COURSE OUTLINE

(1) GENERAL

SCHOOL	School Of Engineering				
ACADEMIC UNIT	Planning And Regional Development Civil Engineering				
LEVEL OF STUDIES	Postgraduate				
COURSE CODE	SEMESTER Sprin		ing		
COURSE TITLE	Spatial And Transportation Networks				
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	
Lectures		Lectures	3		7,5
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, specialised general knowledge, skills development	Skills Developr	ment			
PREREQUISITE COURSES:	-				
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek				
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes				
COURSE WEBSITE (URL)					

(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 Objectives

The course presents the spatial dimension of transport systems, analysing the structure, functions and interrelationships of transport in geographical space, at all spatial levels. The course also presents patterns of structures that develop in geographical space due to differentiated spatial demand.

The aim of the course is to understand the forces and mechanisms that shape spatial demand, cause flows between different spatial locations and lead to the development of spatial and transport networks. The course aims to understand the interactions of spatial and transport networks with the economy, society and the environment at local, regional and global levels and to describe them quantitatively using graph theory and statistical mechanics.

Knowledge

- Understanding of the basic transport geography's principles and the networks functionality.
- Understand the interconnection patterns between economic activities, space, and transport.
- Analysis of different types of transportation networks and their topological and functional attributes.

Competences

- Pattern recognition in geographical space.
- Mapping and analysis of spatial and transportation networks data.
- Model application to evaluate the functionality and efficiency of spatial and transport networks.
- Recognition of spatial and transportation networks growth models.

Skills

- Software usage (graph modeling) for transportation data modeling, visualization, and analysis in the geographical space.
- Management of spatial and transportation network model parameters and their graphical representation.
- Evaluation of spatial planning scenarios and prediction of spatial growth .

General Competences

Production of free, creative and inductive thinking

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	Project planning and management					
information, with the use of the necessary technology	Respect for difference and multiculturalism					
Adapting to new situations	Respect for the natural environment					
Decision-making	Showing social, professional and ethical responsibility and					
Working independently	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 in an interdisciplinary environment						
Production of new research ideas						
Criticism and self-criticism						

(3) SYLLABUS

The content of the course is structured as follows:

Part A (Theoretical)

- Introduction to Transport Geography.
- Transport and Economic Geography: theoretical approaches.
- Forms of spatial organization and networks in geographical space.
- Introduction to Graph Theory, modeling, and complex networks analysis.
- Measures of complex network analysis and centrality measures.
- Statistical mechanics of complex networks, null models.
- Community detection in spatial and transportation networks.
- Multimodality and multilevel spatial networks.

Part B (Laboratory)

- Graph modeling of spatial networks and transport systems (creation, visualization, layouts representations, layers) using software.
- Performing basic operations (shortest path detection, filtering, merging) on spatial graph models using software.
- Calculation of global network measures and thematic maps of local measures using software.
- Community detection in graphs/spatial networks using software.
- Pattern recognition in empirical networks using software.
- Forecasting, building and evaluating scaling scenarios in spatial and transport networks using software.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY	Distance and physical presence lectures		
Face-to-face, Distance learning, etc.			
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	PC usage during the course lectures and in communication with students. Use of word-processing software, spreadsheets, data processing, graph design and analysis, internet, e-mail, asynchronous and modern tele- education platforms.		
TEACHING METHODS	Activity	Semester workload	
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	Lectures Seminars Laboratory Exercise Field Exercise Literature study and analysis Tutoring Practice (Placement) Educational visits Interactive teaching Preparation of a study (project) Essay Writing	39 25 20 16	
ECTS	Course Total	100	
STUDENT PERFORMANCE	Evaluation Process	YES/NO	
EVALUATION	Language of evaluation	Greek	
Description of the evaluation procedure	Evaluation Methods, Formative or Inferential		
Language of evaluation, methods of	Multiple Choice	Yes	
evaluation, summative or conclusive, multiple	Short Answer Questions		
choice questionnaires, short-answer questions,	Open-Ended Questions		
open-ended questions, problem solving, written	Problem solving	Yes	
work, essay/report, oral examination, public	Written Work	Yes	
presentation, laboratory work, clinical	Essay / Report	Yes	
examination of patient, art interpretation,	Oral Exam		
other	Public Presentation		

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	Laboratory Work Other / Other			
	Defined evaluation criteria			
	Evaluation criteria	Weight		
	Written Essay (Project)	40%		
	Written Examination	60%		
	The evaluation criteria used are linked to the learning outcomes, since the students' ability to externalize the knowledge they have acquired and the depth of understanding of the basic content of the course are assessed. The evaluation system and criteria are known to the students, and are judged as sufficient to capture the degree of understanding of the course and in depth of knowledge of its content.			

(5) **BIBLIOGRAPHY**

Suggested Literature:

- Rodrigue, J-P. (2024). *The Geography of Transport Systems* (6th Edition). New York: Routledge. DOI: 10.4324/9781003343196
- 2. Barthélemy, M. (2011). Spatial networks. Physics reports, 499(1-3), 1-101.
- 3. Marshall, S., Gil, J., Kropf, K., Tomko, M., & Figueiredo, L. (2018). Street network studies: from networks to models and their representations. *Networks and Spatial Economics*, *18*, 735-749.
- 4. Lin, J., & Ban, Y. (2013). Complex network topology of transportation systems. *Transport reviews*, 33(6), 658-685.
- Boccaletti, S., Bianconi, G., Criado, R., Del Genio, C. I., Gómez-Gardenes, J., Romance, M., ... & Zanin, M. (2014). The structure and dynamics of multilayer networks. *Physics reports*, 544(1), 1-122.
- 6. Kivelä, M., Arenas, A., Barthelemy, M., Gleeson, J. P., Moreno, Y., & Porter, M. A. (2014). Multilayer networks. *Journal of complex networks*, *2*(3), 203-271.
- 7. Fortunato, S. (2010). Community detection in graphs. *Physics reports*, 486(3-5), 75-174.
- 8. Tsiotas, D., & Polyzos, S. (2018). The complexity in the study of spatial networks: an epistemological approach. *Networks and Spatial Economics*, *18*, 1-32.
- 9. Tsiotas, D. (2021). Drawing indicators of economic performance from network topology: The case of the interregional road transportation in Greece. *Research in Transportation Economics*, *90*, 101004.
- 10. Tsiotas, D. (2017). Links Between Network Topology and Socioeconomic Framework of Railway Transport: Evidence From Greece. *Journal of Engineering Science & Technology Review*, *10*(3).
- 11. Tsiotas, D., & Polyzos, S. (2015). Analyzing the maritime transportation system in Greece: a complex network approach. *Networks and Spatial Economics*, *15*, 981-1010.
- 12. Tsiotas, D., & Polyzos, S. (2015). Decomposing multilayer transportation networks using complex network analysis: a case study for the Greek aviation network. *Journal of Complex Networks*, *3*(4), 642-670.

Relevant Scientific Journals:

Journal of Transport Geography, GeoJournal Networks and Spatial Economics, Global Networks Transport Reviews, Transportation Transportation Research Record Journal of Advanced Transportation, Journal of Complex Networks Nature Proceedings of the National Academy of Sciences Nature Physics Physics Reports Scientific Reports Physica A: Statistical Mechanics and its Applications,