

Co-funded by the
Erasmus+ Programme
of the European Union



WP4 – Development of teaching and training resources with the use of remote teaching methodology

IO.13 Development of road pavement management resources

This project has been funded with the support of the European Commission. This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Copyrights



Università
di Catania



List of authors:**Gdansk University of Technology**

Wojciech Kustra, Marcin Budzynski, Joanna Wachnicka, Tomasz Mackun, Lukasz Mejlun, Alina Guzik

Cracow University of Technology

Mariusz Kiec, Remigiusz Wojtal, Krzysztof Ostrowski, Stanislaw Gaca

University of Zylina

Miroslava Mikusowa, Patrik Hrkut

University of Gyor

Attila Borsos, Daniel Miletics

University of Catania

Salvatore Damiano Cafiso, Giuseppina Pappalardo

Alpen Adria University

Kyamakya Kyandoghery, Jean Chedjou, Patrik Grausberg

Contents:

1	Introduction	3
2	Subject Assumptions.....	5
2.1	Division of Road Pavement Management Lessons	5
2.2	Type of didactic and training resources	6
3	Didactic and training Materials for Road Pavement Management.....	10
3.1	Gdansk University of Technology e-learning platform.....	10
3.2	Introduction and purpose of the e-learning platform.....	11
3.3	Detailed division of didactic and training materials	12

1 INTRODUCTION

The COVID-19 pandemic has forced a departure from the current functioning of society in many aspects of the economy, travel, work and education, not excluding higher education. The necessity of remote education is one of the ways to maintain social distancing and protect our health and life.

A preliminary assessment of the situation at universities in European countries indicates that academic staff were not sufficiently prepared to conduct attractive and practical classes in a remote format.

The necessity to conduct classes remotely involves developing a dedicated didactic and training process project, considering the specific requirements of interdisciplinary engineering knowledge. Transferring this knowledge in remote education, due to its large scope, requires various didactic tools (lectures, fieldwork, design, practicals, laboratories, student assignments and assessment of the progress and knowledge of students and trainees).

The measurable expected final results are:

- Development of a remote learning methodology for Road Infrastructure Management (RIM) as a model solution to provide a basis for extending the methodology to include further aspects of civil engineering and transport.
- Developing an e-handbook for academic staff supporting the remote learning process.
- Development of model digital teaching and training materials dedicated to technical colleges and training for road management staff on RIM:
 - Road safety audit,
 - Roadside safety management,
 - Safety management of vulnerable road users,
 - Road pavement management.
- Developing an e-learning platform with access to project products.
- Appointment of a panel of experts in road infrastructure management.

The InfRO@D project targets the following groups:

- 1) Students, researchers, and academic teachers at universities.
- 2) Road authority staff at national, regional and local levels.
- 3) Experts, specialists, and practitioners involved in RIM activities, including staff who conduct training in various RIM courses.
- 4) All users of road infrastructure, as an indirect target group, for whom the risk of road accidents will ultimately be reduced by increasing the effectiveness and efficiency of RIM activities.

The project is also supported by a group of associates who will cooperate with project partners to consult and evaluate the results. They will implement final products and promote the dissemination and accessibility of the project results.

ABOUT OUTPUT IO.13

- **Objective:** Development of road pavement management resources.



- **Work package:** The task falls under WP4 – Development of teaching and training resources with the use of remote teaching methodology.
- Target Groups:
- Research and teaching staff from institutions involved in the project and other European institutions.
- Students of civil and transportation engineering.
- Road authority staff at a national, local and regional level.

2 SUBJECT ASSUMPTIONS

2.1 Division of Road Pavement Management Lessons

The planned outcome of the task is the development of modern and innovative digital teaching and training content for remote education in the field of road pavement management, with the support of RIM tools. As part of the civil and transportation engineering course syllabus in partner universities. The work included a detailed breakdown of the issue into nine chapters covering a total of 75 teaching hours:

- Introduction to the course.
- Collecting of input data.
- Diagnostic, assessment and classification of pavement condition - basics.
- Identification of pavement damages.
- Laboratory assessment of road asphalt materials.
- Diagnosis, assessment and pavement condition classification - students' reports.
- Prediction of pavement condition changes over time.
- Maintenance of road asphalt pavement - treatment methods.
- Summary of the course.

Following the assumptions made during the development of the methods of remote education (task IO.4 – IO.9), it is assumed learning by doing. Emphasis on practical activities, student collaboration, and knowledge exchange during group work or webinars. The planned division of road pavement management lessons is shown in Table 1. The potential extension of the programme will be possible when syllabuses have been adapted.

