COURSE OUTLINE

(1) GENERAL

SCHOOL	**UNIVERSITY OF THESSALY**		
ACADEMIC UNIT	DEPARTMENT OF CIVIL ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ΓΚ1402	**SEMESTER**	3
COURSE TITLE	GEOGRAPHIC INFORMATION SYSTEMS		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	4	3
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialized general knowledge, skills development*	General background & skills development
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. If there are ERASMUS students, material is given in English, and the subjects/exams of the course are in English.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://eclass.uth.gr/eclass/courses/MHXC176/

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Learning outcomes:

Geographic Information Systems (GIS) are systems designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data. Scope of the course is the introduction of Geographic Information Science which studies geographic information systems. The course imparts the basic theoretical and practical understanding represented by the knowledge and skills outcomes via a mix of self-learning and formal teaching, including formal lectures and practicals in the lab sessions with active student participation. Lectures introduce theory and concepts, which are then exemplified in computer labs and exercises using specialist packages and tailored data sets. A substantial piece of coursework will test the students' ability to understand and apply the knowledge they acquire in practice at the lab sessions, including the use of methods and software. In addition, as it is an open-ended work it also tests students' initiative. Furthermore, the course is focused on applied spatial analysis using GIS for civil engineering applications. It includes methods and techniques for modelling spatial processes for decision making. Hence, this course strengthens students' technical and intellectual competency in spatial analysis with GIS in civil engineering applications.

Upon completion of the course, students should be able to demonstrate:

- Understanding of the basic concepts and techniques related to geographical information science and systems

- Ability to create, manipulate and analyse geographical and spatial data by combining multiple sources in vector and raster formats
- Skills for processing spatial (raster and vector) data with specialized software
- Ability to create flow diagrams and models for spatial analysis using geoprocessing operations
- Ability to identify and model spatial patterns from point, line and polygon entities and continuous surfaces
- Ability to perform Multi-Criteria Decision Analysis within GIS for spatial development projects

Specific knowledge:
The student after the completion of the course has advanced knowledge which implies a critical understanding of theories and principles in:

- geographical information systems,
- spatial analysis,
- the use of geographic information systems in civil engineering.

Skills
The student after completion of the course has advanced skills in the processing, analysis and solution of complex problems in civil engineering related to

- geographical information systems
- spatial analysis methods.

Competences
Upon completion of the course, the student will manage complex work plans and be able to make decisions for the design and operation of civil engineering projects. He/she is also able to work individually and in teams when designing, operating and simulating such projects. In particular, students will be able to

- evaluate and judge technical, environmental, social and economic factors in the design of civil engineering projects; and
- - synthesise and propose optimal or new solutions based on this evaluation.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Team work on Laboratory
- Working in an interdisciplinary environment
- Project planning and management
- Production of free, creative and inductive thinking
- Respect for the natural environment

(3) SYLLABUS

Geographic Information Systems (GIS) are information systems that have as a basic dimension the reference of the data managed in a specific geographical area. These systems are called upon to manage a heterogeneous set of data that provide various sources of information such as topographic maps, satellite maps, cadastre, city plans, zoning plans, population data, land use, road traffic, water and sewerage networks, data and photographs of traditional buildings, old archive maps, and historical data by region.

Within this course, the emphasis is equally divided between the qualitative and quantitative dimensions of geographic data and geographic information systems. The educational process of the course consists of in-session lectures aimed at presenting the theoretical background and basic concepts, practical training and familiarization with GIS software through laboratory exercises, and the preparation of a compulsory semester topic. The course helps students to develop their technical and intellectual capacity, preparing them for work as engineers and for postgraduate studies. The course introduces students to the computational techniques of GIS that used in modern civil engineering practice.

Week No.	**Course Contents**	**Hours**	
		Course attendance	**Preparation**
1	• Geographical Information Systems (GIS): An Introduction. General Principles of GIS. • GIS Lab – Introduction in the GIS software. Viewing and creating datafiles	**4**	**1**
2	• Geographic and Projected Coordinate Systems. • GIS Lab – Coordinate Systems. Exercise 1.	**4**	**1**
3	• GIS and Spatial Analysis. Methodology of Spatial Analysis. • GIS Lab – Map and Image Georeferencing. Exercise 2.	**4**	**1**
4	• Entities: Vector and Raster Models. • GIS Lab – Digitization. Editing vector files and attribute tables. Exercise 3.	**4**	**1**
5	• Data Analysis of Vector and Raster Models. Topological modeling. • GIS Lab – Image Processing. Automatic vectorization. Exercise 4.	**4**	**1**
6	• Database Management. Database Management Systems (DBMS). Spatial DBMS. • GIS Lab – Geodatabases. Relational Database Management Systems (RDBMS). Exercise 5.	**4**	**1**
7	• Data output and Cartography. • GIS Lab – Layouts. Exercise 6.	**4**	**1**
8	• GIS Analysis - Geoprocessing. Preprocesses. Analysis of Vector Data (e.g. Boolean Algebra, Logical Operations). Analysis of Raster Data (Local, Focal, Zonal and Global Functions). • GIS Lab – Geo-processes. Flow Diagram and Model Builder. Exercise 7.	**4**	**1**
9	• Methods of Spatial Analysis – Point Entities: Spatial Patterns. • GIS Lab – Geo-processes. Flow Diagram and Model Builder. Exercise 8.	**4**	**1**

