Universitat Autònoma de Barcelona

2019/2020

Science of Geographical Information: Remote Sensing and GIS

Code: 43380
ECTS Credits: 15

Degree	Type	Year	Semester
4314828 Remote Sensing and Geographical Information Systems	OB	0	1

Contact

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Use of Languages

Principal working language: spanish (spa)

Other comments on languages

Approximately 10 % of the classes are in Catalan and 90 % in Spanish. Most of the literature is in English

Teachers

Joan Masó Pau
Miquel Ninyerola Casals
Alaitz Zabala Torres

External teachers

Adriano Camps
Antoni Broquetas
Carolina Puig
Eduardo de Miguel
Javier Muñoz
Josep A. Gili
Sergi Gumà

Prerequisites

Prerequisites are not required

Objectives and Contextualisation

This module aims at creating an introductory framework, broad and specific at the same time, of the science and technology of geographic information, focusing on key concepts both of aspects of classical cartography and global positioning, as well as on aspects related to remote sensingand the use of Geographic Information Systems.

At the end of the course, the student will be able to:

1. Understand the main functions of different software used in GIS and Remote Sensing.
2. Properly use different data and metadata formats.
3. Master the fundamental concepts of the various disciplines related to the position and representation of elements in space, such as photogrammetry, remote sensing or global navigation satellite systems.
4. Properly represent a geographic reality in a digital or analog cartographic document.
5. Making informed decisions about the use of remote sensing in land studies
6. To discriminate between different types of platforms and sensors according to their characteristics and to know how to choose the appropriate ones according to the objectives of the study to be carried out.

Competences

- Apply knowledge of remote sensing platforms and sensors to analysing and processing data in different types of studies.
- Choose the most suitable tools and applications to fulfil the objectives of a project in the field of spatial planning or analysis.
- Communicate and justify conclusions clearly and unambiguously to both specialist and non-specialist audiences.
- Continue the learning process, to a large extent autonomously.
- Design and apply a methodology, based on the knowledge acquired, for studying a particular use case.
- Take a holistic approach to problems, offering innovative solutions and taking appropriate decisions based on knowledge and judgement.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
- Use different specialised GIS and remote sensing software, and other related software.

Learning Outcomes

1. Communicate and justify conclusions clearly and unambiguously to both specialist and non-specialist audiences.
2. Continue the learning process, to a large extent autonomously.
3. Design and apply a methodology, based on the knowledge acquired, for studying a particular use case.
4. Differentiate between different types of platforms and sensors based on their characteristics and choose ones that are suited to the aims of the study to be performed.
5. Handle different data and metadata formats appropriately.
6. Master the fundamental concepts of the various disciplines related to the position and representation of elements in space, such as photogrammetry, remote sensing and global positioning systems.
7. Represent a real geographic area appropriately in a digital or analogue cartographic document.
8. Take a holistic approach to problems, offering innovative solutions and taking appropriate decisions based on knowledge and judgement.
9. Take informed decisions on the use of remote sensing in land-use studies.
10. Understand the main functions of different programmes used in GIS and remote sensing.
11. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.

Content

PRINCIPLES OF CARTOGRAPHY

1/ History of cartographic representation.
2/ Geodesy.
3/ Cartographic projections.
4/ The UTM reference system.
5/ Cartographic products: the maps.
6/ Topographic and thematic mapping.

GEODESY AND POSITIONING SYSTEMS

1/ Geodesy and Cartography
2/ Nomenclature: what is GNSS; other systems besides the GPS
3/ Introduction to the systems of global positioning and historical development
4/ Fundamentals of the system
4.1/ Sectors or segments
4.2/ Basic measures. Code and phase
5/ Methods of operation
6/ Type of receivers
7/ Accuracy
8/ Applications

FUNDAMENTALS OF GIS

1/ Introduction
1.1/ Definition of GIS
1.2/ Geographical information and GIS
1.3/Connections and differences between GIS and other systems
1.4/ GIS Applications
1.5/ Introduction to the ArcGIS and MiraMon software
2/ Models of data
2.1/ Raster model
2.2/ Vector model
2.3/ Topological structure
2.4/ Attributes, tables and validation
2.5/ Model of observations and measures.
2.6/ Formats: import and export. CAD model
3/ Production of data
3.1/ Data entry
3.2/ Validation and errors
4/ Processing of data
4.1/ Classification and reclassification
4.2/ Raster transformations - vector: rasterization and vectorization
4.3/ Cartographic generalization
5/ Introduction to the GIS analysis
5.1/ Arithmetic and logic operations between layers
5.2/ Analytical combinations of layers

COMPOSITION AND PRINTING OF CARTOGRAPHIC DOCUMENTS

Eminently practical contents based on the use of different software to obtain paper cartography. It will deal with formal issues of the composition as well as advice aimed at obtaining intelligent printing and faithful to the reality that one wants to represent.

