UNIVERSITÀ DEGLI STUDI DI BRESCIA

# Università degli Studi di Brescia

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| **Study Programme** | 05821 - ELECTRONICS ENGINEERING |
| **Course unit** | 750603 - INSTRUMENTATION ELECTRONICS, SENSORS AND MICROSYSTEMS |
| **Academic year** | 2021/2022 |
| **Course leader:** | FERRARI VITTORIO |
| **Period** | Secondo Semestre |
| **Teaching Methods** | Convenzionale |
| **Teaching Language** | ita |

## MAIN COURSE

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| **Study Programme** | 05821 - ELECTRONICS ENGINEERING |
| **Course unit** | 750603 - INSTRUMENTATION ELECTRONICS, SENSORS AND MICROSYSTEMS |
| **Tenured Professor** | FERRARI VITTORIO |

# SYLLABUS

## LINGUA INSEGNAMENTO

Italian, with learning material mostly in English.

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## CONTENUTI

INSTRUMENTATION ELECTRONICS, SENSORS AND MICROSYSTEMS 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 microsystems. 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 micro-electromechanical systems (MEMS), energy-harvesting for powering wireless autonomous sensors and Internet of Things, wearable systems for monitoring physiological parameters. Course syllabus 1. General concepts on measurement, 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.

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## 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.

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## OBIETTIVI FORMATIVI

The course is intended to provide skills and develop design abilities on circuits and techniques for signal treatment in electronic instrumentation, and on sensors and microsystems.

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## PREREQUISITI

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

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## 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.

## 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 final grade comes from the weighted average of the results of the written test (maximum 32/30 points) and the report plus presentation (maximum 30/30 points).

## 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.

## OTHER TEACHERS

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| BAU' MARCO |
| FERRARI MARCO |