Spatial analysis and modeling

Geomatics

NAME OF THE SUBJECT: Spatial analysis and modeling
Seminary 1 XXX

- Obligatory (x): Basic (x) Complementary ( )
- Elective (): Intrinsic ( ) Extrinsic ( )

NUMBER OF ACADEMIC CREDITS: Four (4).

COURSE TYPE: THEORETICAL: ___ PRACTICAL: ___ THEORETICAL-PRACTICAL: _X_
Methodological alternatives:
Master Class (X), Seminar ( ), Seminar - Workshop (X), Workshop ( ), Practice (X), Tutored projects (X), Other: _____

Justification

SYNOPSIS OF THE SUBJECT:

The spatial analysis comprises the set of analytical techniques associated with the study of the location of geographic phenomena including their spatial dimension and attributes. The spatial analysis process includes all the transformations, methods, and procedures to generate information from spatial data and thus support decision-making processes, which are the foundation of Geographical Information Systems. In this sense, for masters in Geomatics is essential to know spatial analysis tools to generate decision and geoprocessing models, to solve geographic problems and to support decision-making focused on sustainable development and improvement of the communities' quality of life.

JUSTIFICATION:

Spatial analysis and modeling constitute one of the most important functionalities of Geographical Information Systems (GIS) since it allows finding solutions to different problems, establishing relationships, recognizing patterns, understanding phenomena, and processes that involve the management of spatial data.

Through GIS, it is possible to make a digital and simplified representation of the reality, to apply the analysis and modeling functions, which allow processing this data, to extract useful information, which requires a general methodology that includes conceptualization and representation of the problem, data exploration, model formulation and validation of the results.

Applying techniques of spatial analysis, from simple queries on the attributes of the data to the formulation and implementation of complex mathematical or statistical models, it is possible to achieve the understanding and explanation of geographic reality through modeling, simulation, and representation of geographic phenomena and processes.

This course enables the student to solve questions related to: 1) what methods of spatial analysis may be appropriate for a certain type of research or the solution of geographic problems ?; 2) how can these methods be used in a GIS project ?; 3) how can spatial analysis methods be combined with other functions provided by GIS and how are they adapted or extended ?; 4) How is it possible to link map generation and visualization capabilities with spatial data analysis to discover and explore new spatial relationships that were earlier difficult to perceive?

PREREQUISITE: Principles of Geographical Information Systems

Content

GENERAL OBJECTIVE
This subject seeks to conceptualize, explore, expose and apply from the theoretical and practical components the techniques and methodologies of spatial analysis and modeling for

the study of geographical phenomena and solutions of real-world problems that serve as support for decision making.

SPECIFIC OBJECTIVES

- Appropriate knowledge, concepts, and experiences in the use of spatial analysis methods and techniques
- Study models, methods and techniques of spatial analysis and their use in solving real-world problems
- Familiarize and generate knowledge about the importance of the use of geoprocessing techniques
- Enable the ability to find and solve specific spatial problems, from the conceptualization of the problem to its solution.
- Know and implement the main spatial analysis functions with the different vector and raster GIS data models through problem-solving and practical geographical examples.
- Know and build the spatial analysis process flow models
- Know and apply the Python scripting language for automation and batch processing of spatial analysis processes.
- Know the different ways visualization of the results of the processes of analysis and spatial modeling such as simulations of geographical phenomena, three-dimensional views (2.5D and 3D) and reports of a spatial matters.

SYNTHETIC PROGRAM:

Unit 1: Principles and concepts for spatial analysis and modeling

1.1 Introduction to spatial analysis
1.2 GIS data storage models and structures
1.3 Concept of spatial analysis and classification of spatial analysis functions

Unit 2: Functions and tools for Spatial Analysis

2.1 Transformations and overlays
2.2 Proximity analysis
2.3 Statistical analysis

Unit 3: Applications of spatial analysis

3.1 Multi-criteria analysis
3.2 Network analysis
3.2 Analysis of the terrain
3.2 Temporal space analysis
3.3 Business analytics and intelligence
3.4 Geomarketing

Unit 4: Spatial Modeling - Geoprocessing
4.1 Introduction to spatial modeling
4.2 Spatial Modeling using ArcGIS Model Builder
4.3 Python Scripting Language

Unit 5: Visualization, representation and spatial analysis in 2.5D / 3D
5.1 Visualization and representation in 2.5D and 3D
5.2 Map making techniques

Strategies

EDUCATIONAL METHODOLOGY:

Computer Lab practices and workshops:
Consist of workshops and practices (using GIS software) focused on multiple case studies and solution of spatial problems. The aim is to put theoretical concepts into practice, using guides designed for this purpose. Students must show evidence of the analysis carried out, and they must answer the questions formulated and present a report of each practice.

