COURSE GUIDE: 2016-17

COURSE DETAILS

Name :	Geographical Information Systems and Environmental Remote Sensing		
Code :	45093216	Plan :	2009
Academic year :	2015-2016	Level :	Bachelor
Course :	3th	Type :	Obligatory
Semester :	Second		

TIME DISTRIBUTION IN ACCORDANCE WITH REGULATION

ECTS :	12	In-class hours:	90
		Not in-class hours:	210
		Total time (in hours):	300
USE OF VIRTUAL PLATFORM:			Yes

LECTURER DETAILS

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ACTIVITIES ORGANIZATION

Planned activities for learning and workload distribution per activity (in hours)

I. STUDENT'S ACTIVITIES (In-class / Online)	• Seminars [Example]	0,0
	• Teaching group [Example]	52.0
	• Work group / small group [Example]	38.0
	Total In-class/Online time :	90.0
II. STUDENT'S AUTONOMOUS ACTIVITIES (not in-class)	•	210.0
	Total not in-class time :	210.0
TOTAL WORKING HOURS		300.0

ELEMENTS OF INTEREST FOR COURSE LEARNING

Justification of contents

Environmental Remote Sensing and GIS is an instrumental subject, with a strong methodological component that is used to solve a wide range of issues related to the acquisition, storage and analysis of information where the location of features is of particular importance. The subject is directly linked to cartography and mapping, incorporating the use of satellite imagery for the acquisition of information.

To develop the course, firstly basic concepts on the conception and cartographic representation of earth's surface are analyzed, as well as on geographical space, introducing geodesy basic notions for understanding technical aspects such as datum, projection systems or coordinate systems, with particular attention to the various and important implications of the scale in the representation of space-time processes. Subsequently, the nature of geographic data will be addressed including spatial, temporal and thematic components. Also the importance of metadata and the quality of information will be explained.

The second thematic unit is dedicated to Geographic Information Systems (GIS) and it is focused on technical-instrumental aspects and also on theoretical and methodological facets. Data structure in GIS and its representation by two basic models (raster and vector) will be studied. General strategies for geographic information processing (i. e. spatial analysis) will be addressed.

The next section will be devoted to Remote Sensing, which will focus on one of the main sources of spatial information. Physical principles involved on images acquisition and their relations with Earth's surface characteristics will be studied. Finally, the extraction and interpretation of environmental information from image processing will be treated.

Once the student knows the sources of geographic information and is able to manipulate and get new information, we will address Thematic Cartography, in which the student will learn how to produce thematic maps.

The last lessons will be devoted to solve a environmental problem involving decision support tools for Multi-Criteria Evaluation and the student´s work will be implemented in a design problem-based learning. This block will allow the student to integrate all the acquired information in previous blocks and to implement most studied techniques and tools to solve a real environmental problem.
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Other courses related

The need to handle a lot of information on land for any type of study, project report, etc. requires to have available tools able to obtain, organize and analyze this extensive information in a fast way and also able to easily update it. Taken into account that the acquired knowledge and skills facilitate the analysis and understanding of ecological processes and enable the management of environmental information, the course will have direct application in other subjects of the Degree in Environmental Sciences, and it will be essential in the professional future of the student. Currently, the application of these techniques, which are essential for better management of the territory, environmental planning and sustainable use of natural resources is spreading fast in practice, both in public and private contexts. This together with the fact that the development of these technologies is recent and it is increasing rapidly lead to a shortage of professionals capable of handling such tools, so the presence of this subject in the student´s curriculum will favor its rapid incorporation into professional practice. The subject is also related with those subjects of the Environmental Sciences Degree that involve the above mentioned aspect, and it relates directly to: - Planning and Urbanism, third year - Fundamentals of Environmental Engineering, second year -Techniques for soil, water and landscape restoration and conservation, third year – Natural spaces conservation and management- third year.

Minimum knowledge required to deal with the Course
None.

