



## UNDERGRADUATE STUDY: **TRANSPORT**

### **SEMESTER (VI)**

### **Syllabus**

Academic year 2024/2025

Course:		<b>Railway Signalling</b>				
Head of course: Assoc. Prof. <b>Hrvoje Haramina</b> , Ph.D.						
Co-lecturers:						
Semester: <b>W</b>	Course code: <b>36081</b>	Lectures: <b>30</b>	Seminars: <b>15</b>	Auditory exercises: <b>10</b>	Laboratory exercises: <b>5</b>	ECTS credits: <b>6</b>
Group for lectures and seminars:				Group for auditory and laboratory exercises:		

#### **Objectives of the course:**

- The course aims to introduce students to the area of Railway Signalling and its implementation in railway traffic management process.

#### **Learning outcomes:**

At the end of the course students will:

1. know the role of all types of railway signals and train control devices
2. know the basic principles of train separation
3. know the basic principles of interlocking and routing trains through railway station
4. be able to analyze and explain an impact of train control system on the railway traffic efficiency





## LECTURES, EXERCISES and SEMINARS

Week	Syllabus	Form of classes	Performed by	Lessons	Remark
1.	<ul style="list-style-type: none"><li>Introduction with syllabus, literature and credit system</li><li>Introduction to the area of railway signalling</li></ul>	L	Hrvoje Haramina	3	
	<ul style="list-style-type: none"><li>Classification of tracks, stations and signals, movement of track vehicles</li></ul>	AE	Matea Mikulčić	1	
2.	<ul style="list-style-type: none"><li>Railway signs and signals and their meanings (analysis of Croatian national signalling system)</li></ul>	AE	Matea Mikulčić	3	
	<ul style="list-style-type: none"><li>Railway turnouts and derailleurs</li></ul>	L	Hrvoje Haramina	1	
3.	<ul style="list-style-type: none"><li>Analyzing and modelling of railway signals arrangement on railway line section from Velika Gorica to Turopolje railway station</li></ul>	LE	Matea Mikulčić	2	
	<ul style="list-style-type: none"><li>An analysis of different examples of signalling systems in Europe</li></ul>	AE	Matea Mikulčić	2	
4.	<ul style="list-style-type: none"><li>Track clear detection systems (track circuits and axle counters)</li></ul>	L	Hrvoje Haramina	2	



	<ul style="list-style-type: none"> <li>▪ Analyzing and modelling of railway track circuit arrangement on railway line section from Velika Gorica to Turopolje railway station</li> <li>▪ Testing of axle counter and track circuit laboratory models</li> <li>▪ Railway turnouts lock</li> </ul>	LE	Matea Mikulčić	2	
5.	<ul style="list-style-type: none"> <li>▪ Station interlocking principles</li> </ul>	L	Hrvoje Haramina	2	
	<ul style="list-style-type: none"> <li>▪ Railway-station signalling and interlocking devices</li> </ul>	L	Hrvoje Haramina	2	
6.	<ul style="list-style-type: none"> <li>▪ Construction of interlocking table</li> </ul>	S	Hrvoje Haramina	4	
7.	<ul style="list-style-type: none"> <li>▪ Construction of interlocking table</li> </ul>	S	Hrvoje Haramina	4	
8.	<ul style="list-style-type: none"> <li>▪ Train separation principles</li> <li>▪ Automatic block operation</li> <li>▪ Basic principles of cab signalling and Moving Block operation</li> </ul>	L	Hrvoje Haramina	4	
9.	<ul style="list-style-type: none"> <li>▪ Automatic train protection systems</li> </ul>	L	Hrvoje Haramina	4	
10.	<ul style="list-style-type: none"> <li>▪ "Autostop - RAS 8385" an automatic train protection device (technical specifications and principle of operation)</li> <li>▪ Incident recorder IRAS19 (reading the data from system memory card)</li> </ul>	AE	Matea Mikulčić	3	





	<ul style="list-style-type: none"><li>Testing of laboratory model of automatic train protection device (RAS 8385)</li></ul>	LE	Matea Mikulčić	1	
11.	<ul style="list-style-type: none"><li>Railway telecommunications</li></ul>	L	Hrvoje Haramina	4	
12.	<ul style="list-style-type: none"><li>Simulation of train operation on the open line</li><li>Simulation of train operation on the open line equipped with automatic block system (analysis of effects of system failures)</li></ul>	S	Hrvoje Haramina	4	
13.	<ul style="list-style-type: none"><li>Special safety systems in Marshalling yards</li><li>Railway level crossings</li></ul>	L	Hrvoje Haramina	3	
	<ul style="list-style-type: none"><li>Calculation of basic parameters for train sensor based automatic level crossing protection system</li></ul>	AE	Matea Mikulčić	1	
14.	<ul style="list-style-type: none"><li>Basic principles of European train control system (ETCS)</li></ul>	L	Hrvoje Haramina	4	
15.	<ul style="list-style-type: none"><li>Basic principles of centralised train and traffic control operations</li></ul>	L	Hrvoje Haramina	1	
	<ul style="list-style-type: none"><li>Design and evaluation of train operation with ETCS (Level 1,2,3)</li></ul>	S	Hrvoje Haramina	3	

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





## STUDENT OBLIGATIONS AND EXAMS

### Conditions for obtaining signatures:

Attendance is mandatory and students are required to attend at least 70% of the classes. In addition, at the end of the course students are required to write and present their seminar paper and to oral examination.

**Seminar work** (mandatory): The students independently prepare a seminar work, independently studying the recent professional and scientific literature, and finally present their seminar work.

**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.

## LITERATURE

### a) Obligatory literature:

1. E. Anders at all: Railway Signalling & Interlocking, Eurailpress, Hamburg, 2009.
2. J. Pachl: Railway Operation and Control 3rd edition, VTD Rail Publishing, Mountlake Terrace(USA), 2009.
3. P. Stanley: ETCS for Engineers, Eurailpress, Hamburg, 2011.

### b) Recommended literature:

1. P. Winter: Compendium on ERTMS, International Union of Railways, 2009.





## **METHODOLOGY OF THE IMPLEMENTATION OF THE COURSE PLAN**

### **1. LECTURES**

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

### **2. SEMINAR**

In the course of the seminar examples of construction of interlocking tables and train operations under different train control systems are presented and discussed.

### **3. AUDITORIAL EXERCISES**

Auditory exercises are performed in a way that students solve numerical tasks related to teaching units explained in lectures and work in specialized software solutions for modelling of train control systems.

### **4. LABORATORY EXERCISES**

Laboratory exercises are performed in the Laboratory for railway safety and Laboratory for modelling and simulation of railway systems in a way that students create, simulate and analyse models of train control systems.





## 5. DOCUMENTATION

Attendance list is signed by students prior to every lecture.

## 6. SCORING SYSTEM

**Table 1** - The credit values in ECTS credits

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