Table 1. The planned division of road pavement management lessons

Types of classes	Chapter									Total
	1	2	3	4	5	6	7	8	9	
Lecture	8	-	3	1	-	-	1	4	1	18
Field activities	-	-	-	4	-	5	-	-	-	9
Practicals (remote)	1	8	10	2	-	-	-	-	-	21
Design class	-	-	-	-	-	-	5	5	-	10
Laboratory	-	-	-	-	17	-	-	-	-	17
Number of lessons	9	8	13	7	17	5	6	9	1	75

In line with the project's objectives, the work included preparing examples of didactic and training materials. Materials for all chapters were prepared.

2.2 Type of didactic and training resources

Road pavement management also includes specialist knowledge. This knowledge is insufficiently imparted to students and infrastructure management personnel in curricula and various training courses. The materials developed will make it possible to fill this gap in the learning process. The work includes theoretical and practical activities:

- lectures (Pavement Management System, input data to the system, diagnostics, assessment, classification of pavement condition, automatic systems of pavement diagnostics, pavement damages, prediction of pavement condition changes over time, maintenance and treatment of road pavements),
- fieldwork (collecting data on road sections, their damage, condition assessment and classification),
- practical classes (exercise in recognizing various types of damage, pavement condition assessment and classification),
- design classes (model of pavement condition changes over time, pavement maintenance and treatment plan),
- laboratories (taking samples from the pavement, laboratory tests and devices, laboratory assessment of road materials).

As part of the project implementation, the following type of data was prepared:

- PowerPoint-teacher – PowerPoint presentation, which should be presented by the teacher (Figure 1),
- Pictures gallery – PowerPoint presentation for students/road specialists to self-training and exercises (Figure 2),
- PowerPoint with YouTube resources – webinars, videos, lectures, instructions, etc. (Figure 3).
- Interview with the specialist (Figure 4).
- Shapefile, kml, png, pdf with prepared localisation of analysed regional and local road sections (Figure 5, Figure 6)
- Interactive quizze – introductory and summary tests (a-b-c-d questions, multichoice).
- PowerPoint-student – PowerPoint presentation prepared by groups of the students as results of homeworks
- Group discussion – Q&A, consultations and students-teacher discussions.

