![Department of Intelligent Transport Systems logo]

Department of Intelligent Transport Systems

UNIVERSITY OF ZAGREB
FACULTY OF TRANSPORT AND TRAFFIC SCIENCES

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

Syllabus

Academic year 2024/2025

Course:	**Fundamentals of Intelligent Transportation Systems**				
Head of course: Asst. Prof. **Martin Gregurić**, Ph.D.					
Co-lecturers:	**Krešimir Kušić,** Ph.D. **Maja Tonec Vrančić,** MSc Traff. Eng. **Lucija Bukvić,** MSc Traff. Eng.				
Semester: **S**	Course code: **47710**	Lectures: **45**	Auditory exercises: **0**	Seminars: **15**	ECTS credits: **7**
Group for lectures: **70 students**			Group for seminars: **20 students**		

Objective of the course:

- Introduce students to the basic features of intelligent transport systems, their importance in the technology of traffic and transport, the scientific foundations on which is based, the features of development and use of various services within ITS and etc.
- Provide students with theoretical knowledge to define requirements in the design of intelligent transport systems, methods of measuring their effects and evaluation procedures.
- Train students to think critically in terms of the choice or conceptual design of a particular ITS subsystem, service, and the like.

Learning outcomes:

After the completion of the course the students will be able to:

1. Describe user and system requirements for certain parts of intelligent transport systems.
2. Use the systematic analysis methodology for ITS description
3. Analyze the possible effects of applying particular components of intelligent transport systems
4. Evaluate individual solutions within intelligent transport systems and related technologies
5. Apply acquired knowledge in teamwork when dealing with complex issues in the ITS environment with other departments (electrical engineering, computing, telecommunications, mechanical engineering etc.)

LECTURES and EXERCISES

Week	Syllabus	Form of classes	Performed by	Lessons	Remark
1.	▪ INTRODUCTIVE LECTURE / (introducing teachers and students, reviewing the literature, reading, teaching mode, student grading). Subject of study and basic concepts. The basic idea and definition of ITS. Taxonomy and standardization of ITS services. Supportive Technology for ITS (Fuzzy Systems, Neural Networks, Expert Systems)	L	Martin Gregurić	4	
2.	▪ PERFORMANCES AND QUALITY OF SERVICES IN ITS / Performance requirements for ITS. Criteria for selection of potential ITS solutions. Measurable values in ITS. Key Performance Indicators.	L	Martin Gregurić	4	
3.	▪ ITS METHODOLOGY AND METHODS / System approach and methodology. System requirements specification. ITS Methodology Elements. Functional decomposition and static view of activity. Methods of Systematic Analysis and Formal Specification. Modelling dynamics. Object oriented approach in system engineering. Examples of objects and classes. Lifecycle of object-oriented systems.	L	Krešimir Kušić	4	
4.	▪ ARCHITECTURE OF ITS / Concept and development of ITS architecture. Concept and principles of good architecture. Types of ITS architecture. Physical and logical architecture. ITS Architecture Levels. Evaluation of the system.	L	Lucija Bukvić	4	
5.	▪ PUBLIC DEFENCE OF THE SEMINAR PAPERS / Students present selected presentations in the field of ITS methodology, ITS introduction and use analysis, ITS impact analysis, etc.	S	Martin Gregurić Lucija Bukvić Maja Tonec Vrančić	4	