SYNOPTICAL VIEW OF REMOTE SENSING

1/ Introduction. Overview of remote sensing
1.1/ Definition
1.2/ What tools do we have?
1.3/ What is intended
1.4/ Type of platforms: aerial and satellite, heliosynchronous and geostationary
1.5/ Types of sensors according to the way of obtaining the data, the type of information recorded, the spectral region to which they are sensitive, etc.
1.6/ Typical image processing chain (corrections, improvements, extraction of image information, etc.).
1.7/ Basics: pixel; spatial, spectral, radiometric, temporal and angular resolutions; grayscale and palette images, real color renderings in false color
1.8/ Visual analysis versus digital processing

1.9/ Satellite remote sensing versus airborne remote sensing and UAV (drones)
1.10/ Important characteristics and limitations of remote sensing
1.11/ Brief history of remote sensing. Remote sensing in Spain and internationally: associations, congresses, publications
1.12/ Comment of the recommended bibliography and main journals
2/ Electromagnetic spectrum and spectral signatures.
2.1/ Basic concepts
2.2/ Solar radiation; thermal radiation emitted by the Earth; microwave
2.3/ Spectral signatures
3/ Nature of images. Corrections, improvements, transformations
3.1/ Nature of images
3.2/ Most common formats in remote sensing
3.3/ Geometric corrections
3.4/ Radiometric corrections
3.5/ Image enhancement
3.6/ Transformations: Vegetation indexes, prinipal components, etc.
4/ Reading and interpretation of satellite images
5/ Obtaining information from the images
5.1/ Supervised classification
5.2/ Unsupervised classification
5.3/ Hybrid classification
5.4/ Estimation of continuous variables
5.5/ Verification of results
6/ Remote sensing, mapping and geographic information systems

PHOTOGRAMETRY

1/ Fundamentals of photogrammetry
1.1/ Introduction
1.2/ Air photogrammetry
1.3/ Measures on photographs and corrections
1.4/ Vertical photography
1.5/ Stereoscopic vision
1.6/ Stereoscopical parallax
1.7/ Rectification
1.8/ Restitution
2/ Topographical photogrammetry
2.1/ Phases of a topographic surveing
2.2/ Classification of photogrammetric surveys
2.3/ Photographic scale and mapping scale
2.4/ Planning work. Flight projects. Plan and flight execution
2.5/ Post-photogrammetric flight operations (restoration, rectification, generation of digital terrain models, etc)
2.6/ Orthophotography Vs Rectification

Methodology

In this module there are 3 groups of learning activities:

Targeted activities consist of classes of theory and practices that will be carried out in a specialized computer room. At the beginning of each of the subjects that make up the module, the teachers will explain the structure of the theoretical-practical contents, as well as the evaluation method.

Supervised activities consist of classroom practices that will allow you to prepare the work and exercises of each subject, as well as tutorial sessions with the teachers in case the students request it.

Autonomous activities are a set of activities related to the elaboration of works, exercises and exams, such as the study of different material in the form of journal articles, reports, data, etc., defined according to the needs of autonomous work of each student

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Exercices resolution classes	34	1.36	10, 4, 6, 5, 9, 7
Master classes / exhibitions	49	1.96	10, 4, 6, 5, 9, 7
Type: Supervised			
Classroom practices	87	3.48	10, 4, 6, 5, 9, 7
Tutorials	10	0.4	10, 4, 6, 5, 9, 7
Type: Autonomous			
Personal study	30	1.2	4, 6, 5, 9, 7
Preparation of works	157	6.28	10, 4, 6, 5, 9, 7
Reading of articles / reports of interest	3	0.12	10, 6

Assessment

The evaluation of this subject consists of the following system:

a) The realization of 3 exams, that will be between 40 % and 50 % of the final mark and that will include the theoretical and practical contents carried out. An exam not reaching the minimum mark of 5 out of 10 must be repeated the day assigned by the teacher of the subject.

b) The accomplishment of different practical works proposed throughout the teaching of the module and delivered within the fixed term, that will be between 40 % and 50 % of the final mark. A correct formal presentation and careful preparation will be taking to account.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Theoretical exam	40 % - 50 %	5	0.2	10, 8, 4, 3, 6, 5, 9, 1, 2, 7, 11
Writing reports	40 % - 50 %	0	0	10, 8, 4, 3, 6, 5, 9, 1, 2, 7, 11

Bibliography

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