Course guide
295118 - 295II233 - Sensors and Mems

Last modified: 04/06/2026

Unit in charge: Barcelona East School of Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.
702 - CEM - Department of Materials Science and Engineering.

Degree: MASTER'S DEGREE IN INTERDISCIPLINARY AND INNOVATIVE ENGINEERING (Syllabus 2019). (Optional subject).
ERASMUS MUNDUS MASTER IN SUSTAINABLE SYSTEMS ENGINEERING (EMSSE) (Syllabus 2024). (Optional subject).

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: EDGARDO ADEMAR SAUCEDO SILVA

Others: Primer quadrimestre:
HOSSEIN BESHARATLOO - Grup: T11, Grup: T12
LUIS MIGUEL LLANES PITARCH - Grup: T11, Grup: T12
EDGARDO ADEMAR SAUCEDO SILVA - Grup: T11, Grup: T12

PRIOR SKILLS

Electronic Systems, Computing, Mechanical Systems, Material Science and Technology

REQUIREMENTS

Data acquisition & Instrumentation

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMUEII-15. Design and implement acquisition, actuation and control systems that integrate electronic, electrical and mechanical technology in the field of intelligent production systems. (Specific competence of the Advanced Manufacturing Systems specialty)

Generical:
CGMUEII-01. Participate in technological innovation projects in multidisciplinary problems, applying mathematical, analytical, scientific, instrumental, technological and management knowledge.
CGMUEII-05. To communicate hypotheses, procedures and results to specialized and non-specialized audiences in a clear and unambiguous way, both orally and through reports and diagrams, in the context of the development of technical solutions for problems of an interdisciplinary nature.

Transversal:
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

LEARNING RESULTS

Knowledges:
K06. Design and implement systems and applications in the field of intelligent production systems.
K05. Design and implement acquisition, actuation and control systems that integrate electronic, electrical and mechanical technology.

Skills:
S05. Apply pattern recognition, artificial intelligence and statistical data analysis techniques to make objective, quantitative and reproducible decisions in multidisciplinary problems.
S02. Educate well-trained and enthusiastic professionals with broad multidisciplinary knowledge of tools and technologies for sustainable systems engineering. Training takes place in an international and multicultural environment to stimulate global collaboration in addressing complex challenges in a wide range of application fields, such as logistics, transport, advanced production systems, energy systems management and health improvement.

Competences:
C03. Manage the acquisition, organisation, analysis and presentation of data and information in the field of complex systems engineering and critically assess the results obtained.
C05. Propose advanced scientific and technological solutions to complex industrial challenges in areas such as intelligent production, robotic systems, logistics, fault detection and predictive maintenance.
C02. Work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

TEACHING METHODOLOGY

Lectures
Laboratory classes
Laboratory practical work
Individual and group work

LEARNING OBJECTIVES OF THE SUBJECT

The aim of this course is to train students in methods to design and use intelligent sensor systems and their connection to the Internet-of-Things, with special emphasis to Micro-Electromechanical Systems (MEMS)

STUDY LOAD

Type	Hours	Percentage
Hours small group	21,0	14.00
Self study	108,0	72.00
Hours large group	21,0	14.00

Total learning time: 150 h

CONTENTS

The signal acquisition chain

Description:
Introduction to intelligent sensor systems and its signal acquisition stages. Microelectronics and amplifiers.

Specific objectives:
Analyze, design and use analog front-end stages for sensor signal acquisition

Related activities:
Lectures and application exercises.
Laboratory exercicises:
Sensor signal acquisition

Full-or-part-time: 30h
Theory classes: 4h
Laboratory classes: 4h
Guided activities: 2h
Self study : 20h

MEMS. The microfabrications process.

Description:
MEMS materials and the microfabrication process (Litography and other microfabrication techniques, Introduction to Process integration)

Specific objectives:
Understand and know the different MEMS microfabrication process and materials.

Related activities:
Lectures and application exercises.
Laboratory exercises:
Fabrication of a model MEMS by masking

Full-or-part-time: 28h
Theory classes: 4h
Laboratory classes: 4h
Self study : 20h

MEMS structures and modeling

Description:
Description of the most common MEMS structures and their mechanical analysis.

Specific objectives:
Analyse MEMS structures and determine its fundamental parameters.

Related activities:
Lectures and application exercises.
Laboratory exercises:
MEMS simulation and experimental measures.

Full-or-part-time: 28h
Theory classes: 4h
Laboratory classes: 4h
Self study : 20h

Digital signal processing and their implementation on microcontrollers

Description:
Description and use of the microcontroller system to acquire and process signals from sensors.

Specific objectives:
Use microcontroller systems for signal acquisition and wireless connection.

Related activities:
Lectures and application exercises.
Laboratory exercises:
Microcontroller system electronic circuit and its programming

Full-or-part-time: 32h
Theory classes: 4h
Laboratory classes: 6h
Guided activities: 2h
Self study : 20h

Networks

Description:
Data link layer for IoT: Wireless communication technologies, wire communciation technologies, Manet Networks. RFID, Bluetooth.
Network layer for IoT: 6lowPAN, dynamic routing for wireless ad-hoc network.
Communication protocols for IoT: Service-oriented protocols (COAP, protocols based on the exchange of messages (MQTT), Service discovery protocols.
Data processing for IoT: Cloud computing, Fog computing.

Specific objectives:
Understand current communication network protocols for IoT.
Know how to connect and internetwork devices, with real-time data processing.

Related activities:
Lectures and application exercises.
Laboratory:
Internet connection. Devices showing actual real-time monitoring, Exposition of device functionality as services – COAP protocol, Machine-to-machine communications: Broadcast and MQTT application.

Full-or-part-time: 32h
Theory classes: 6h
Laboratory classes: 4h
Self study : 22h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

Final exam, Group assessments, Laboratory assessments

EXAMINATION RULES.

To be determined

BIBLIOGRAPHY

Basic:
- Rayes, Ammar; Salam, Samer. Internet of things from hype to reality : the road to digitization [on line]. 2nd ed. Cham: Springer International Publishing : Imprint: Springer, 2019 [Consultation: 14/04/2020]. Available on: https://doi.org/10.1007/978-3-319-99516-8. ISBN 9783319995168|.
- Senturia, Stephen D. Microsystem design [on line]. New York [etc.]: Kluwer Academic Publishers, cop. 2002 [Consultation: 14/04/2020]. Available on: https://link.springer.com/book/10.1007/b117574. ISBN 9780792372462.
- Di Paolo Emilio, Maurizio. Data Acquisition Systems : From Fundamentals to Applied Design [on line]. New York, NY: Springer, 2013 [Consultation: 14/04/2020]. Available on: http://dx.doi.org/10.1007/978-1-4614-4214-1. ISBN 978-1-4614-4214-1.
- Zhu, Yifeng. Embedded systems with ARM Cortex-m microcontrollers in assembly language and C. 3rd ed. E-Man Press LLC, 2017. ISBN 780982692660.