No.	Topic	Type	Lecturer	Hours	
6.	▪ DESIGING USER REQURMENTS FOR DEVELOPMENT OF ITS SERVICES / Use case scenario based on passenger information system for road traffic	S	Maja Tonec Vrančić	4	
	▪ FIRST COLLOQUIUM - Written Exam	S	Maja Tonec Vrančić	1	
7.	▪ DRIVER ASSISTANCE AND VEHICLE CONTROL / Vehicle Control – Definition. Key benefits of Vehicle Control. Main functions. Impacts of Vehicle Control. Examples of Vehicle Control	L	Martin Gregurić	3	
8.	▪ FREIGHT AND PUBLIC TRANSPORT / Freight and fleet management functions. Optimization of public transport. Advanced Public Transportation Systems Technologies ▪ WEATHER AND ENVIRONMENTAL MONITORING / Road weather monitoring station. RWIS software. Winter maintenance operations	L	Lucija Bukvić	4	
9.	▪ EMERGENCY AND ROAD TRANSPORT RELATED PERSONAL SAFETY ▪ IMPROVING ROAD TRAFFIC SAFETY USING ITS SOLUTION / General Risk Theory with Risk Assessment Analysis in ITS. ITS Security Risk Assessment Model	L	Maja Tonec Vrančić	4	
10.	▪ ITS LOCATION AND NAVIGATION SERVICES / ITS pre-journey and travel information services. Routing guide and navigation.	L	Lucija Bukvić	4	
11.	▪ INTELLIGENT TRAFFIC/TRANSPORT CONTROL AND MANAGEMENT / Development of intelligent transport and transportation management system. Collection of data and analysis of relevant indicators. Urban traffic management with public transport priorities	L	Maja Tonec Vrančić	4	

12.	▪ TAXONOMY AND STANDARDIZATION OF ITS SERVICES / Standardisation in data exchange in ITS services. ITS functional areas. KAREN Framework Architecture Process Diagram. Standardization for connected vehicles.	L	Lucija Bukvić	4	
13.	▪ DESIGING USER REQURMENTS FOR DEVELOPMENT OF ITS SERVICES / Use case scenario based on traffic control in urban environments	S	Krešimir Kušić	4	
14.	▪ AI AND MACHINE LEARNING IN ROAD TRANSPORT / Configuration of learning datasets. Learning and validation of machine learning models. Supervised learning. Reinforcement learning. Deep learning.	L	Martin Gregurić	4	
15.	▪ SECOND COLLOQUIUM - Written Exam	L	Lucija Bukvić	1	
	▪ PUBLIC DEFENCE OF USER REQUIRMENTS FOR ITS SERVICE DESIGN/ Students present their project related to the design of user requirements for specific ITS service. ITS service as the use case scenario is chosen by students.	S	Martin Gregurić Lucija Bukvić Maja Tonec Vrančić	3	

L = Lectures; **AE** = Auditory Exercises; **LE** = Laboratory Exercises; S = Seminars

STUDENT OBLIGATIONS AND EXAMS

Conditions for obtaining signatures:

The student acquires the right to get a signature for ≥ 70% of attendance during the lectures (10 credits from Table 1). There are no pre-conditions from other courses except basic knowledge of system engineering and objective-oriented approach in system design. If part-time students attend consultations, this is regarded as attendance in class, if absence from class has been excused and announced to teachers. The attendance in the percentage lower than 70% at lectures may be compensated by making an additional seminar paper for documented absence due to a justified cause and in this case a positively graded seminar paper is worth 20 credits (Item 3 in Table 1). The scope and content of the seminar paper depends on the number of absences.

Seminar work (mandatory and additional one which is compensatory)**:** The students independently prepare mandatory seminar work which must be related with the implementation of most prominent ITS services in their origin country. Students must independently study the recent professional and scientific literature with the aim of achieving learning outcomes from 1 to 5. Compensatory seminar work is done in case if a student doesn't have enough percentage of attendance to the lectures.

Written exam: written evaluation of the cognitive skills of applying empirical facts and theoretical knowledge, as well as logical thinking in analytical tasks and theoretical models or algorithms of procedures, with the aim of achieving learning outcomes from 1 to 5.

There are two ways of passing the exam:
   a) **Written colloquies –** consist of written tests twice during the semester. The first colloquia can be attended by all students enrolled in the course in the current academic year. The second colloquia at the end of the semester can be attended by the students who have passed first written colloquia. Student must pass both colloquies in order to pass this course.

   b) **Written test –** consists of a written exam at regular examination periods. The written exam can be attended by students who are eligible for signature in the course Fundamental of ITS (if not exempted from the written part of exam, according to Table 2, or if they want to achieve a better grade than the one obtained in the written colloquies), provided they have received a positive grade from the obligatory seminar paper defended orally at the time of consultation or at time agreed with the lecturer.

Oral exam: Verbal evaluation of the cognitive skills of applying empirical facts and theoretical knowledge, as well as logical thinking on different theoretical ITS system models, with the aim of achieving learning outcomes from 1 to 4.

