UAB
Universitat Autònoma de Barcelona

Science of Geographical Information: Remote Sensing and GIS

Code: 43380
ECTS Credits: 15

2025/2026

Degree	Type	Year
Remote Sensing and Geographical Information Systems	OB	0

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

Prerequisites are not required

Objectives and Contextualisation

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

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

- Understand the main functions of different programs used in GIS and Remote Sensing.
- Properly use different data and metadata formats.
- Dominate the fundamental concepts of the various disciplines related to the position and representation of elements in space, such as photogrammetry, remote sensing or global positioning systems.
- Properly represent a geographical reality in a digital or analogical cartographic document.
- Making informed decisions about the use of remote sensing in territorial studies.
- 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

PLATFORMS AND SENSORS

1. Platforms: Aircraft.
2. Platforms: Unmanned Aircraft.
2.1. Key points of regulation.
2.2. Classification.

3. Platforms: satellites.
3.1. Subsystems satellite.
3.2. Launching.
3.3. Spatial Orbits.
3.4. Orbital maneuvers.
3.5. Segment Earth.
4. Sensors.
4.1. Telescopes.
4.2. Lidar.
4.3. Microwave radiometers and radar.
4.3.1. Microwave Remote Sensing.
4.3.2. SAR: Synthetic Aperture Radar.
4.3.3. Geometry and spatial resolution SAR.
4.3.4. "Performance" SAR.
4.3.5. SAR acquisition modes.
4.3.6. Systems airborne and satellite-SAR.
4.3.7. Interferometric applications.
5. Characterization of an instrument/Remote Sensing missions.
5.1. Spatial characterization (geometric).
5.2. Spectral characterization.
5.3. Radiometric Characterization.
5.4. Temporal characterization.

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 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. Data processing.
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 IMPRESSION OF CARTOGRAPHIC DOCUMENTS

Practical contents based on the use of different software to obtain cartography on paper. It will deal with formal issues of the composition as well as advice aimed at obtaining intelligent impressions 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; space, spectral, radiometric, temporal and angular resolutions; grayscale and palette images, true color and false color renderings.
1.8. Visual analysis *versus* digital processing.
1.9. Satellite remote sensing *versus* aeroported remote sensing and UAV.
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 the 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 the 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, main components, etc.
4. The interpretation of satellite imagery.
5. Obtaining information from the images.
5.1. Supervised classification.
5.2. Unsupervised classification.
5.3. Mixedclassification.
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. Stereoscopic parallax.
1.7. Rectification.
1.8. Restitution.
2. Topographical photogrammetry.
2.1. Phases of a topographic uprising.
2.2. Classification of photogrammetric surveys.
2.3. Photographic scale.
2.4. Planning of work. Flight projects Plan and flight execution.
2.5. Post-photogrammetric flight operations (restoration, rectification, generation of digital terrain models, etc.).
2.6. Orthophotography *versus* Rectification.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Master classes / exhibitions	49	1.96	10, 8, 4, 3, 6, 5, 9, 1, 2, 7, 11
Resolution exercises	34	1.36	10, 8, 4, 3, 6, 5, 9, 1, 2, 7, 11
Type: Supervised			
Classroom practices	87	3.48	10, 8, 4, 3, 6, 5, 9, 1, 2, 7, 11
Tutorials	10	0.4	10, 8, 4, 3, 6, 5, 9, 1, 2, 7, 11
Type: Autonomous			
Personal study	30	1.2	10, 8, 4, 3, 6, 5, 9, 1, 2, 7, 11
Reading of articles / reports of interest	3	0.12	10, 8, 4, 3, 6, 5, 9, 1, 2, 7, 11
Writing reports	157	6.28	10, 8, 4, 3, 6, 5, 9, 1, 2, 7, 11

Principal working language: spanish (spa), although the bibliographic materials may be in other languages, mostly English.

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

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Theoretical and practical exam	40% - 60%	5	0.2	10, 8, 4, 3, 6, 5, 9, 1, 2, 7, 11
Writing reports	40 % - 60 %	0	0	10, 8, 4, 3, 6, 5, 9, 1, 2, 7, 11

This module does not incorporate single assessment.

The evaluation of this subject consists of the following system:

- The realization of several exams, that will be between 40 % and 60 % of the final note and that will include the theoretical and practical subject carried out. The exam that has not reached the minimum mark of 5 out of 10 must be repeated the day assigned by the teacher of the subject.
- 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 60 % of the final note. A correct formal presentation and careful preparation will be assessed.

Aspects to take into account.

- Regular class attendance is highly recommended in order to follow the lessons properly. Follow on through streaming is only justified in cases of physical impossibility for face-to-face assistance, since an important part of the experiences and learning are fully achieved through contact with the teaching staff and classmates.
- If you have to deliver practical work, this delivery must be done within the deadlines for them to be evaluated.
- On carrying out each evaluation activity, Lecturers will inform of the procedures to be followed for reviewing all grades awarded, and the date on which such a review will take place.

Extraordinary exams.

- The exams or other evaluation procedures not reaching the minimum mark of 5 out of 10 must be repeated. This extraordinary exam is unique.
- Students will have the opportunity to take a extraordinary exam the day or days scheduled by the faculty.

Cheating: Copies and plagiarisms.

- By copies, we refer to the evidence that the work, project, exam, etc has been partially or totally created/answered without the intellectual contribution of the author. In this definition, we also include the proven attempt to copy in the exams and delivered works and projects and the violation of the laws that assure intellectual authorship. Plagiarisms refer to the works and texts from other authors that someone pretends to be his/her own creation. It is a crime against intellectual property. In order to avoid committing plagiarism, quote all the sources that you use when writing the report of a project. According

to UAB's law, copies and plagiarisms or any other attempt to alter the results of one's own evaluation or someone else's -allowing to copy, for example- implies a result in the corresponding part (theory, problems or practical tasks) of a 0 and, in this case, the student will fail the subject. This does not limit the right to take academic and legal actions against those who have participated. See UAB documentation about copies and plagiarisms
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Remote Sensing. MDPI
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International Journal of Applied Earth Observation and Geoinformation. Elsevier SciencePublishing Company.
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Photogrammetric Engineering & Remote Sensing. American Society for Photogrammetry and Remote Sensing.
International Journal of Remote Sensing. Taylor and Francis.
Canadian Journal of Remote Sensing. Canadian Aeronautics and Space Institute
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Journal of Applied Remote Sensing. SPIE.
Photointerprétation. Éditions Technip.

Software

MiraMon, ArcGIS, QGIS, MATLAB, ENVI, Mission Planner, Office Microsoft

Groups and Languages

Name	Group	Language	Semester	Turn
(TE) Theory	1	Spanish	first semester	afternoon