parameters.

LIBRI DI TESTO/LIBRI CONSIGLIATI

Lecture short-notes and support material prepared by the instructor and made available on line.

Reference textbooks:
- R. Pallás-Areny, J. G. Webster, “Sensors and Signal Conditioning” 2nd Edition, John Wiley & Sons, 2001.
- S. D. Senturia, “Microsystem Design”, Kluwer Academic Publishers, 2001.

OBIETTIVI FORMATIVI

The course is intended to provide skills and develop design abilities on electronic circuits and techniques for signal readout and treatment in instrumentation, and on sensors and microsystems.
At the end of the course the students will gain the capability to:
- know techniques and circuits for signal readout and treatment in instrumentation;
- understand problems and solutions to amplify signals and reject/mitigate unwanted disturbances due to noise, interference and influencing quantities;
- analyze structure and functioning and apply modeling techniques of sensors and microsystems (MEMS);
and the ability to:
- apply the acquired knowledge in the project of systems composed of sensors and/or MEMS plus their respective signal readout electronic circuits, with reference to different applications, and document and present the obtained results.

PREREQUISITI

Electronic circuits and systems (analog, digital and mixed-signal), basics of signal theory, basics of semiconductor physics.

METODI DIDATTICI

Following a design-oriented approach, the course includes lectures on both fundamentals and more advanced topics, followed by a project-based laboratory activity where students agree with the instructor to deepen into specific topics of interest and design case studies, typically forming small working teams.

ALTRE INFORMAZIONI

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MODALITÀ DI VERIFICA DELL'APPRENDIMENTO

Written test on the course contents, delivery of a written report on the laboratory project and oral presentation of the results.
The written test has a duration of 2 hours and is composed of three open questions of similar type of representative examples made available in advance to the students. Total points are up to 32/30. The laboratory project includes experimental activities, preparation of a written report on the obtained results and a summarizing oral presentation. Total points are up to 30/30.
The final grade comes from the weighted average of the points of the written test and the report plus presentation. Written test and project presentation can be given in different exam terms.
The final assessment procedure is the same for both attending and nonattending students.

PROGRAMMA ESTESO

Course syllabus

1. General concepts on information and signals, noise, interference and influencing quantities.

2. Amplification of DC and AC signal sources, electronic noise in circuits, electromagnetic interference (EMI) and mitigation of the same in cabled connections.

3. Techniques for information extraction and signal-to-noise ratio maximization: modulation and demodulation, phase-sensitive detection, lock-in amplifiers, filtering, averaging, correlation.

4. Introduction on sensors, actuators and transduction systems.

5. Microfabrication technologies and MEMS.

6. Sensor and microsystem design.

7. Sensor systems and applications.

8. Project-based laboratory activity.

DOCENTI ASSOCIATI

FERRARI MARCO

NASTRO ALESSANDRO