



## Course guide

### 295118 - 295II233 - Iot Sensors & Mems

Last modified: 27/05/2024

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

**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:** 2024    **ECTS Credits:** 6.0    **Languages:** English

#### LECTURER

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**Coordinating lecturer:** EDGARDO ADEMAR SAUCEDO SILVA

**Others:** Primer quadrimestre:  
EMILIO JIMENEZ PIQUÉ - Grup: T10  
ANTONI PEREZ POCH - Grup: T10  
EDGARDO ADEMAR SAUCEDO SILVA - Grup: T10

#### PRIOR SKILLS

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

#### REQUIREMENTS

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Data acquisition & Instrumentation

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**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.



## TEACHING METHODOLOGY

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Lectures  
Laboratory classes  
Laboratory practical work  
Individual and group work

## LEARNING OBJECTIVES OF THE SUBJECT

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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

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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

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### 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 exercises:

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 (Lithography 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 communication 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 interconnect 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

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.