Department of Railway Transport
Chair of Railway Transport Safety

UNIVERSITY OF ZAGREB
FACULTY OF TRANSPORT AND TRAFFIC SCIENCES

GRADUATE STUDY: TRANSPORT

SEMESTER (III)

Syllabus

Academic year 2023/2024

Course: **Railway Automation**						
Head of course: Assoc. Prof. **Hrvoje Haramina**, Ph.D.						
Co-lecturers:						
Semester: **III**	Course code: **60615**	Lectures: **30**	Seminars: **20**	Auditory exercises: **5**	Laboratory exercises: **5**	ECTS credits: **6**
Group for lectures and seminars:			Group for auditory and laboratory exercises:			

Objective of the course:

- The course aims to introduce students to the area of automation and its implementation in railway systems.

Learning outcomes:

At the end of the course students will:

1. understand basic principles of industrial automation
2. understand main principles of railway automation
3. know the state of the art in the area of railway automation and its impact on railway traffic efficiency improvement
4. know basic principles of RAMS and application of fault tree analysis (FTA)

LECTURES, EXERCISES and SEMINARS

Week	Syllabus	Form of classes	Performed by	Lessons	Remark
1.	▪ Introduction to the course content, literature and credit system ▪ Introduction to the Area of Railway Automation ▪ Introduction to Cybernetics ▪ Systems Theory	L	Hrvoje Haramina	4	
2.	▪ Introduction to Automatic Control ▪ Feedback control ▪ Feedforward control ▪ Basic principles of railway automation	L	Hrvoje Haramina	4	
3.	▪ Sensors ▪ Transducers ▪ Application of Programmable Logic Controllers (PLCs) in industrial automation	L	Hrvoje Haramina	4	
4.	▪ ROBO Pro- visual programming language for the fischertechnik robotics kit	AE	Hrvoje Haramina	1	
	▪ Programming of RoboPro interface by application of state flow diagramming	LE	Hrvoje Haramina	3	
5.	▪ Programming of RoboPro interface of the automatic level crossing model	S	Hrvoje Haramina	4	
6.	▪ Programming PLCs using Ladder Logic	AE	Hrvoje Haramina	2	

	▪ Programming of Mitshubishi Alpha 2 controller (experiment with laboratory model of railway main signal)	LE	Hrvoje Haramina	2	
7.	▪ Programming of Mitshubishi Alpha 2 controller of the automatic level crossing model	S	Hrvoje Haramina	4	
8.	▪ Expert systems ▪ Automatic Train Control ▪ Automatic route setting ▪ Automatic train protection systems	P	Hrvoje Haramina	4	
9.	▪ Application of decision support systems in train and traffic control processes ▪ Train driver advisory systems	P	Hrvoje Haramina	4	
10.	▪ Automatic train operation	P	Hrvoje Haramina	2	
	▪ Analysis of the automatic train protection system RAS 8385	AE	Hrvoje Haramina	2	
11.	▪ Application of fuzzy logic in rail automation	P	Hrvoje Haramina	4	
12.	▪ RAMS ▪ Fault tree analysis (FTA) ▪ CENELEC railway standards	P	Hrvoje Haramina	4	
13.	▪ Application of Open FTA software in analysis of railway level crossing	S	Hrvoje Haramina	4	

14.	▪ Fuzzy logic control of automated rail system	S	Hrvoje Haramina	4	
15.	▪ Simulink model of automated rail system based on Fuzzy logic control	S	Hrvoje Haramina	4	

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

STUDENT OBLIGATIONS AND EXAMS

Conditions for obtaining signatures:

Attendance is mandatory and students acquire the right to get a signature for ≥ 80% attendance at lectures and attendance at ≥ 80% of exercises.
In addition, at the end of the course students are required to write and present their seminar paper and to pass an oral examination.

Oral exam: Students are required to answer questions in such a way so as to demonstrate sufficient knowledge of the subject matter in order to pass the oral exam.

Documentation:
Attendance list is signed by students prior to every lecture.

LITERATURE

a) Obligatory literature:

1. E. Anders et all: Railway Signalling & Interlocking, Eurailpress, Hamburg, 2009.
2. J. Pachl: Railway Operation and Control 3nd edition, VTD Rail Publishing, Mountlake Terrace(USA), 2009.

b) Recommended literature:

1. Jens Braband et all: The CELENEC – Standards regarding Functional Safety

METHODOLOGY OF THE IMPLEMENTATION OF THE COURSE PLAN

The curriculum is conducted through lectures, exercises and a seminar.

1. LECTURES

In the course of the lectures the theoretical framework of the curriculum is presented and followed by practical examples.

2. AUDITORIAL EXERCISES

In the course of exercises students are analysing PLCs programming methods and railway automated systems.

3. SEMINAR

In the course of the seminar application of Fault Tree Analysis and different models of automated control systems are presented and discussed.

4. DOCUMENTATION

Attendance list is signed by students prior to every lecture.

5. SCORING SYSTEM

Table 1 Explanation of the credit values in evaluations

Activity	ECTS credits
Lectures	**2,5**
Oral exam	**2**
Seminar	**1,5**
In total:	**6**