UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Geographic Information Systems (gis)

2627-3-E3401Q056

Aims

The course aims to provide students in Geological Sciences and Technologies with:
basic theoretical and practical knowledge of Geographic Information Systems (GIS), with a specific focus on applications in the geosciences;
the ability to manage, analyze, and process georeferenced data for the representation, synthesis, and interpretation of geological phenomena;
competence in the use of the open-source software QGIS, which is widely adopted in both professional and academic settings;
the skills to produce thematic and geographic digital maps, useful for geological surveying, geomorphological process modeling, and territorial management.
the knowledge of the main modern technologies for the acquisition and integration of geospatial data (such as GNSS, remote sensing, UAV/drone photogrammetry, and Digital Elevation Models - DEMs) and their application within a GIS environment for geoscience applications.
The course is primarily held in a computer lab, where students receive guided practical training through individual exercises using GIS software, applied to real-world geological case studies.

By the end of the course, students will be able to:
use digital geospatial data for geological analysis and mapping;
manage and work with raster and vector data in a GIS project;
create thematic maps for geological and environmental studies;
integrate multiple data sources for geological surveying and mapping;
apply GIS skills in various fields of geosciences, including resource management, geological hazard assessment, and environmental analysis.

Students will also develop the ability to:
critically select and apply the most appropriate GIS data and tools to different geological problems;
assess the quality, reliability, and limitations of geospatial data and the results of GIS analyses.

The course also contributes to the development of:

the ability to independently learn new techniques and digital tools for spatial analysis in Earth sciences;
the capacity to interpret and understand technical and scientific documentation related to GIS applications in geosciences;
the ability to effectively communicate GIS analysis results through digital cartographic products accompanied by appropriate explanatory notes.

Contents

Principles and applications of Geographic Information Systems (GIS) for the analysis and modelling of spatial data in geological studies.

Detailed program

Overall objectives

The course aims to provide students with the fundamental theoretical knowledge and methodological principles underlying Geographic Information Systems (GIS). The main fields of GIS application in the geosciences will also be presented. Particular attention will be devoted to the use of modern technologies for the acquisition, management, and processing of geospatial data (including GNSS, remote sensing, UAV/drone photogrammetry, Digital Elevation Models (DEMs), and geospatial databases), illustrating their applications in terrain characterization, geomorphological analysis, georesource management, and environmental monitoring.

Contents of lectures

Introduction to SIT: definition, main functionalities and illustration of the main fields of application in geology.

Principles of cartography: short history of cartography, reference systems, geographic projections, Italian Cartography.

Spatial data representation through computer systems.

Database definition, database models, spatial databases.

Introduction to the QGIS software: QGIS user interface and project, data formats. Management of vector and raster layers. Attribute tables and queries. Layer editing and digitalization techniques. Georeferentiation. Data rendering and layout elaboration.

Geoprocessing: main techniques of vector geoprocessing, spatial queries, raster geoprocessing.

Statistical surfaces and digital elevation models (DEM): statistical surfaces, DEM, DEM-based morphometric analysis.

Examples of the use of GIS in geological applications.

Laboratory contents

Laboratory sessions will be carried out using the open-source software QGIS to apply all the techniques presented in the theoretical part of the course. Practical activities will also include the processing and integration of geospatial data acquired through modern surveying and Earth observation technologies (e.g., GNSS, satellite and UAV/drone

imagery, Digital Elevation Models (DEMs), and geospatial databases), with applications to cartographic representation, spatial analysis, and geological characterization of the territory. The laboratory sessions constitute a fundamental part of the course and will be conducted entirely through computer-based exercises focused on solving geological problems.

Prerequisites

Teaching form

Lessons (4 credits)
16 two-hour lectures, in person, Delivered Didactics

Laboratories (2 credits)
8 three-hour lab activities, in person, Interactive Teaching using virtual computer laboratories

Textbook and teaching resource

Handouts and slides

Noti, Valerio. "GIS Open Source per geologia e ambiente-Analisi e gestione di dati territoriali e ambientali con QGIS." *Dario Flaccovio Editore, Palermo* (2014): 71-91.

Semester

first semester

Assessment method

The exam allows to evaluate the preparation reached in terms of theoretical and practical knowledge of the topics covered during the lessons and the laboratories. This knowledge is evaluated with a theoretical and practical examination based on a GIS exercise in computer lab.

The evaluation of the examination is established through the resolution of problems on geological topics with QGIS software and with open questions which allow to verify both the knowledge of the theoretical fundamentals given in the course and the student’s skills to apply the theoretical foundations to practical cases. The expositive ability and adequacy of the student's language is also assessed. The examination is retained positive for an evaluation of 18-30/30.

An additional oral examination may be taken at the student's request if a minimum grade of 18/30 is achieved in the written exam. The oral examination will focus on the discussion of the written test and the topics covered in the lectures.

Office hours

During working hours with email appointment to micol.rossini@unimib.it

Sustainable Development Goals

INDUSTRY, INNOVATION AND INFRASTRUCTURE