Course guide
230252 - TELED - Remote Sensing and Earth Observation Systems

Last modified: 17/06/2024

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

Degree: BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Optional subject).
BACHELOR'S DEGREE IN DATA SCIENCE AND ENGINEERING (Syllabus 2017). (Optional subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: ADRIANO JOSE CAMPS CARMONA

Others: Primer quadrimestre:
ALBERTO ALONSO GONZÁLEZ - 11
ADRIANO JOSE CAMPS CARMONA - 11
CARLOS LOPEZ MARTINEZ - 11

PRIOR SKILLS

Remote Sensing is a multidisciplinary subject applied to Earth Observation and uses a large number of technologies and techniques related to Microwaves, Antennas, Optics, Radar, Signal Processing which are studied in other Courses. For this reason it is recommended having notions of these topics. The eventual lack of knowledge of the cited areas can be easily surmountable by consulting basic reference books.

TEACHING METHODOLOGY

Fundamentals Lectures
Exercises
Laboratory practice
Selected Topic teamwork

LEARNING OBJECTIVES OF THE SUBJECT

The course provides the basic concepts and techniques necessary to work on the development and use of spaceborne and airborne sensors for earth observation.

STUDY LOAD

Type	Hours	Percentage
Hours large group	39,0	26.00
Self study	98,0	65.33
Hours small group	13,0	8.67

Total learning time: 150 h

CONTENTS

1. Introduction

Description:
The course contents and objectives are presented
1.1 Remote Sensing techniques and technologies

Full-or-part-time: 1h
Theory classes: 1h

2. Air and space platforms. Space missions

Description:
2.1 Mission Phases and Segments
2.2 Types of orbits. Orbital parameters and perturbations
2.3 Polar orbits. Synchronism with the Earth and the Sun.

Full-or-part-time: 4h
Theory classes: 4h

3. Mapping projections. GIS systems

Description:
3.1 Mathematical model of the earth surface. The Geoid
3.2 Global and local ellipsoids. Datum and coordinate transformations
3.3 Mapping projections. UTM and Mercator
3.4 Integration of remote sensing images in GIS systems

Full-or-part-time: 4h
Theory classes: 4h

4. RADAR sensors

Description:

4.1 Radar backscattering
4.2 Radar polarimetry. Calibration
4.3 Real and and Synthetic Aperture Radars (SAR)
4.4 SAR image reconstruction
4.5 Geometric correction and noise reduction (speckle) in SAR images
4.6 Other radar sensors: scatterometers and altimeters

Full-or-part-time: 12h
Theory classes: 12h

5. Optical and infrared sensors

Description:
5.1 The imact of atmosphere
5.2 Spectral signatures of materials
5.3 Sensor Technology
5.4 Cameras and hyperspectral classification
5.5 Geometric correction of optical images
5.6 Examples of space programs: NOAA, Meteosat, Landsat, etc.
5.7 Laser sensors (LIDAR) and applications

Full-or-part-time: 12h
Theory classes: 12h

6. Microwave radiometers

Description:
6.1 Radiation Laws.
6.2 Brightness, Apparent and Antenna Temperatures.
6.3 Total power, Dicke and noise-injection radiometers.
6.4 Calibration and Applications.

Full-or-part-time: 12h
Theory classes: 12h

7. Image characteristics and post-processing

Description:
7.1 Quality parameters and evaluation
7.2 Radiometric and geometric distortions

Full-or-part-time: 4h
Theory classes: 4h

8. The Remote Sensing sector

Description:
8.1 Main agencies and institutions
8.2 Final users categories. Business and Careers

Full-or-part-time: 4h
Theory classes: 4h

GRADING SYSTEM

- Final examination 45%
- Written group assignment 20%
- Practical laboratory work (1h per week on average): 20%
- 2 random controls during the semester: 15%

EXAMINATION RULES.

A4 form written both sides can be brought to the exam with formulas, duration 2 h, but no books or class notes.

BIBLIOGRAPHY

Basic:
- Fortescue, P.; Swinerd, G.; Stark, J. (eds.). Spacecraft systems engineering. 4th ed. Chichester ; New York: Wiley, 2011. ISBN 9780470750124.
- Elachi, C.; Van Zyl, J. Introduction to the physics and techniques of remote sensing. 2nd ed. New York [etc.]: John Wiley and Sons, 2006. ISBN 0471475699.
- Ulaby, F.T.; Moore, R.K.; Fung, A.K. Microwave remote sensing: active and passive. Norwood, MA.: Artech House, 1981-1986. ISBN 0890061939.
- Schott, J.R. Remote sensing: the image chain approach [on line]. 2nd ed. Oxford: Oxford University Press, 2007 [Consultation: 10/10/2018]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=415718. ISBN 9780199724390.
- Emery, W.; Camps, A.J. Introduction to satellite remote sensing: atmosphere, ocean, land and cryosphere applications [on line]. Amsterdam: Elsevier, 2017 [Consultation: 04/09/2020]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=5013967. ISBN 9780128092545.

Complementary:
- Szekielda, K.-H. Satellite monitoring of the earth. New York: Wiley, 1988. ISBN 0471613304.
- Curlander, J.C.; McDonough, R.N. Synthetic aperture radar: systems and signal processing. New York [etc.]: John Wiley and Sons, 1991. ISBN 047185770X.
- Measures, R.M. Laser remote sensing: fundamentals and applications. Malabar, Fla.: Krieger, 1992. ISBN 0894646192.

RESOURCES

Audiovisual material:
- Remote Sensing Cool Videos (for K-12). Remote Sensing Introductory Videos for K-12

Hyperlink:
- Remote Sensing Tutorial In Spanish, French, Portuguese, and English. Recurs
- Remote Sensing Video Tutorials in Spanish & English. Remote Sensing Video Tutorials in Spanish & English

Other resources:
https://www.grss-ieee.org/resources/tutorials/remote-sensing-tutorial-in-spanish-french-portuguese-and-english/ />
http://www.classic.grss-ieee.org/wp-content/uploads/2015/05/jurse2015_tutorials/media/ />http://www.classic.grss-ieee.org/wp-content/uploads/2015/05/more_tutorials_2016/media/ />
https://www.grss-ieee.org/cool-videos/