10	• Methods of Spatial Analysis – Continuous Surfaces: Spatial Patterns and Spatial Interpolation. • GIS Lab – Spatial Interpolation Methods and Models. Exercise 9.	**4**	**1**	
11	• Methods of Spatial Analysis – Continuous Surfaces: Spatial Patterns and Spatial Interpolation. • GIS Lab – Triangulated Irregular Networks (TINs) and Geomorphology. Exercise 10.	**4**	**1**	
12	• Methods of Spatial Analysis – Non-continuous Surfaces: Spatial Patterns of Polygons. • GIS Lab – Site Mapping of Technical Projects. Exercise 10.	**4**	**1**	
13	• Spatial Sampling. Sampling Techniques. • GIS Lab – Multi-Criteria Decision Analysis with GIS.	**4**	**1**	
14	• Integrated Spatial Analysis with GIS. Examples and Case Studies.	**4**	**1**	

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY ***Face-to-face, Distance learning, etc.***	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Lectures with PowerPoint and live examples using GIS software. Notes, Exercises and Announcements in e-class
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non- directed study according to the principles of the ECTS*	see table below

Activity	*Semester workload*
Lectures - Exercises	14 * 2 = 28 hours
Laboratory Practice (Labs)	14 * 2 = 28 hours
Study	14 * 1 = 14 hours
Project	18 hours
Project examination	2 hours
Course total	***90***

STUDENT PERFORMANCE EVALUATION ***Description of the evaluation procedure*** *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open- ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	*Language of Evaluation* Greek (English for Erasmus students) *Evaluation Procedure* A substantial piece of coursework will test the students' ability to understand and apply the knowledge they acquire in practice at the lab sessions, including the use of methods and software. In addition, as it is an open ended work it also tests students' initiative. The assessment will be 100% coursework. A headstart will be made using computational resources during the lab sessions, with further analysis and writing up afterwards. 100% Project evaluation: Comprehensive example of spatial analysis. Integrated geographic analysis using GIS software. Mandatory project. Presentation and oral examination of topic on a specified date.

(5) ATTACHED BIBLIOGRAPHY

-Suggested bibliography:

Koutsopoulos, K.X., 2017. «Geographic Information Systems and Spatial Analysis», Disigma Publications, ISBN: 978-618-5242-11-4. [in Greek]

Koutsopoulos, K.X., N. Androulakakis, 2011. «Geographic Information Systems with ArcGIS 10», A. Papasotiriou & Sia OE, ISBN: 978-9604910304. [in Greek]

Tsouchlaraki, A., G. Achileos, N. Kourgialas, 2019. «Learning GIS: ArcGIS 10.5», 3rd Edition, Disigma Publications, ISBN: 978-618-5242-57-2. [in Greek]

Kavouras, M., darra, A., kontaxaki, S., & tomai, E. (2016). *Επιστήμη Γεωγραφικής Πληροφορίας - Αρχές και Τεχνολογίες* [Undergraduate textbook]. Kallipos, Open Academic Editions. https://dx.doi.org/10.57713/kallipos-696.

Tsoulos, L., Skopeliti, A., & Stamou, L. (2015). *Cartographic Composition and Rendering in Digital Environment* [Undergraduate textbook]. Kallipos, Open Academic Editions. https://dx.doi.org/10.57713/kallipos-770.

Burrough, P.A., and R.A. McDonnell, 1998. «Principles of Geographical Information Systems», Oxford University Press, Oxford, ISBN: 978-0198233657.

Chang, K.-T., 2010. «Introduction to Geographic Information Systems», 5th Ed., McGraw-Hill, ISBN: 978-0071267588.

De Smith, M.J., M.F. Goodchild, P.A. Longley, 2018. «Geospatial Analysis: a Comprehensive Guide to Principles, Techniques and Software Tools», 6th Ed., ISBN: 978-1-912556-05-2.

Heywood, I., S. Cornelius, and S. Carver, 2012. «An Introduction to Geographical Information Systems», 4th Ed., Prentice Hall, Pearson, ISBN: 978-0273722595.

Longley, P.A., M.F. Goodchild, D.J. Maguire, D.W. Rhind, 2015. «Geographic Information Systems and Science», 4th Ed., Wiley, ISBN: 978-1118676950.

- Related academic journals:

Computers & Geosciences, IEEE Transactions on Geoscience and Remote Sensing, Applied Earth Observation and Geoinformation, IEEE Applied Earth Observations and Remote Sensing, Remote Sensing, Remote Sensing of Environment, Photogrammetric Engineering and Remote Sensing, IEEE Geoscience and Remote Sensing Letters, GIScience & Remote Sensing, International Journal of Geographical Information Science, Journal of Geographical Sciences, Transactions in GIS, Journal of Spatial Science, International Journal of Digital Earth, GeoInformatica, Journal of Geographical Systems, Geocarto International, Journal of Geographic Information System, Geo-spatial Information Science, GeoJournal, Geographical Research, Geography Compass, GeoJournal, International Journal of Spatial Data Infrastructures Research, Natural Hazards and Earth System Sciences, Environmental Modelling and Software.