Department of Intelligent Transportation Systems
Chair of Fundamental Courses

UNIVERSITY OF ZAGREB
FACULTY OF TRANSPORT AND TRAFFIC SCIENCES

GRADUATE STUDY: TRANSPORT, ITS AND LOGISTICS, AERONAUTICS
SEMESTER (II)

Syllabus

Academic year 2024/2025

Course:	**Transport Geoinformation Systems**				
Head of course: Asst. Prof. **Petar Feletar**, Ph.D. Asst. Prof. **Damir Budimir**, Ph.D.					
Co-lecturers: Asst. Prof. **Petar Feletar**, Ph.D. Asst. Prof. **Damir Budimir**, Ph.D.					
Semester: **S**	Course code: **94614 + 47902**	Lectures: **30**	Auditory exercises: **0**	Laboratory exercises: **15**	ECTS credits: **4**
Group for lectures: **10 students**			Group for auditory and laboratory exercises: **10 LV (1 group)**		

Objective of the course:

- Providing knowledge and information necessary for understanding the structure and operation of the geographic information systems (GIS), the way of collecting, presentation, processing and publishing of geospatial data, and the possibilities for application of the geographic information systems.
- Adopting the approach, methods and procedures for collecting and using of geospatial data and the efficient and effective application of the geographic information systems in the field of the traffic and transport technology.

Learning outcomes:

After the completion of the course, the student will be able to:

1. **Define** the basic terms connected with the geographic information systems (GIS), geospatial data, coordinate systems and map projections, vector and raster data models, and geometrical and attribute databases. **Describe** the processes and procedures for collecting, analysing and publishing of geospatial data, preparing a simple geographic information system and reaching the solution of a geospatial problem.
2. **Classify and give examples** of attribute data and their types. **Edit** attribute data and be able to **join and connect** attribute data by application of the GIS tools. Be able to **create** SQL queries to the attribute database.

3. **Apply** the global navigation satellite system (GNSS) for collecting and entering geospatial data, the geographic information system for presentation and analysis of the collected and derived data, and preparing of maps.
4. **Perform** georeferencing and geotagging of data, geocoding of maps and transformations between map projections and coordinate systems, **measurements** of the distance and surfaces by application of the GIS tools. **Devise and solve** tasks connected with geocoding of addresses, the dynamic segmentation and analysis of the route with the **presentation** of the results.
5. **Explain** the application and basic algorithms for analysis of the route on the transport network. **Develop** the transport network by application of the GIS tools, and **calculate** the shortest route on the transport network.
6. **Make** conclusions based on the calculation and select the most favourable problem solutions by using the GIS tools.

LECTURES and EXERCISES

Week	Syllabus	Form of classes	Performed by	Lessons	Remark
1.	▪ Introductory lecture ○ Getting acquainted with the course content ○ Getting acquainted with the literature, the flow chart for successful passing through the course, the way of conducting the exams ▪ The subject of study and the basic terms, definitions of GIS	L	Tonči Carić	2	
	▪ Getting acquainted with the bases of working in the geographic information system ▪ Getting acquainted with the tools used for execution of practical classes	LE	Petar Feletar	1	
2.	▪ Introduction to GIS ○ Integral parts necessary for operating of GIS (software, hardware, persons, infrastructure) ○ Short overview of the development of GIS ○ GIS programme products ○ Application of GIS • Geospatial data • GIS operations • GIS models and modelling	L	Tonči Carić	2	
	▪ Working with the overview of data and metadata ▪ Creating of own geo database ▪ Importing and exporting of data ▪ Creating of characteristic data overviews	LE	Petar Feletar	1	
3.	▪ Coordinate systems and projections ○ Geographical coordinate system ○ Map projections ○ Generally used map projections ○ Projection coordinate systems ○ Working with mapping systems in GIS	L	Tonči Carić	2	