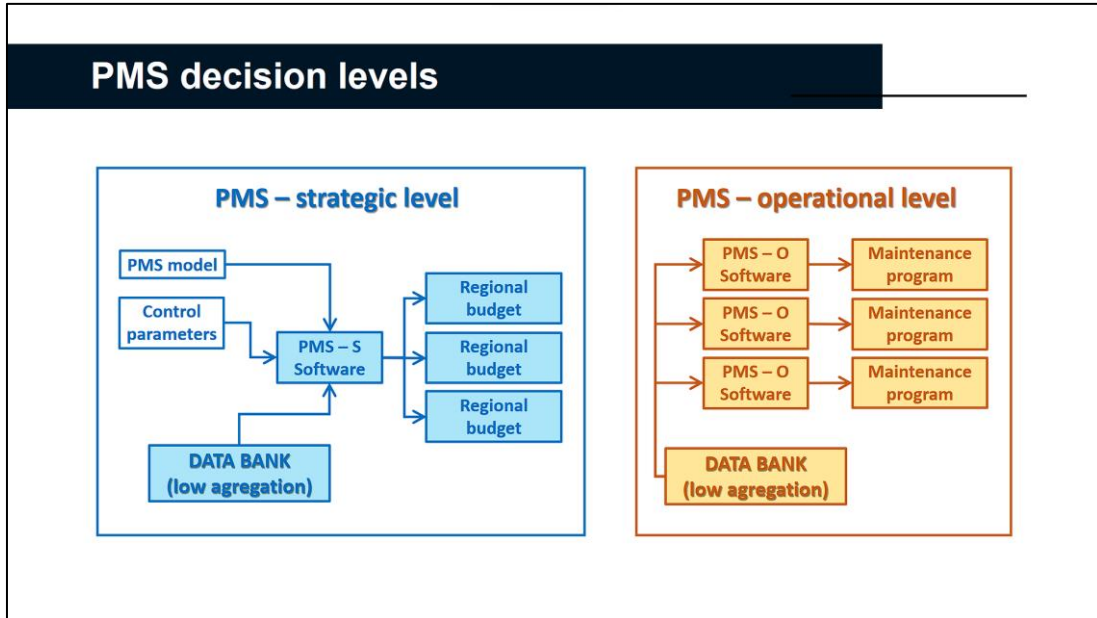


Figure 1. Example of didactic materials – PowerPoint-teacher presentation



Figure 2. Example of didactic materials – pictures gallery



Figure 3. Example of didactic materials – presentation with YouTube resources

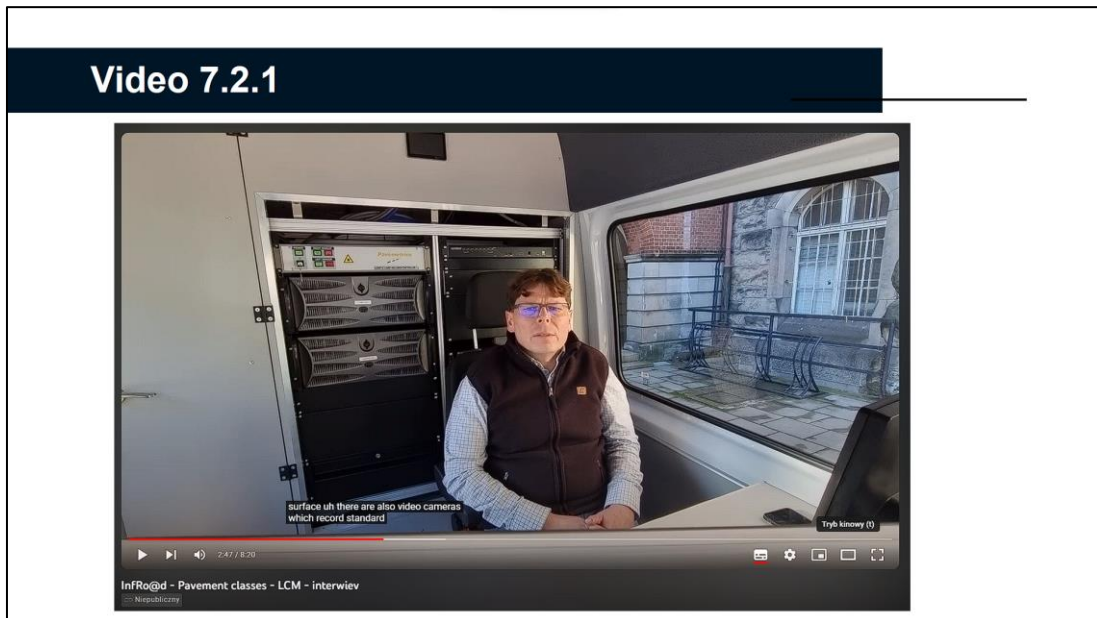


Figure 4. Example of didactic materials – interview with the specialist



Figure 5. Example of didactic materials – prepared kml files

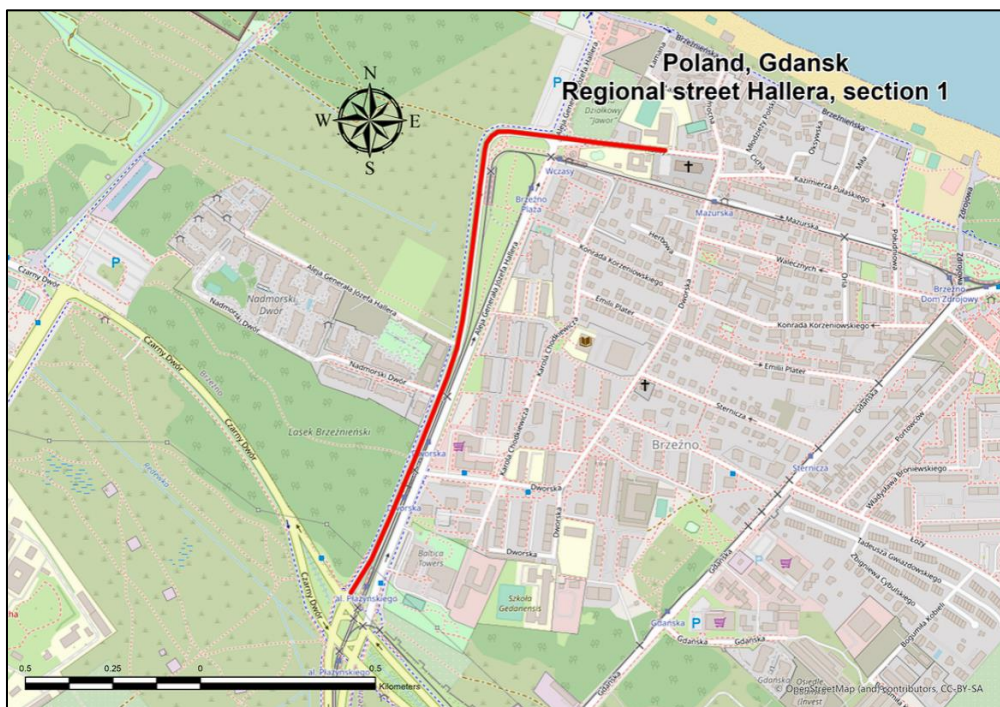


Figure 6. Example of didactic materials – maps of local roads

An interactive introductory and summary quizzes.

Each of the quizzes consist of 24 multi-choice test-questions:

- 1) The wheel load causes:
- 2) The forces acting at the contact point between the tire and the road surface are:
- 3) Water affects:
- 4) Water has positive / negative effect on...

- 5) High temperature of the pavement affects:
- 6) Low temperature of the pavement affects:
- 7) Permanent deformations can occur in:
- 8) Permanent deformations can be caused by:
- 9) Permanent deformations arise as a result of:
- 10) Cracks can occur in:
- 11) Cracks can be caused by:
- 12) Mark the correct answers related to pavement cracks:
- 13) Asphalt concretes (a type of hot asphalt mixture) include:
- 14) Binder content in the hot asphalt mixture (HMA) should be:
- 15) Stiffness modulus is equal to:
- 16) The stiffness modulus is:
- 17) Mark the correct answers related to binder penetration:
- 18) Repetitive load is used in:
- 19) In the case of permanent deformations treatment, it is (general) possible to use:
- 20) In the case of pavement cracks treatment, it is (general) possible to use:
- 21) Milling methods are used in the case of:
- 22) Filling methods are used in the case of:
- 23) Cover by a new layer is used in the case of:
- 24) Reconstruction methods are used in the case of:

3 DIDACTIC AND TRAINING MATERIALS FOR ROAD PAVEMENT MANAGEMENT

Per the adopted assumptions, the material development is available on a publicly accessible e-learning platform.

3.1 Gdansk University of Technology e-learning platform

GUT e-learning is a platform developed by the Gdansk University of Technology to provide remote education, conduct tests to verify knowledge, and access virtual laboratories. E-learning is integral to the university's education and virtualisation, utilising ICT (Information and Communication Technologies). The courses are available in electronic form via web browsers and mobile applications, created using Moodle - a popular software for eLearning.

At Gdansk University of Technology, it covers a fully remote form (e-learning) and a mixed form, in which traditional classes and distance learning complement each other (blended learning).

