Geographical Information Systems and Image Processing

Code: 101031
ECTS Credits: 4

2025/2026

Degree	Type	Year
Geology	OB	2

Contact

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Teachers

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Teaching groups languages

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

Prerequisites

The students have to make use of their knowledge they are acquiring at their Geologic Cartography class.

The students have to use their basic IT knowledge.

The students will have to use their own external storage system (pen drive, external hard drive, ...) to manage all the information and data used throughout the course.

Objectives and Contextualisation

Within the concept of Information Technology, Geographic Information Systems (GIS) are a set of tools of great interest for its versatility and multidisciplinarity.

The application of GIS in cartography for natural resouces, prevention of natural hazards, tracking and simulation of dynamic processes (changes in land uses, water management ...) make the GIS a series of basic tools in numerous scientific disciplines and research.

GIS also represents a powerful spatial-temporal information management tool for all fields related to Geology and the Environment.

The overall purpose is that students integrate the theoretical and practical aspects of these technologies to be able to apply these skills for managing and solving of problems.

Competences

- Learn and apply the knowledge acquired, and use it to solve problems.
- Suitably transmit information, verbally, graphically and in writing, using modern information and communication technologies.
- Use geographical information systems applied to geology.
- Work independently.

Learning Outcomes

1. Learn and apply the knowledge acquired, and use it to solve problems.
2. Manage georeferenced information using suitable GIS computer programmes.
3. Master the different ways of acquiring and managing geographical information as a tool for territorial interpretation, especially maps and images of the Earth.
4. Suitably transmit information, verbally, graphically and in writing, using modern information and communication technologies.
5. Work independently.

Content

Block 1. Introduction to geographic information systems and basic concepts of cartography.

• What is a GIS. Type of information contained.

• Files formats and formats for different type of data sets within the software.

• Map projections. What are they and what are the implications on their assignation.

• Display of online maps. WMS services and downloading platforms.

• Elements of a map. Layouts.

Block 2. Vector data

• Basic concepts. Vector data. Topology: point, line, route, polygon.

• Georeferencing images.

• Digitization of vector data. Geodata Bases. Exporting to a shape file.

• Tables associated with vector entities. Introduction to BBDD.

• Queries in databases. Know and use different display options for each layer. Calculation of statistical values.

Block 3. Raster data

• Basic concepts. What is a raster and how is it structured according to the type of information represented in this format: MDE, Orthophotos, Satellite images.

• Elaboration of a raster using different sources of information (isolines, points, Lidar, vegetation, land use, etc.).

• MDE analysis: shading, topographic profiles, slopes, orientation, flow extraction.

• Generation of a raster. Interpolation techniques.

Block 4. Analysis of the information

• Calculation of zonal and focal statistical values.

• Processing of a satellite image: spectrometry data organization, delivery-source-agency processed level.

• Band algebra. Physical meaning.

• Vector data analysis. Overlap, proximity and zonal operations.

• Spatial measurements on objects.

• Analysis with raster-vector data. Conversion from raster to vectorial format. Example.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Computer lab practices	40	1.6	1, 2
Master classes with information technology support	40	1.6	1, 3, 2
Type: Autonomous			
Practicing using specific software and recommended bibliography	16	0.64	1, 4

Master classes with computer support

Through the attending of classes the students will acquired their own knowledge on the subject. At all times, work will be done in the computer to consolidate the use of specific software and analysis techniques.

Laboratory practices

Practical exercises are distributed to learn two GIS programs (ArcGIS Pro and QGIS), use geological data, and solve practical problems.

The group of students enrolled will be divide in two groups on the basis of the university program and name.

In case of the need, the software can be used remotely and each student can work individually and remotely in a computer tha physically is at the lab.

Autonomous work:

Study/Practice of topics should carry out through exercises using the specific SIG programs.

Estudent evaluation of the class:

The teacher will assign approximately 15 minutes of the class to allow that his students to answer the surveys of evaluation on contents and professor's performance.

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 exams	100%	4	0.16	1, 3, 2, 4, 5

Continued avaluation

• Mandatory attendance of classroom lectures. There will be attendance control.

• Two theoretical-practical partial exams: 1st Partial 20% + 2nd Partial 20%.

• Two analysis projects. Delivery by 2-persons team: one over the first part of the cours (15%) and the second on the second part of the course (15%)

• Class Exercises (30%).

• Extra Activity: Generation of resumes for in-class practical exercises. Individual delivery.

Re-evaluation

• Re-evaluation only applies for exams, not for the class exercises neither for the analysis work .

• Students who did not pass the course will be able to choose the part they want to be re-graded for (first part, second part or both parts of content) to improve their grades on exams.

• Students who passed the course but they want to improve their grades, may present again the corresponding exams of the part of the course that they want to improve their gradess. The best grade (the original or the obtained during recovery exam) will be kept for the final assessment of their grades.

Unique Evaluation

• If a student choose unique evaluation, the student must notify the teacher during the first two weeks after the begining of classes. Academic Management of the Faculty of Sciences will make available to the student a form to formalize the request to take part in a unique grading assessment.

• The unique grading assessment will take place on the date and hour of the second partial exam, it will consist of three parts:

1. A theoretical exam (20%) of the content of the entire course.

2. A practical exam (50%) of the entire course content.

3. A digitization/incorporation of georeferenced information/analysis project to be determined at the beginning of the semester with the teacher (30%).

•The student who has opted for this single grading assessment may present himself/herself for re-evaluation of exams only if he/she has previously submitted the three issues mentioned above.

Bibliography

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Chuvieco, E. (2002), ***Teledetección ambiental***. Ariel. Barcelona. 586 p

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Maguire, D.J., Goodchild, M.F., Rhind, D.W. (eds.) (1991) Geographical Information Systems. Principles and Applications. 2 Vol. Longman Scienti Technical. Essex. 1096 p.

Moldes Teo, F.J. (1995). ***Tecnología de los sistemas de información geográfica***. Ra-Ma, Madrid. 190 p.

Nogueras-Iso, J., Zarazaga-Soria, F.J., Muro-Medrano, P.R. (2005) ***Geographic Information Metadata for SpatialData Infrastructures: Resources, Interoperability and Information Retrieval***. Springer. 264 p.

Santos Preciado Santos Preciado, J.M. (2004) ***Sistemas de información geográfica. Unidad didáctica***. (60105UD01A01) UNED. Madrid. 460 p. ISBN: 84-362-2006-4.

Software

ArcGIS Pro 3.5.1 y QGIS 3.40 LTR

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PLAB) Practical laboratories	1	Catalan	first semester	morning-mixed
(PLAB) Practical laboratories	2	Catalan	first semester	morning-mixed