Universitat de Lleida

DEGREE CURRICULUM

GEOGRAPHIC INFORMATION SYSTEMS AND REMOTE SENSING

Coordination: MARTINEZ CASASNOVAS, JOSE ANTONIO

Academic year 2023-24

GEOGRAPHIC INFORMATION SYSTEMS AND REMOTE ... 2023-24

Subject's general information

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<tr><td>Subject name</td><td>GEOGRAPHIC INFORMATION SYSTEMS AND REMOTE SENSING</td></tr>
<tr><td>Code</td><td>11376</td></tr>
<tr><td>Semester</td><td>1st Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
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<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Erasmus Mundus Master's Programme in Mediterranean Forestry and Natural Resources Management (MEDFOR)</td><td>1</td><td>OPTIONAL</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>3</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
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<tr><th>Activity type</th><th>PRALAB</th><th>TEORIA</th></tr>
<tr><td>Number of credits</td><td>2</td><td>1</td></tr>
<tr><td>Number of groups</td><td>1</td><td>1</td></tr>
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<tr><td>Coordination</td><td>MARTINEZ CASASNOVAS, JOSE ANTONIO</td></tr>
<tr><td>Department</td><td>ENVIRONMENT AND SOIL SCIENCES AND CHEMISTRY</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>Lecture (concepts and examples): 1.6 ECTS including personal work
Practical exercises: 1.4 ECTS including personal work</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>English</td></tr>
<tr><td>Distribution of credits</td><td>Lecture (concepts and examples): 1.6 ECTS including personal work
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GEOGRAPHIC INFORMATION SYSTEMS AND REMOTE ... 2023-24

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
MARTINEZ CASASNOVAS, JOSE ANTONIO	joseantonio.martinez@udl.cat	3	

Subject's extra information

The course teaches basic techniques and methods for the representation and spatial analysis of land and territory (in the broadest sense), with the ultimate goal of problem solving and land planning.

Remote sensing is the science that involves the detection, identification, classification and analysis of the ground cover, land use and phenomena occurring at the Earth surrface through remote sensors installed in airborne or space platforms. Meanwhile, Geographic Information Systems (GIS) is the science and technology oriented to manage, query, update, analyze and model spatial information generated through surveying methods and / or remote sensing, in an integrated manner.

GIS and remote sensing are based on the management of specific hardware and software. The use of these technologies is of great interest and application in other matters of the MsC degree, particularly those related to the mapping of land use and vegetation cover, management of forest systems, territorial and environmental planning, forest fires, reforestation, analysis of changes in ground cover, landscape analysis, environmental impact assessment or watershed hydrologic analysis, among others.

In summary, the basic descriptors of the course are: Remote Sensing. Physical principles of remote sensing. Techniques of remote sensing data acquisition. Digital image processing. Geographic Information Systems. GIS data structures (Vector and Raster). Spatial analysis of land information.

Learning objectives

Knowledge objectives. A student who passes the subject must understand and demonstrate knowledge in:

- The role of GIS and Remote Sensing in the acquisition, processing and analysis of information from the territory for inventory, planning and management.
- The nature and the physical basis of remote sensing techniques and the advantages and limitations of remote sensing for use in studies of the territory.
- The image analysis techniques (visual interpretation and digital processing), for subsequent application in the resolution of individual cases of inventories of natural resources and environment.
- Modeling structures of information relating to the territory, both thematic and topographic (geometry + attributes) in GIS.
- The main techniques and analysis functions of GIS, for subsequent application in the resolution of individual cases of natural resource inventories and / or environmental studies.
- The main sources of information and other resources related to these geographic information technologies and their application to forestry.

Competences

Capacity objectives (competencies. A student who passes the subject must be able of:

- Applying the knowledge about data structures in the representation of land information when creating geodatabases.
- Define and apply the techniques of remote sensing image analysis (visual interpretation and digital processing) and technical analysis functions of geographic information using GIS software, to solve special cases of planning, analysis and forest management.
- Solve problems, aimed at planning and management of forest resources through the application of integrated remote sensing techniques and GIS, and know where to acquire additional knowledge on the subject.
- Prepare and present thematic mapping processes resulting from analysis of geographic information as a communication tool in planning and land management.

Subject contents

Lessons

Lesson 1. INTRODUCTION TO GIS. Concept of geo-information and components.

Lesson 2. GEOINFORMATION CHARACTERISTICS. Geographic objects and phenomena. Measurement scales of the descriptive information.