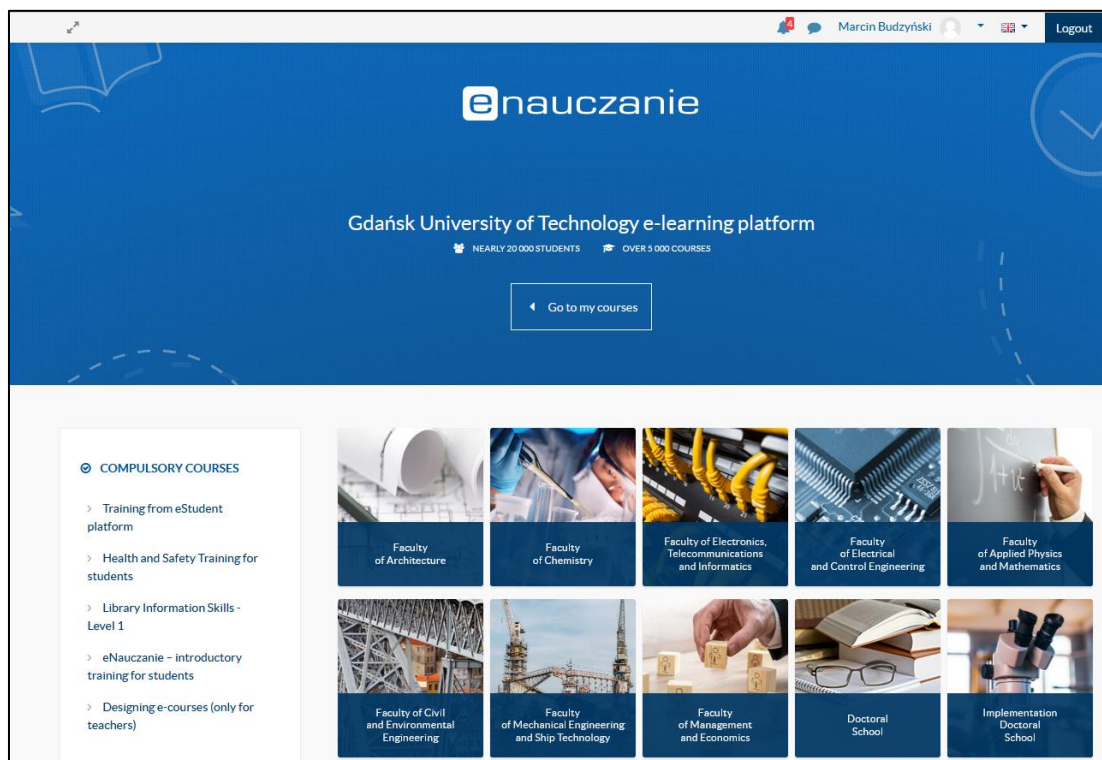


Figure 7. Start menu of e-learning

3.2 Introduction and purpose of the e-learning platform

The Moodle-based e-learning platform, developed under the project InfRo@D, is a comprehensive digital tool to enhance road pavement management education.

The e-learning platform is available on the Internet, which enables its use by research centres and road authorities throughout Europe. The e-learning platform contains road pavement management courses, all available to be applied to existing university course curricula. Through the e-learning platform, the project is committed to creating a one-stop solution for online learning on Pavement Management by offering training on all aspects of the subject that cater to all levels.

The platform's content is a synthesis of extensive research on the impact of infrastructure on road safety, combined with established road safety methodologies. Users of the platform can:

- Observe Road Safety Audit (RSA) - Erasmus+ European Digital Education in Road Infrastructure Management INFRO@D.
- Observe Roadside safety management - Erasmus+ European Digital Education in Road Infrastructure Management INFRO@D.
- Observe Safety management of vulnerable road users - Erasmus+ European Digital Education in Road Infrastructure Management INFRO@D.
- **Observe Road pavement management - Erasmus+ European Digital Education in Road Infrastructure Management INFRO@D.**

The platform with InfRo@d courses is accessible at: <https://enauczanie.pg.edu.pl/moodle/my/>

The didactic and training materials will be available after logging into the e-learning platform. Detailed information describing the process of registration is available at <https://support.pg.edu.pl/archive/display/HPPG/Access+to+eLearning+platform>.

A Chrome browser on a PC or Laptop is recommended for optimal performance. A user registration process is mandatory for full access. Post-registration, certain features may require administrative approval.

