# Course guide
# 230635 - MRS - Microwave Imaging for Remote Sensing

**Last modified:** 25/05/2023

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| **Unit in charge:** | Barcelona School of Telecommunications Engineering |
| **Teaching unit:** | 739 - TSC - Department of Signal Theory and Communications. |

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| **Degree:** | MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject). MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject). |

**Academic year:** 2023    **ECTS Credits:** 5.0    **Languages:** English

## LECTURER

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| **Coordinating lecturer:** | Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura |
| **Others:** | Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma |

## PRIOR SKILLS

Camps electromagnètics, Radiació i Ones Electromagnètiques

## DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

**Specific:**
1. Ability to apply advanced knowledge in photonics, optoelectronics and high-frequency electronic
2. Ability to design radio-navigation and location systems, as well as radar systems.
3. Ability to develop, direct, coordinate, and technical and financial management of projects in the field of: telecommunication systems, networks, infrastructures and services, including the supervision and coordination of other's subprojects; common telecommunications infrastructures in buildings or residential areas, including digital home projects; telecommunication infrastructures in transport and environment; with corresponding energy supply facilities and assessment of electromagnetic emissions and electromagnetic compatibility.
4. Ability to develop electronic instrumentation, as well as transducers, actuators and sensors.
5. Ability to integrate Telecommunication Engineering technologies and systems, as a generalist, and in broader and multidisciplinary contexts, such as bioengineering, photovoltaic conversion, nanotechnology and telemedicine.

**Transversal:**

6. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

7. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding how companies are organised and the principles that govern their activity, and being able to understand employment regulations and the relationships between planning, industrial and commercial strategies, quality and profit.

8. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

9. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

10. TEAMWORK: Being able to 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

The students must attend the course lectures imparted mostly using power point presentations. A copy of the slides can be downloaded from the Atenea course web page. Several imaging exercises are proposed during the course to allow the students to write their own imaging algorithms. Some of the lectures will be given in the laboratory to allow the students to acquire a hands-on imaging and processing experience using experimental data. The exercises difficulties and results are commented by the students themselves in the lecture room with the assistance of the course professors.

## LEARNING OBJECTIVES OF THE SUBJECT

The main objective of this course are the physical and engineering principles to obtain images and additional information of distant objects, including penetrable ones, at microwaves frequencies. The course is specially convenient in Remote Sensing research. The theoretical basis and presented techniques of the course are common to most imaging systems using the Electromagnetic Spectrum, including optical frequencies and X Rays with important applications in the industry and biomedicine.

## STUDY LOAD

| Type | Hours | Percentage |
|------|-------|------------|
| Self study | 86,0 | 68.80 |
| Hours large group | 39,0 | 31.20 |

**Total learning time:** 125 h

## CONTENTS

**(ENG) 1 Introduction. 1.1 Interaction of EM waves with matter**

**(ENG) 2 Direct and inverse problems in electromagnetics**

**(ENG) 3 Imaging radars**

| (ENG) 4 Imaging radiometers and applications |
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| (ENG) 5 Other imaging sensors and applications: GNSS Reflectometers |
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## GRADING SYSTEM

The course evaluation is based on the solution of excercises proposed and works addressing the image reconstruction from existing measured or simulated data.

## EXAMINATION RULES.

At home, in the classroom durign regular lecture hours, or during the scheduled exam.

## BIBLIOGRAPHY

**Basic:**
- Blackledge, J.M. Quantitative coherent imaging: theory, methods and some applications. London [etc.]: Academic Press, 1989. ISBN 0121033007.
- Wehner, D.R. High-resolution radar. 2nd ed. Boston [etc.]: Artech House, 1995. ISBN 0890067279.
- Soumekh, M. Fourier array imaging. New Jersey: Prentice Hall, 1994. ISBN 01306376966.
- Goodman, J.W. Introduction to Fourier optics. 3rd ed. Englewood, Colo.: Roberts & Co., 2005. ISBN 0974707724.