COMPETENCIES
General competencies
General objectives of the University of Almería - Problem solving skills
Other general objectives -Application of knowledge
Specific competencies developed
- Application of knowledge of the profession - To be able to generate and interpret thematic maps - To manage, analyze and graphically represent spatial information. - Awareness of the temporal and spatial dimensions of environmental processes
LEARNING OJECTIVES/OUTCOMES
During the course, students will develop the skills mentioned above, so, in the end, they should be able to: (a) generate conceptual maps on the main theoretical aspects of the subject (b) Regarding to the ability to solve problems, it will involve: - recognition of a problem and ability to decompose it into manageable parts. - To develop an action plan and an appropriate experimental design to build a solution or different solutions to the considered problem. - To prepare reports to describe, analyze, diagnose and validate the solution or different solutions to the problem. (c) Regarding the awareness of the temporal and spatial dimensions of environmental processes, the student should be able: - to understand, compare and link spatial and temporal scale concepts in environmental processes; - to select appropriate materials to solve environmental problems at different scales. - to use spatial and temporal scales concepts to design the solution of the problem. (d) To manage, analyze and plot the spatial information, the student should be able to handle the appropriate software to store, view and analyze georreferenced data and should be able to apply concepts from graphic design to mapping thematic layers. (e) With respect to the ability to create and interpret thematic maps it requires:

- identification of mapping properties (reference system, datum, projection, scale and legend) for the thematic data.

- harmonisation of mapping properties between different layers of thematic information.

- application of appropriate software to produce different types of thematic maps.

CONTENTS	
Module	I. Geographic space representation and geoinformation
Content	Lesson 1. The real world and its representation: the process, forms of representation. Spatial information and remote sensing process: acquisition, transformation and analysis of information. Advantages of remote sensing

Learning system and methodology

System	*Learning procedures and activities*	*Observations*	*Hours In-class/ Online*
Teaching group	Lecture	Explanation of main theoretical concepts	1.0
	Audiovisuals		1.0

Description of autonomous workload

Readings offered by the teacher. Search on communication media news related to the topic of the course.

Content	Lesson 2. Mapping principles and transformation of geographic information. Definition of geographic space: shapes and surfaces of the Earth, datums and reference systems. Map projections: classification, distortions, changes and regular screenings. Coordinate systems: geographic and rectangular. The scale forms of expression and resolution

Learning system and methodology

System	*Learning procedures and activities*	*Observations*	*Hours In-class/ Online*
Teaching group	Lecture	Explanation of main theoretical concepts	2,0
	Others	Seminar: Conceptual map constructions tool	2,0
	Discussion and Round Table	Conceptual map construction	2,0
	Evaluation session		0,5

Workgroup	Practical Exercises	Basic training with Georreferencing and geographical data transformation software	1,0
	Field Work	Localization practical exercises	4,0

Description of autonomous workload
Readings offered by the teacher and study of lesson notes. Construction of conceptual maps for basic concepts. Training with GPS, maps coordinates systems and software for transformation of coordinates.

Module	II. Geographic Information and Information Systems
Content	Lesson 3. The Geographic Data. The Geographic conceptual model. The nature of geographic data: spatial, thematic and temporal components. Data: Sources of data, database and spatial data infrastructure. Data quality. Introduction to Geographical Information Systems. GIS components. GIS Functions. Models for geographic information: spatial data models and data structure.

Learning system and methodology			
System	*Learning procedures and activities*	*Observations*	*Hours In-class/ Online*
Teaching group	Lecture	Explanation of main theoretical concepts	3,0
	Discussion and Round Table	Conceptual map construction	2,0
	Evaluation session		0,8
Workgroup	Practical Exercises	Exercises on the basic functions in GIS	3,0

Description of autonomous workload
Readings offered by the teacher and study of lesson notes. Construction of conceptual maps for basic concepts. Practical exercises: Training with the software ArcGis.

Content	Lesson 4. Data spatial analysis: Types of spatial analysis: Measurement, query and classification functions; overlay functions; neighbourhood functions; network analysis.

Learning system and methodology			
System	*Learning procedures and activities*	*Observations*	*Hours In-class/ Online*
Teaching group	Lecture	Explanation of main theoretical concepts	1
	Evaluation session		0,4
Workgroup	Practical Exercises	Training on spatial analysis tools with GIS specific software	2,0

	Problems Resolution	Application of spatial analysis tools (within GIS software) to solve problems	2,0

Description of autonomous workload
Readings offered by the teacher and study of lesson notes. Training with spatial analysis tools within specific GIS software by means of practical exercises and environmental problems to be solved.