Articles reading:
The topics will be worked from guided readings in which the concepts, methods, and techniques of spatial analysis are explained. Students prepare a presentation of the topics reviewed in each unit and present these topics in a group discussion focused on a concept review activity. It is expected that through the reading the student will investigate each topic, understand how to apply the analysis techniques, and the most, understand how to interpret the results obtained by applying these techniques. The student will be able to demonstrate the ability of abstraction and understanding of concepts, ability to support and defend their ideas and ability to show them in the class room**.**

Final project:
The most important component of the course is to conceptualize, propose, design, and implement a project that involves the extensive use of spatial analysis to solve a problem. Students are encouraged to propose a project directly related to their thesis topic. This approach will allow them to investigate different and innovative methods and solution models. Alternatively, the student can propose a topic from the professional field or topics becoming from the research groups.

Virtual space
The virtual space of the Faculty of Engineering will be used for the management of bibliographic material, upload technical papers, and discussions of the different topics through the network

	Hours			Teacher hours / week	Student hours / week	Total Hours Student / semester	Academic credits
Type of course	DW	CW	AW	(DW + CW)	(DW + CW +AW)	X 16 weeks	
	3	1	8	4	12	192	4

Direct presence Work (DW): classroom work in plenary session with all students.
Mediated-Cooperative Work (CW): Teacher tutoring work to small groups or individually to students.
Autonomous Work (AW): Student work without the presence of the teacher, which can be done in different instances: in work groups or individually, at home or in a library, laboratory, etc.)

Resources

PHYSICAL RESOURCES REQUIRED:

- Video Beam
- Internet
- Computer Laboratory

BIBLIOGRAPHY:

Funzalida, M.; Buai, G.; Moreno, A.; García de León. Geografía, tecnología y análisis espacial. Primera edición. ISBN: 978-956-9539-01-5. 2015

Goodchild, MGoodchild, M; Longley, P; Maguire, D; Rhind, D. Geographic Information and Sciences. Second Edition. Wiley & sons ltd. 2005

Olaya, Victor; Luaces, Miguel; Orellana, Daniel et al. Sistemas de Información Geográfica. OSGEO: Capítulo local de la Comunidad Hispano-hablante, 2007. Capítulos: 15, 16, 19, 21, 22, 23, 24. URL: http://wiki.osgeo.org/wiki/Libro_SIG

Sarria, Alonso. Sistemas de Información Geográfica. España: Licenciatura de Geografía, Universidad de Murcia, 2006. Capítulos: 5 al 8. URL: http://www.um.es/geograf/sigmur/

Smith; Goodchild y Longley. Geospatial Analysis - a comprehensive guide. 2nd edition, 2008. URL: http://www.spatialanalysisonline.com/output/

Goodchild, Michael. Spatial Analysis and GIS. Esri User Conference, 2001. URL: http://www.csiss.org/learning_resources/content/good_sa/#geographic%20information%20system%20function

BIBLIOGRAPHIC RESOURCES:

- IEEE Database
- SPRINGER Database
- ELSEVIER Database

Course Schedule

Week /Unid	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.																
2.																
3.																
4.																
5.																

Evaluation

ASPECTS TO EVALUATE

	TIPO DE EVALUACIÓN	FECHA	PORCENTAJE
First **GRADE**	Computer Lab Practices (Case Study Solution)		40%
Second **GRADE**	Assigned readings. Presentation and discussion in the class room of the readings		10%
Third **GRADE**	Presentations on topics assigned in class		15%
Quart **GRADE**	Final Project		35%

TEACHER INFORMATION:

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