	▪ Coordinate systems and projections, ○ Defining the coordinate system and date ○ Defining and entering new projections	LE	Petar Feletar	1	
4.	▪ Vector model of spatial data ○ Presentation of simple spatial features ○ Topology of spatial data ○ Georelation data model ○ Object based data model ○ Presentation of complex spatial features	L	Tonči Carić	2	
	▪ Transformations of coordinate data, ○ introducing of a new existing coordinate system (import), ○ projection of the shapefile by using the predefined coordinate system ▪ Measuring the distances and surfaces by application of the GIS tools	LE	Petar Feletar	1	
5.	▪ Raster model of spatial data ○ Elements of the raster data model ○ Types of raster data ○ Structure of raster data ○ Summing up of raster data ○ Transformation and unification of data	L	Tonči Carić	2	
	▪ Getting acquainted with the operation of the GIS software package - Arc Map / QGIS (basic operations, tools that will be used, downloading of raster and vector data) ▪ Adding data to the overview and selecting the layers ▪ Identification of data and overviews ▪ Working with symbols ▪ Classification of data ▪ Representing the classified data	LE	Petar Feletar	1	
6.	▪ Collecting GIS data ○ Available GIS data ○ Metadata ○ Transformation of the existing data ○ Preparing of new data	L	Petar Feletar	2	

	▪ Working with raster data layers ▪ Georeferencing of raster surveys • On-screen digitalization	LE	Petar Feletar	1	
7.	▪ Editing of attribute data ○ Attribute data in GIS ○ Relational data model ○ Merging, connecting and relational classes ○ Entering of attribute data ○ Editing of attributes and attribute data ○ Queries to the attribute database	L	Petar Feletar	2	I. Colloquium
	▪ GNSS (basics of operation) ▪ Collecting of data ▪ Synchronization of GNSS devices and computers ▪ Downloading of GNSS data	LE	Petar Feletar	1	
8.	▪ Analysis of vector data ○ Operating range ○ Covering ○ Measuring of distances ○ Analysis of samples ○ Processing of spatial features	L	Petar Feletar	2	
	▪ Creating databases and base of features (*feature dataset*) • Conversion of the shapefile • Downloading of GNSS traces • Entering of x and y data	LE	Petar Feletar	1	
9.	▪ Analysis of raster data ○ Requirements of the analysis ○ Local operations ○ Adjacent operations ○ Zone operations ○ Measuring of distances ○ Other operations	L	Petar Feletar	2	
	• Working with the GIS tool for image processing - Arc Photo • Geotagging of the collected data • Assigning the recording angle to the data	LE	Petar Feletar	1	

10.	▪ Vector and raster analysis ○ Comparison ▪ Advantages, shortcomings and adequacy of the vector, i.e. raster analysis. Examples of application	L	Petar Feletar	2	
	▪ Creating of a new shapefile from the geotagged data ▪ Preparing of own data layer ▪ Presentation on the existing map	LE	Petar Feletar	1	

11.	▪ Geocoding
	  ○ Address geocoding
	  ○ Procedure of address geocoding
	  ○ Preparing of addresses for geocoding
	  ▪ Ways of geocoding
	  ○ Addressing of intersections
	  ○ Geocoding of the post code
	  ○ Reverse geocoding
	  ▪ Application of geocoding
	  ○ Services based on the location
	  ○ Business applications
	  ○ Wireless emergency services
	▪ Mapping and analysis of traffic accidents
		L	Damir Budimir	2	

	▪ Editing of attribute tables ▪ Adding of new attributes ▪ Presentation of data	LE	Petar Feletar	1	

12.	▪ Dynamical segmentation
	  ○ Defining the route
	  ○ Preparing the route
	  ○ Appearances on the route (line and spot appearances)
	  ○ Preparing the appearance table
	▪ Application of dynamical segmentation
		L	Damir Budimir	2	

	▪ SQL queries and data analysis ▪ 'join' and 'relate' operations	LE	Petar Feletar	1	

13.	▪ Transport network and the analysis of the route ○ Developing of the transport network • Collecting of linear features of the network • Developing the network topology • Joining of attributes to the network features	L	Damir Budimir	2	
	▪ Analysis of the shortest route on the vector data record	LE	Tomislav Erdelić	1	
14.	▪ Examples of the analyses on the transport network ○ Finding the shortest route ○ Selection of the nearest object ○ Analysis of the arrangement ○ Analysis of the placement and arrangement	L	Damir Budimir	2	
	▪ Problem of the allocation and location of serving	LE	Tomislav Erdelić	1	
15.	▪ Application of the GIS tools for planning of transport by the four-step method ○ trip generation ○ trip distribution ○ selection of the way of travelling (modal choice) ○ trip assignment ▪ Final lecture ▪ Summary of acquired knowledge	L	Damir Budimir	2	II. colloquium
	▪ Preparing of own maps ○ Presentation of multiple areas and singled out area on the map ○ Map editing (adding a legend, scale, designation of north and denomination of maps)	LE	Tomislav Erdelić	1	

STUDENT OBLIGATIONS AND EXAMS

Conditions for obtaining signatures:

To obtain the signature, the student must attend at least 80% of the lectures and 100% of the practical classes, and prepare the seminar paper using the ArcGIS, ArcView 10.1 (ESRI), and QGIS programmes.