Content	Lesson 5. Digital Terrain Models. Concept of Digital Elevation Model (MDE) . Data structure in DEM. Data capture. MDE construction. Errors in MDE. Terrain attributes extraction from MDE.

Learning system and methodology

System	*Learning procedures and activities*	*Observations*	*Hours In-class/ Online*
Teaching group	Lecture	Explanation of main theoretical concepts	1,0
	Evaluation session		0,3
Workgroup	Practical Exercises	Training on terrain attributes derived from DEM using GIS specific software	2,0
	Problems Resolution	Spatial analysis tools application on MDE and terrain attributes	2,0

Description of autonomous workload
Readings offered by the teacher and study of lesson notes. Training with spatial analysis tools within specific GIS software by means of practical exercises and environmental problems to be solved in which MDE will be used.

Module	III. Remote Sensing
Content	Lesson 6. Electromagnetic radiation, physic fundamentals of remote sensing What is Remote Sensing? The nature of electromagnetic radiation. Electromagnetic Spectrum. Interactions with the Atmosphere Interaction of electromagnetic radiation on terrestrial surface. Spectral characteristics of the main surface covers.

Learning system and methodology

System	*Learning procedures and activities*	*Observations*	*Hours In-class/ Online*
Teaching group	Lecture	Explanation of main theoretical concepts	2,0
	Discussion and Round Table	Conceptual map construction	1,0
	Others	Seminar on Visual analysis	2,0

	Evaluation session		0,3
Description of autonomous workload			
Readings offered by the teacher. Construction of conceptual maps for basic concepts			
Content	Lesson 7. Images acquisition: sensors and platforms Sensing of electromagnetic energy. Sensing Properties. Sensor on the ground, in the air, in the space. Satellite characteristics. Spatial resolution: Pixel size, and Scale. Spectral resolution. Radiometric resolution. Temporal resolution. Types of sensores: cameras and aerial photography, multispectral scanning, termal imaging. Geometric distorsion. Weather satellites. Land Observation Satellites. Marine Observation satellites. Other Sensors. Data Reception.		
Learning system and methodology			
System	*Learning procedures and activities*	*Observations*	*Hours In-class/ Online*
Teaching group	Lecture	Explanation of main theoretical concepts	2,0
	Discussion and Round Table	Conceptual map construction	2,0
	Others	Seminar on sensors	1,0
	Working group exposition	Exposition of work on sensors characteristics and application	1,0
	Evaluation session		0,3
Description of autonomous workload			
Readings offered by the teacher. Construction of conceptual maps for basic concepts. Database and web search of application of specific remotes sensing sensors and platform to solve environmental problems.			
Content	Lesson 8. Digital images analysis and applications: Digital images structure. Digital images adquisition and formats. Digital Image Processing. Pre-Processing. Image Enhancement. Image Transformations. Image classification and Analysis. Data Integration and Analysis. Applications. Calculating biophysical variables.		
Learning system and methodology			
System	*Learning procedures and activities*	*Observations*	*Hours In-class/ Online*
Teaching group	Lecture	Explanation of main theoretical concepts	3,0
	Discussion and Round Table		2,0
	Evaluation session		0,4
Workgroup	Practical Exercises	Training on satellite image processing using specific	2,0

		software	
Description of autonomous workload			
Readings offered by the teacher. Construction of conceptual maps for basic concepts. Training with image processing tools within specific software. Practical exercise resolution.			
Module	IV. Thematic Mapping		
Content	Lesson 9. Data quality: errors and consitency. Database. Geographic Information Generalization.		
Learning system and methodology			
System	*Learning procedures and activities*	*Observations*	*Hours In-class/ Online*
Teaching group	Lecture	Explanation of main theoretical concepts	1,0
Workgroup	Practical Exercises	Training to produce maps using specific software	2,0
Description of autonomous workload			
Readings offered by the teacher. Training practices for creating maps using specific software provided to the student. They will solve autonomously the proposed practical exercises.			
Content	Lesson 10. Cartographic communication and map objective. Basics concepts on visualization, visual variables. properties. Perceptual properties of visual variables. Thematic mapping and map base. Types of thematic information and Their representation. Qualitative mapping. Quantitative mapping. Elements and composition map.		
Learning system and methodology			
System	*Learning procedures and activities*	*Observations*	*Hours In-class/ Online*
Teaching group	Lecture	Explanation of main theoretical concepts	2,0
	Evaluation session		1,0
Workgroup	Practical Exercises	Training to prepare and plot maps using specific software	4,0
Description of autonomous workload			
Readings offered by the teacher. Training practices for creating maps using specific software provided to the student. They will solve autonomously the proposed practical exercises.			
Module	IV. Integration of spatially distributed data for environmental problems resolution		

