University of Zagreb Faculty of Agriculture
Svetošimunska cesta 25, 10000 Zagreb
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Spatial analysis and GIS (146052)

Course coordinator

Assoc. Prof. Hrvoje Kutnjak, PhD

Course description

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This topic will introduce students to the use of Geographic Information Systems and provide a solid grounding in the theoretical and conceptual aspects of GIS. It aims to give participants experience of working with GIS package and teach students skills which will be applicable in a wide range of application areas in agriculture and environment. Furthermore, students will gain knowledge about the basics of remote sensing, principally about usage of different images for natural resources assessment. During lectures and practical work students will got knowledge about GIS and similar technologies (global positioning system, digital elevation models). Within the GIS, explanations about: different kind of GIS models, different kind and forms of data (geographic data, attribute data and their maintenance), techniques for merging geographic and attribute data, queries and analysis of spatial data will be given. Students will also got knowledge about scanning, digitizing and vectorisation of maps as well as cartographic datums and projections and georeferencing of scanned maps. They will also learn about practical use of GIS as well as methods of maps and reports creation and printing.

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ECTS: **3.00**

English language: **L1**

E-learning: **L1**

Teaching hours: 30
Lectures: 19
Practicum: 9
Seminar: 2

Lecturer

- Assoc. Prof. Hrvoje Kutnjak, PhD
- Asst. Prof. Vladimir Kušan, PhD
- Assoc. Prof. Monika Zovko, PhD
- Prof. Guido d´Urso, PhD

Associate teacher for exercises

- Assoc. Prof. Hrvoje Kutnjak, PhD
- Asst. Prof. Vladimir Kušan, PhD

Associate teacher for seminars

- Assoc. Prof. Monika Zovko, PhD

Grading

Sufficient (2): 60%
Good (3): 70%
Very good (4): 80%
Excellent (5): 90%

Type of course

- Graduate studies / Environment, agriculture and resource management (Compulsory course, 3 semester, 2 year)

General competencies

After completion of the module and passing the exam, students will have knowledge about: types and characteristics of computer hardware and software required for GIS; ways of establishing a GIS; work with graphical and attribute databases; the use of global positioning system (GPS) to maintain the graphic database; fitting data and remote sensing products in GIS; Application of digital elevation model (DEM), and analysis of data and the creation of new information using GIS.

Types of instruction

- Lectures
- Practicum
  Practical work will be performed on open source GIS software – Quantum GIS. The main procedures for work with spatial data, establishment, management, analysis of vector and raster format data , interpretation of satellite images and digital orthophoto, preparation of maps and reports will be explained and trained.
- Seminars
  Seminars for particular topics (dependent on student previous education and interest) of connection remote sensing and GIS for spatial analysis will be prepared and presented by students in form of lectures.

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Learning outcomes

Learning outcome	Evaluation methods
gain practical experience using GIS to solve a real world problem;	written exam, oral exam
understand the basic geography of the earth and how it is mapped;	written exam, oral exam
understand the basic spatial questions that can be addressed with GIS;	written exam, oral exam
understand the key components and tools of any GIS program and how they work;	written exam, oral exam
collect and manipulate spatial data using GPS;	written exam, oral exam
establish new data base, to update existing data bases, to analyse spatial information;	written exam, oral exam
create digital elevation models (DEM);	written exam, oral exam
conduct spatial analysis and create new information through the GIS.	written exam, oral exam

Methods of grading

Evaluation elements	Maximum points or Share in evaluation	Grade rating scale	Grade	Direct teaching hours	Total number of average student workload	ECTS
oral exam	100	0-59 60-70 71-80 81-90 91-100	Insufficient (1) Sufficient (2) Good (3) Very good (4) Excellent (5)	30	90	3
Oral exam	100	-	-	30	90	3

Evaluation elements	Maximum points or Share in evaluation	Grade rating scale	Grade	Direct teaching hours	Total number of average student workload	ECTS
written exam	100	0-59 60-70 71-80 81-90 91-100	Insufficient (1) Sufficient (2) Good (3) Very good (4) Excellent (5)	30	90	3
Total	100	-	-	30	90	3

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Weekly class schedule

1. Introduction to GIS L - Introduction to Geographic Information System. Historical Review. Definitions of terms. Geographical information systems. The benefits of GIS.
2. GIS design and methods L - Methods and systems of GIS design. Types and characteristics of computer hardware and software necessary for GIS.
3. Building the GIS database L - File formats for various databases. The vector and raster GIS.
4. Working with GIS database E - Creating and using database. Geometric data (raster and vector). Attribute data (numerical, descriptive).
5. Linking geometric and attribute data E - Linking digitized data bases. Establishment of permanent and virtulanih relationship between geometric and descriptive data.
6. Raster data in GIS L/E - Raster database. Rasterization and pixel operations. Spatial analysis and generalization.
7. Case study I - Land use database entry and processing
8. GPS (collection and data entry in GIS) L - Using global positioning system (GPS) for the maintenance of graphical database.
9. Digital model of relief, (DMR) L - Analysis of relief, methods of making and real examples.
10. Integrating data and products of remote sensing in GIS L - Types of remote sensing from space. Digital interpretation of aerial and satellite imagery.
11. Monitoring agriculture & ecosystems L - Basic principles of remote sensing in different region of the electromagnetic spectrum. Active and passive sensors. Orbiting platforms. Reflectance and spectral signatures of soils, vegetation covers and water bodies. Vegetation indexes. Semi-empirical models for estimating geo-physical parameters from remote sensing. Concepts for the integration between remote sensing.
12. Monitoring agriculture & ecosystems L - Basic principles of remote sensing in different region of the electromagnetic spectrum. Active and passive sensors. Orbiting platforms. Reflectance and spectral signatures of soils, vegetation covers and water bodies. Vegetation indexes. Semi-empirical models for estimating geo-physical parameters from remote sensing. Concepts for the integration between remote sensing.
13. Agro-hydrological models and Earth Observation techniques for improving water management L - Basic elaboration techniques of satellite images (different source data will be made available) in an open-source GIS environment. Image statistics and Visualisation techniques. Preliminary processing. Maps of canopy parameters (fractional vegetation cover, LAI, crop coefficient). Maps of crop water requirements.
14. Practicum: Agro-hydrological models and Earth Observation techniques I - Applications and case-studies for the monitoring of agro-forestry resources and environmental monitoring
15. Seminar S - Geographical Information Systems and soil water balance models.

Obligatory literature

1. Oluić, M.: Photographing And Investigating Earth From Space: satellites, sensors, application . HAZU & Geosat, Zagreb, 516 pages, 2001
2. Kušan, V.: New techniques in surveying and cartography, Croatian Forests & Faculty of forestry, Zagreb, 1994.
3. Brukner, M. i dr.: GIZIS - basics, INA INFO, Zagreb, 1994.
4. Kereković, D.,: GIS in Croatia, INA - Industrija nafte d.d., Zagreb, 1997.
5. Castrignano A. 2011. Introduction to spatial data processing. CRA-SCA, Bari, Italy
6. Hengl, Reuter (Eds.) 2009. Geomorphometry. Concepts, Software, Applications. Developments in Soil Science, Vol. 3, Elsevier.
7. Landgrebe D., (1998), Multispectral Data Analysis: A Signal Theory Perspective, Purdue University West Lafayette IN, USA, 46 p.

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Recommended literature

1. Software required: Open-source QuantumGIS: download installation at: http://hub.qgis.org/projects/quantum-gis/wiki/Download