Written exam:

There are two ways of passing the exam:

a) **In two parts by *colloquiums***: the first colloquium is held by the middle of the semester, and the second at the end of the semester. The number of points the student can realize at one colloquium is 25. The students that realize the number of points smaller than 15 per colloquium have not passed the colloquium, and will have to realize the points for the written knowledge assessment at the final written part of the exam. The students that realize the number of points smaller than 30 on both colloquiums have not passed the written part of the exam.
The colloquium can be taken by all the students attending classes regularly (min. 80%).

b) **In one part by the *final written exam*:** In the written exam, 50 points can be realized. The students that realize the number of points smaller than 30 have not passed the written part of the exam. The written part of the exam is taken by all those students which have not collected a sufficient number of points separately at the colloquiums, or are not satisfied with the points collected at the colloquiums, or were not present at the written knowledge assessment by the colloquiums.

Oral exam:

To take the verbal part of the exam, it is necessary to realize the minimum number of points, either by two colloquiums, or by the written exam.
The verbal knowledge assessment is carried out in two parts:

- The first part consists of the basic checking of theoretical knowledge in the form of a short written paper and checking of practical knowledge of working in the GIS tool.
- The second part consists of checking the understanding and acquired knowledge from the field of geographic information systems and their applicability in the field of the traffic and transport technology.

LITERATURE

a) Obligatory literature:

1. Gold, H.**: Prometni geoinformacijski sustavi *(Transport Geographic Information Systems)*,** authorized lectures
2. Chang, Kang-Tsung: **Introduction to Geographic Information Systems**, McGraw Hill, New York, 2002-2014

3. **Prometni geoinformacijski sustavi - Upute za vježbe *(Transport Geographic Information Systems - Instructions for Practical Classes)*** – Merlin 2019

b) Recommended literature

1. Miller, H.J., Shaw, S.: **Geographic Information Systems for Transportation: Principles and Applications**, Oxford University Press, Oxford, 2001
2. Butler, J.A.: **Designing Geodatabases for Transportation**, ESRI Press, Redlands, 2008
3. Lillesand, T.M., Kiefer, R.W.: **Remote Sensing and Image Interpretation**, John Willey, 2000-2008

METHODOLOGY OF THE IMPLEMENTATION OF THE COURSE PLAN

1. LECTURES

The lectures follow the subject matter presented in authorized lectures (presentations and scripts) stated in the required reading list, and are mostly conduced with the use of the Power Point presentations and the blackboard. At a lecture, the discussion on the lectured issues is encouraged.

2. PRACTICAL CLASSES

Laboratory practical classes are conducted in such a way that the tasks are solved on computers so that the students would be trained for solving transport problems by using the geographic information technology, and for the purpose of adopting the approach, methods and procedures for efficient working with the geographic information systems.

Laboratory practical classes are executed in the PC classroom by using the licenced software package Arc View and the additional modules Arc Photo, Network Analyst, and the GIS programmes available on the internet free of charge (Quantum GIS).

3. DOCUMENTATION

The records are kept about the presence at lectures and practical classes, the successfully passed colloquiums and executed tasks.

4. SCORING OF COURSE

Table 1 The scoring system for the monitoring of students and explained credit values in ECTS credits

no	Segment:	Required credits to be achieved:		Remark:	ECTS credits
		Min.	Max.		
1.	Presence in lectures:				**0,40**
2.	LE				**0,65**
3.	Seminar paper (as needed)				**0,95**
4.	Colloquies (written 2x per semester):				**Σ 1**
5.	Written exam (terms):				**1**
6.	The verbal part of the exam:	/	/		**1**
Σ	Overall points*:*	Σ	Σ	Overall ETCS points*:*	**Σ 4**

Assessment and evaluation of the students' work during the classes and at the final exam:

The final grade is formed on the basis of the sum of the points realized in the written and verbal part of the exam.

Written knowledge assessments		**Total number of points**	**Written knowledge assessments**	**Grade**
First colloquium *points*	**Second colloquium** *points*		**Written exam**	
25	25	50	50	**5**
22	22	44	44	**4**
19	19	38	38	**3**
15	15	30	30	**2**