Public defence of the student seminars

Oral presentation of written seminars is considered as the one part of oral exam. Students are obligated to orally present (public defence of student seminars) their seminar work in the middle and at the end of semester. The first seminar is related to the classical seminar about a specific topic in the field of ITS while the second one is related to student projects related to user requirements for the design of specific ITS service. During the public defence of their seminars teachers can ask students questions which are in line with the topic of their seminars. Those questions must be related

with the lectures. Teachers can ask them additional questions in order to validate their overall knowledge in the field of ITS what is in line with the learning outcomes from 1 to 4.

LITERATURE

a) Obligatory literature:

1. Mashrur, C. (Editor), Amy, A. (Editor), and Kakan, D.: Data Analytics for Intelligent Transportation Systems, Elsevier 2017.
2. Gordon, R.: Intelligent Transportation Systems, Springer Cham, 2016.

b) Recommended literature:

1. Articles from scientific journals: Intelligent Transport Systems, IEEE Intelligent Traffic Systems, etc.

METHODOLOGY OF THE IMPLEMENTATION OF THE COURSE PLAN

1. LECTURES

Lectures accompanying material exposed in authorized materials (presentations and written templates) in detailed in the required and supplemental literature, and perform combined: the use of a Power Point presentation and schematic representation of ITS systems on the blackboard. In the lecture, the team encourages discussion of issues that commits.

2. SEMINARS

Teachers trough the discussion with the students try to underline critical ITS services and infrastructure in their native countries. Students are steered towards the validation approach which considers ITS implementation as the one problem in system engineering. Students must be able to evaluate each ITS implementation according to the ITS functional areas. They are trained how to evaluate appropriate literature which will be used for their seminar work.

Note: Individual and/or group viewing negative written test

Individual at the time of consultation or a designated period. If necessary and at the request of a group of students in the form of post seminar-discussions in order to explain the most common mistakes in understanding ITS problematic - typical, after discussion with the team responses to individual student issues.

3. DOCUMENTATION

Kept electronic records of presence in lectures and seminar sessions. In Excel, the leading communications Tabulation registers earned points for attendance at lectures, and public defence of their seminar work. Aforementioned, Tabulation register contains information's about the students credits achieved at each colloquies and exam. The points obtained under the conditions in Table 1 are published in the end of semester at the Merlin e-learning system.

4. SCORING SYSTEM

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

no	Segment:	Required credits to be achieved: Min.	Max.	Remark:	ECTS credits
1.	Presence in lectures:	10	10	Presence ≥ 70%	**1**
2.	Presence at the seminar sessions:	10	10	Presence ≥ 70%	**1**
3.	Seminar paper (as needed)	20	20	*Replacement items 1. and 2.*	**1**
4.	Seminar paper (mandatory):	10	20	Preparation at home and oral presentation at the time of consultation	**1**
5.	Colloquies (written 2x per semester):	Σ 50	Σ 100		**Σ 2**
6.	Written exam (terms):	50	100	Replacement items 5.	**2**
7.	Oral exam	-	-	Theoretical part with lectures	**1**
8.	The public defence of seminar work:	40	40		**1**
Σ	Overall points:	Σ **100**	Σ **200**	Overall ETCS points:	**Σ 7**

Table 2 - Explanation of the credit values in evaluations

CREDITS:	Estimate based on attendance, seminar paper and two colloquies (or written exam) - [4 ECTS]:	The final score [5 ECTS]:
50 - 60	Sufficient (2)	The final score after public defence of seminar work and oral exam
61 - 75	Good (3)	
76 - 90	Very good (4)	
91 - 100	Excellent (5)	Exemption from verbal parts of exam

All 7 ECTS can be gained in total only if the student has received a positive opinion on the oral part of the exam

Information for students (scoring system, implementation plan, learning outcomes, syllabus, literature, consulting teachers, announcement of results of examinations or colloquium, and all other information):

- **https://moodle.srce.hr/2023-2024/**

Student assistants: Additional individual work with the students through individual consultations for optional homework, as well as for insight into the negatively written part of the exam.