Course guide
230610 - RADN - Radar and Radionavigation and Location Systems

Last modified: 11/04/2025

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

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

Academic year: 2025 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: JUAN MANUEL O'CALLAGHAN CASTELLA

Others:

PRIOR SKILLS

The student is supposed to know basic concepts in communication systems and fundamentals of radiation and propagation of radio signals.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Ability to design radio-navigation and location systems, as well as radar systems.
2. Ability to develop radio-communication systems: antennas design, equipment and subsystems, channel modeling, link dimensioning and planning.
3. 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:
4. 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.

5. 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.

6. 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.

TEACHING METHODOLOGY

Lectures
Group work (distance)
Oral presentations of the group work results.

LEARNING OBJECTIVES OF THE SUBJECT

Learning objectives of the subject

The learning objectives of the course are the fundamentals of systems used for detection, guidance and positioning using radio waves. These principles will be studied in a number of representative systems such as primary and secondary radars, satellite positioning systems (GPS, Galileo), and navigation and guidance aids used in civil aviation (VOR, DME, ILS).

Learning results of the subject:

- Ability to grasp an overall system perspective of modern radar, navigation and positioning systems, with the ability to predict their performance from the fundamental system parameters.

STUDY LOAD

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

Total learning time: 125 h

CONTENTS

1. Basic principles

Description:
- Types of navigation.
- Mathematical models for representing the Earth.
- Propagation effects.

Full-or-part-time: 22h
Theory classes: 9h
Self study : 13h

2. Terrestrial systems

Description:
- Hyperbolic systems Loran C, Decca, Omega.
- Air traffic support systems: Primary and Secondary radar, ILS, MLS, VOR, DME, TACAN.

Full-or-part-time: 22h
Theory classes: 9h
Self study : 13h

3. Satellite systems

Description:
- Orbits and geometry.
- Principles of satellite navigation. Observables. Integration with inertial sensors.
- Systems based on the Doppler effect. Traffic Cospass-SAR, Argos.
-GPS and Galileo.

Full-or-part-time: 81h
Theory classes: 19h
Practical classes: 2h
Self study : 60h

ACTIVITIES

PRACTICE

Description:
Use of a handheld GPS in campus. Observation of number of available satellites and Expected Position Error in various reception scenarios.

ORAL PRESENTATION

Description:
Presentation of a work group.

SHORT ANSWER TEST (TEST)

Description:
Partial evaluation test with theoretical questions and short exercises.

GRADING SYSTEM

The final mark is the highest between:

* The mark from the final examination.
* The mark obtained by averaging: 60 % Final examination + 40 % Work assignment.

For the work assignment, 70 % is the written report and 30 % the oral presentation.

EXAMINATION RULES.

Short answer test (Test)

BIBLIOGRAPHY

Basic:
- Parkinson, B.W.; Spilker,J.J. (Eds.). Global positioning system: theory and applications. Washington: American Institute of Aereonautics and Astronautics, 1996. ISBN 156347106X.
- Forsell, B. Radionavigation systems. Boston ; London: Artech House, 2008. ISBN 9781596933545.
- Kaplan, E.D.; Hegarty, C.J. (eds.). Understanding GPS/GNSS: principles and applications [on line]. 3rd ed. Boston: Artech House, 2017 [Consultation: 18/03/2020]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=5430709. ISBN 9781630814427.

Complementary:
- Kayton, M.; Fried, W. Avionics navigation systems [on line]. 2nd ed. New York: John Wiley and Sons, 1997 [Consultation: 26/06/2020]. Available on: https://onlinelibrary.wiley.com/doi/book/10.1002/9780470172704. ISBN 0471547956.
- Skolnik, M.E. Introduction to radar systems. 3rd ed. Boston (Mass.): Mc Graw-Hill, 2001. ISBN 0072909803.