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Course Unit	Geographic Information Systems			Field of study	Earth Sciences	
Bachelor in	Environmental Engineering			School	School of Agriculture	
Academic Year	2022/2023	Year of study	2	Level	1-2	ECTS credits 6.0
Type	Semestral	Semester	2	Code	9099-309-2205-00-22	

| Workload (hours) | 162 | Contact hours | T - | TP 60 | PL - | TC - | S - | E - | OT 20 | O - |

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

| Name(s) of lecturer(s) | José Manuel Correia Santos Ferreira Castro, João Paulo Miranda Castro |

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Recognize the possibilities and limitations of GIS in ecology and land planning
2. Handle computer applications taught in this class and learn other systems available in the market and export and import formats.
3. Choose and process remotely sensed imagery.
4. Understand the relational processes involving graphic and alphanumeric tables and be able to search geographically by attribute and location.
5. Use GPS technology in surveys and navigation.
6. Realize the importance of availability of updated information through the internet.

Prerequisites

Before the course unit the learner is expected to be able to:
1. Understand phenomena of Ecology and Remote Sensing
2. Define processes of Cadastral, Surveying and Mapping and Thematic Cartography
3. Have notions of Statistics and Informatics

Course contents

Introduction to GIS. Background, definitions, and components. Land use analysis. Analysis of roadways, population density, and landfill location. Measuring and using distances to locate facilities. Determination of erosion and flood risk maps. Development of precipitation maps. National Forest Inventory (NFI) analysis. Acquisition of remote sensing data. Determination of remote sensing indices. Land classification based on remote sensing information.

Course contents (extended version)

1. 1. Introduction to GIS: history, definitions, and components.
    - The QGIS system: the menu, toolbars, geographical area, scale and coordinates, and panels;
    - Downloading of web feature service vector layers (WFS).
    - Selecting and saving vector files.
    - Import tables with vector-related data.
    - Joining records by table fields.
    - Calculating and displaying population density.
    - Inserting graphics on vector features
    - Displaying labels of vector elements.
    - Preparing and printing geographic information.
2. Land use land cover
    - Obtaining vector layer with land use and occupation.
    - Set up the "Group Stats" module and calculate the area covered by each land cover class.
    - Composing land cover maps with labels and with diagrams regarding the area of each land cover class.
3. Roads, population density, and waste landfill location.
    - Installing Open Street Map modules to obtain information about the road network.
    - Creating vector layers of point, linear and polygonal type.
4. Measuring and using distances to locate facilities.
    - Encoding and converting vectors to raster.
    - Assessing distances to roads and land uses.
5. Determining erosion and flood risk maps.
    - Getting a digital terrain and elevation model (DEM).
    - DEM hydrological correction.
    - Using basic terrain analysis to obtain LS potential erosion factor and TWI flood risk index maps.
6. Rainfall maps development.
    - Selecting data points for annual precipitation.
    - Interpolating precipitation from data points to raster maps using TIN and IDW.
7. Analyzing the National Forest Inventory (IFN).
    - Creating the WFS link for IFN.
    - Using the Group Stats module to learn about primary/secondary forest cover
8. Acquiring and representing remote sensing data.
    - Acquiring and preparing Sentinel-2 image(s) with the QGIS SCP module
    - Spectral and atmospheric correction of imported images.
    - Creating RGB compositions representing natural colors, infrared, agriculture, and geology.
9. Determining and representing remote sensing indices.
    - Determining the NDVI, EVI, SBL, and NDBI.
    - Evaluating the median vegetation, soil, and building indices for administrative units.
10. Land classification based on remote sensing information.
    - Performing automatic classification by the ISODATA method.
    - Performing a supervised classification for four land cover types using spectral signatures.

Recommended reading

1. ARONOFF, S. 1989. Geographic information systems: A management perspective. WDL Publications, Ottawa, Canada.
2. BOSQUE SENDRA, J. 1997. Sistemas de información geográfica Madrid, Rialp, 2º edição corrigida, 451 p.
3. EASTMAN, J. R. 1992. IDRISI. Users Guide. Clark University, Worcester, 178 p.
4. LILLESAND, T. M. , KIEFER, R. W. 2000. Remote sensing and image interpretation, Fourth edition, John Wiley and sons. New York.
5. MAGUIRE, D. J. ; GOODCHILD, M. F. ; RHIND, D. W. 1991. Geographical Information Systems. Iongman Scientific ¿ Technical, New York.

Teaching and learning methods

Four-hour lectures with labs integrated in a computer laboratory. Theoretical introduction during about 20 minutes followed by practical applicatons using tutorial models and supervision from the instructor. Some of the classes outdoors.

Assessment methods

1. Regular - (Regular, Student Worker) (Final)
   - Practical Work - 100% (Evaluation of technical reports, practice tests, and portfolio (6 ECTS))
2. Non-regular - (Student Worker) (Final, Supplementary, Special)
   - Final Written Exam - 100% (Evaluation of technical reports, practice tests, and portfolio (6 ECTS))
3. Special - Finalists and Workers - (Student Worker) (Special)
   - Final Written Exam - 100% (Evaluation of technical reports, practice tests, and portfolio (6 ECTS))
4. Supplementary - (Regular, Student Worker) (Supplementary)
   - Final Written Exam - 100% (Evaluation of technical reports, practice tests, and portfolio (6 ECTS))

Language of instruction

1. Portuguese
2. Portuguese, with additional English support for foreign students.

Electronic validation

João Paulo Miranda Castro, José Manuel Correia Santos Ferreira Castro	João Carlos Martins de Azevedo	Artur Jorge de Jesus Gonçalves	Maria Sameiro Ferreira Patrício
19-12-2022	11-01-2023	24-02-2023	24-02-2023