Content	GIS and Remote Sensing application to solve environmental problems by using multicriteria decission tools.

Learning system and methodology

System	*Learning procedures and activities*	*Observations*	*Hours In-class/ Online*
Teaching group	Discussion and Round Table	Projects development monitoring	6,0
	Working group exposition	Projects exposition (partial aspects and final project)	6,0
	Others	Seminar to present and assign projects	2,0
Workgroup	Projects Based Learning	Execution of a real environmental project	14,0

Description of autonomous workload

Looking for the needed information. Elaboration of individual action plan. Development plan. Project preparation. Execution draft. Preparation of the presentation of the project. The project will be developed working within cooperative groups.

EVALUATION SYSTEM

Assessment criteria

During the evaluation process we will take into account:
- The acquisition of contents and basic concepts related to the subject
- The capacity of applying specific software tools related to GIS and Remote Sensing, and
- The ability to search, manage and integrate spatially distributed information from different sources.

It will be also valued the ability of the student to recognize and address a problem involving spatially distributed information, to design an action plan and the application of appropriate tools to solve it. Also it will be recognised the worth of their ability to diagnose the validity of the result.
For all this will make use of multi-objective tests. Oral presentation of bibliographic work and the project developed during the last module by means of Project Learning Based system will be also evaluated.
Attendance and participation during theoretical and practical classes will be taken into account for evaluation.

Marking system

	Activity	*(Number of hours)*	*Percentage*
I. STUDENT 'S ACTIVITIES (In-class/Online)			%
	• Teaching group	52	35%
	• Work group/ small group	38	35%
II. STUDENT'S AUTONOMOUS ACTIVITIES (Autonomous work)	• Individual work	210	30%

Assessment instruments

Progress report

Process observations

Final evaluation of projects, works, exersices etc.

Final tests (written and oral)

Monitoring mechanisms

Tutories

Assistance and participation in classes and seminars

Conceptual maps, practical exercises, tasks and projects delivery

Registering and number of accesses to the virtual learning platform

BIBLIOGRAPHY

Recommended bibliography

A visual Guide to Map Design *(Krygier, J. and Wood, D.)* - Basic
Geographic Information Systems and Science *(Longley, P.A.; Goodchild, M.F.; Maguire, D.J.; and Rhind, D.W.)* - Basic
Principles of Geographic Information Systems Rolf A. de By, Knippers, Weir, Georgiadou, Kraak, van Western and Sun). 2004. . International Institute for Geo-Information Science and Earth Observation. 2004. ITC
Remote Sensing and Image Interpretation *(Lillesland, T.M.; Kiefer, R.W. and Chipman, J.W.)* - Basic
Remote Sensing for Natural Resources Management and Environmental Monitoring. *(Ustin, S. L.)*
Remote Sensing Digital Image Analysis An Introduction (John A. Richards)

Bibliography existing in the library of the University of Almeria

http://almirez.ual.es/search/x?SEARCH=70534211

WEB ADRESSES

DIRECCIONES WEB

http://www.mappinginteractivo.com/
http://telenet.uva.es/promotores/revista
http://geofocus.rediris.es/principal.html
http://www.dices.net
http://www.clarklabs.org
http://www.geogra.uah.es
http://www2.ncdc.noaa.gov
http://rst.gsfc.nasa.gov/Homepage/Homepage.html
http://www.nosolosig.com/
https://lpdaac.usgs.gov/lpdaac/get_data/
http://www.geogra.uah.es/gisweb/