

Course guide 300266 - LOWPOW - Low-Power Systems with Energy Harvesting

Last modified: 23/06/2025

Unit in charge: Castelldefels School of Telecommunications and Aerospace Engineering

Teaching unit: 710 - EEL - Department of Electronic Engineering.

Degree: MASTER'S DEGREE IN APPLIED TELECOMMUNICATIONS AND ENGINEERING MANAGEMENT (MASTEAM)

(Syllabus 2015). (Optional subject).

MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional

subject).

ERASMUS MUNDUS MASTER IN COMMUNICATIONS ENGINEERING AND DATA SCIENCE (CODAS 1)

(Syllabus 2024). (Optional subject).

ERASMUS MUNDUS MASTER IN COMMUNICATIONS ENGINEERING AND DATA SCIENCE (CODAS 2)

(Syllabus 2024). (Optional subject).

Academic year: 2025 ECTS Credits: 3.0 Languages: English

LECTURER

Coordinating lecturer: Defined at the infoweb

Others: Defined at the infoweb

PRIOR SKILLS

DC and AC circuit analysis, linear system theory, analysis and design of basic analog, digital and mixed-signal electronic circuits using passive and active electronic components

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:

03 DIS. (ENG) Diseñar aplicaciones de alto valor añadido basadas en las Tecnologías de la Información y las Comunicaciones (TIC), aplicadas a cualquier ámbito de la sociedad.

Transversal:

02 SCS. SUSTAINABILITY AND SOCIAL COMMITMENT. Being aware of and understanding the complexity of social and economic phenomena that characterize the welfare society. Having the ability to relate welfare to globalization and sustainability. Being able to make a balanced use of techniques, technology, the economy and sustainability.

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.

Basic

CB6. Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context.

CB9. Students will be able to communicate their conclusions and the knowledge and ultimate reasons that support them to specialized and non-specialized audiences in a clear and unambiguous manner.

CB10. Students will acquire learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.

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TEACHING METHODOLOGY

Lectures

Blended teaching and flippled classroom Resolution of problems and cooperative learning Lab work and Project based learning

LEARNING OBJECTIVES OF THE SUBJECT

When finishing this subject, students should be able to:

Knowledges

- K1. Identify and describe low-pwer sensor nodes and wireless sensor networks for different applications, including the Internet of Things (IoT).
- K2. Identify and describe energy harvesters to power sensors nodes and also their constituent blocks and functionalities.
- K3. Identify and apply suitable theoretical analyses for designing energy harvesters to power sensor nodes.

Skills

- S1. Use of lab instruments and other tools to perform lab experiments.
- S2. Test and assess sensor nodes and the energy harvesters to power them.

Competences

- C1. Design, implement and assess sensor nodes and the energy harvesters to power them.
- C2. Perform tasks and projects in groups, according to some instructions or initial requirements.
- C3. Communicate orally and in writing with others about the outcome of learning and decision-making.

STUDY LOAD

Туре	Hours	Percentage
Self study	48,0	64.00
Hours large group	4,0	5.33
Hours medium group	23,0	30.67

Total learning time: 75 h

CONTENTS

Introduction

Description:

Introduction to the subject: Learning outcomes, contents, teaching methods, training activities, assessement methods and criteria

Introduction to Energy Harvesters for Powering Sensor Nodes

Related activities:

In classroom: note-taking, answering questions, completing exercises proposed the previous week and during class. Outside class: reviewing theoretical concepts, completing proposed exercises, solving questions with the instructor.

Full-or-part-time: 1h 30m

Theory classes: 1h Self study : 0h 30m

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Sensor Nodes

Description:

Sensors

Analog and digital processing

Transceivers

Related activities:

In classroom: note-taking, answering questions, completing exercises proposed the previous week and during class. Outside class: reviewing theoretical concepts, completing proposed exercises, solving questions with the instructor.

Full-or-part-time: 8h 30m

Theory classes: 3h Self study: 5h 30m

Energy sources and transducers

Description:

Light

Thermal

Mechanical

Radiofrequency

Related activities:

In classroom: note-taking, answering questions, completing exercises proposed the previous week and during class. Outside class: reviewing theoretical concepts, completing proposed exercises, solving questions with the instructor.

Full-or-part-time: 8h 30m

Theory classes: 3h Self study : 5h 30m

Energy storage

Description:

Batteries

Supercapacitors

Related activities:

In classroom: note-taking, answering questions, completing exercises proposed the previous week and during class. Outside class: reviewing theoretical concepts, completing proposed exercises, solving questions with the instructor.

Full-or-part-time: 2h 30m

Theory classes: 1h Self study : 1h 30m

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Power management units

Description:

AC/DC converters

DC/DC converters

Maximum power point tracking (MPPT)

Energy storage management

Related activities:

In classroom: note-taking, answering questions, completing exercises proposed the previous week and during class. Outside class: reviewing theoretical concepts, completing proposed exercises, solving questions with the instructor.

Full-or-part-time: 11h Theory classes: 4h Self study: 7h

Guided labs

Description:

Labs dealing with the topics presented at the theory classes

Related activities:

In classroom: Conduct experimental work, solve questions with the instructor. Outside classroom: Conduct pre-lab work and report experimental lab work.

Full-or-part-time: 17h Laboratory classes: 6h Self study: 11h

Project

Description:

Lab project dealing with the topics presented at the theory classes and practiced in the guided labs Design, implementation and testing of a sensor node powered by energy harvesting

Related activities:

In classroom: Conduct experimental work, solve questions and discussion of the project design with the instructor.

Outside classroom: Project design and reporting.

Full-or-part-time: 17h Laboratory classes: 6h Self study: 11h

Theory exams

Description:

Individual theory exams to assess the topics presented in the theory classes

Related activities:

In classroom: doing the exams.

Outside class: solving questions with the instructor, specific study for the exam.

Full-or-part-time: 9h Theory classes: 3h Self study: 6h



GRADING SYSTEM

Defined at the infoweb

BIBLIOGRAPHY

Basic

- Penella López, María Teresa; Gasulla Forner, Manuel. Powering Autonomous Sensors: An Integral Approach with Focus on Solar and RF Energy Harvesting [on line]. Dordrecht: Springer, 2011 [Consultation: 27/08/2025]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-94-007-1573-8. ISBN 9789400715721.

RESOURCES

Other resources:

Theory:

- Slides, collection of exercices, electronic books, technical documents, scientific papers, internet resources Laboratory
- Basic lab instruments: power source, digital multimeter, waveform generator and oscilloscope
- Accessories for the lab work: electronic devices and components, breadboard and cables
- Lab scripts
- Manuals, datasheets and internet resources

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