Lesson 3. VECTOR DATA MODEL. Types of GIS vector structures: topological and "shapefile". GIS vector analysis: selection of attributes and location, geo-table join, union and intersection.

Lesson 4. RASTER DATA MODEL (regular grid). Representation of continuous variables and discrete variables. Rasterization and vectorization. Spatial resolution. Operations analysis: local, focal, zonal and global.

Lesson 5. ANALYSIS OF DIGITAL ELEVATION MODELS. Importance of MDE in the terrain analysis. Calculation of slopes, directions, curvatures, analytical shading, drainage, drainage basins and visibility analysis.

Lesson 6. INTRODUCTION TO REMOTE SENSING. Electromagnetic energy: nature and sources. Electromagnetic spectrum. Color theory. Interactions of electromagnetic energy with matter. Effect of atmospheric dispersion.

Lesson 7. SPECTRAL CHARACTERISTICS OF THE EARTH'S SURFACE. Concept of spectral signature. Spectral signature of vegetation. Concept of vigour index. Soil spectral signature. Spectral signature of water.

Lesson 8. DIGITAL IMAGE PROCESSING CONCEPTS multispectral images. Contrast enhancement. Radiometric Corrections: effect of atmospheric dispersion. Geometric corrections. Calculation of vegetation indices. Types of vegetation indices. Indices based on the ratio of the IRP and R.

Lesson 9. CLASSIFICATION OF MULTISPECTRAL IMAGES. Spectral space concept. Types of image classification. Supervised classification: phases and accuracy assessment. Unsupervised classification.

Practical training

Exercise 1. GIS program settings and WMS Layers. Introduction to the software. Program and extensions. Access to free version and installation. Geoinformation concepts and visualization of layers. Visualization of layers on remote servers.

Exercise 2. Displaying and Querying of Geoinformation. Visualization of Vector and Raster layers. Properties. Symbology: single symbol, categories, grouped discrete variables, continuous variables. Attribute tables. Selection by attributes and by location.

Exercise 3. Creation and edition of vector layers. Digitizing, table management and map layout creation.

Exercise 4. Geoprocessing operations with vector data. Dissolution of boundaries. Buffers and Clips. Intersection of layers.

Exercise 5. Fundamental characteristics of the Raster data model. Layer properties, pixel values, change of symbology. Rasterization of vector layer. Reclassification, neighbourhood statistics, mathematical and conditional operations with raster layers. Zonal statistics.

Exercise 6. Digital Elevation Models: Creation and extraction of topographic and hydrological attributes. Surface analysis: representation of contours, slope, aspect and exposition, hillshading. Extraction of hydrological information.

Exercise 7. Remote sensing images: visualization and radiometric corrections.

Exercise 8. Image processing: calculation and analysis of vegetation indexes.

Exercise 9. Image processing: classification of multispectral images.

Methodology

Powerpoint lessons of theoretical concepts.

Assisted practical exercises with computer GIS & Rensing Programs.

Development plan

Deatailed information with calendar, timetable, room, lesson and exercises and due date of tests and exercises will be available in the virtual campus of the subject.

Evaluation

The subject will be evaluated according to three blocks of contents:

- BLOCK 1: Exam of concepts (50 %) ***
- BLOCK 2: Continous assessment of exercises (20 %)
- BLOCK 3: Practical exam (with computer and GISRS program) (30 %) ***

The blocks marked with *** means that are compulsory to pass the subject. A mark of 5 out of 10 in each of those compulsory parts is required to pass the subject.

The continuous assessment of the exercises will consist in the realisation of the exercises and the asnwer to tests about concepts related to the correspondent exercise. Only the exercises that are attended in person will be considered in this evaluation.

Bibliography

- Remote Sensing and GIS Free ebook: http://rsgistutorial.blogspot.com/
- Fox, L., 2015. Essential Earth Imaging for GIS. Esri Press. ETSEA-UdL Library 621.398 Fox
- Textbook of Remote Sensing and Geographical Information Systems. MgH | 2008 | ISBN: 8178001357, 1441661522 | 476 pages. http://rsgistutorial.blogspot.com/2013/10/textbook-of-remote-sensing-and.html
- Remote Sensing Tutorials . Canada Centre for Remote Sensing. https://www.nrcan.gc.ca/maps-tools-publications/satellite-imagery-air-photos/tutorial-fundamentals-remote-sensing/9309
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