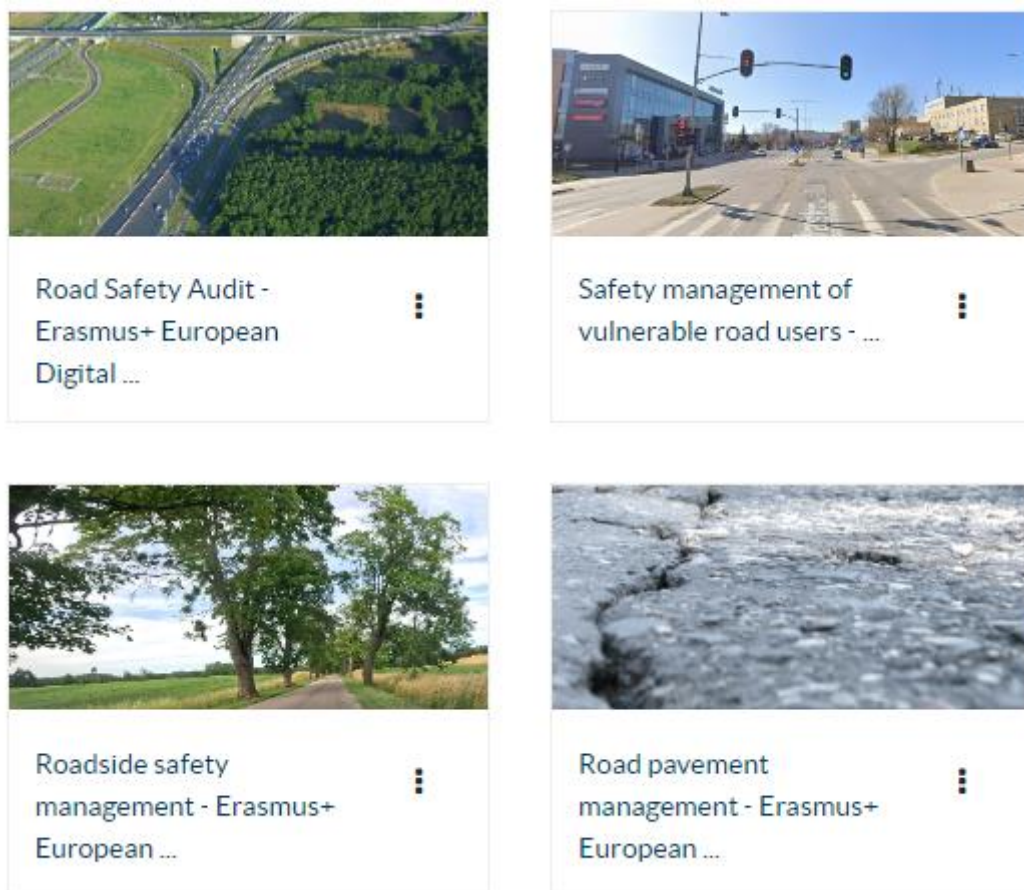


Figure 8 Overview of InfRo@d didactic materials and certification programme available on <https://enauczanie.pg.edu.pl/moodle/my/>

3.3 Detailed division of didactic and training materials

Table 2 provides a detailed description of the planned didactic and training materials under the road pavement management issues.

Table 2. The planned detailed division of road pavement management lessons

No.	Type of classes	Hour	Short Name	Detailed description	Resource Type
Chapter 1 - Introduction to the course					
1	Lecture	2	Course intro	Teacher introduction to the course and course topic. Plan of the course and course details. Interactive introductory quiz.	PowerPoint - teacher Interactive quiz Group discussion
2	Lecture	3	Repetition	Repetition of knowledge about road asphalt materials and pavement structures.	Video recording Group discussion
3	Lecture	3	PMS intro	Teacher introduction to the Pavement Management System (PMS). Teacher information about input data to the PMS.	PowerPoint - teacher
	Practicals (remote)	1	Homework 1+2	Details about students' homework - general information, the choice of the road section and collection of input data (necessary - homework 1, additional - homework 2). How to do homework. Rules and plan for presenting results by students.	PowerPoint - teacher Group discussion
Chapter 2 - Collecting of input data					
4	Practicals (remote)	4	Homework 1 results	Students' presentations about collected input data (results of homework 1).	PowerPoint - students Group discussion
5		4	Homework 2 results	Students' presentations about collected input additional data (results of homework 2).	PowerPoint - students Group discussion

No.	Type of classes	Hour	Short Name	Detailed description	Resource Type
Chapter 3 - Diagnostic, assessment and classification of pavement condition - basics					
6	Lecture	1	Diagnostic intro + homework 3	Introduction to the chapter from the teacher. General information about diagnostic, assessment and classification of pavement condition. Homework 3 details - diagnostic, assessment and classification of pavement condition. How to do homework. Rules and plan for presenting results by students.	PowerPoint - teacher Group discussion
7	Practicals (remote)	10	Homework 3 results	Students' presentation about assessment and classification of the pavement condition, measuring, testing and diagnosing (results of homework 3).	PowerPoint - students Group discussion
	Lecture	2	LCMS	Teacher information about automatic pavement diagnosis - LCMS diagnostic vehicle.	PowerPoint - teacher Interview Group discussion
Chapter 4 - Identification of pavement damages					
8	Lecture	1	Damages info	Introduction to the chapter from the teacher. Types of pavement damages - their appearance, characteristics and causes.	PowerPoint - teacher Group discussion
9	Practicals (remote)	2	Damages identification + homework 4	Exercise on identification of road pavement damages. Homework 4 details - identification of road pavement damages. How to do homework. Rules and plan for presenting results by students.	PowerPoint - teacher Pictures gallery Group discussion
	Field activities	4	Homework 4 results	Students' presentations about collected damages on their roads and identification (results of homework 4).	PowerPoint - students Group discussion



No.	Type of classes	Hour	Short Name	Detailed description	Resource Type
Chapter 5 - Laboratory assessment of road asphalt materials					
10	Laboratory	1	Lab intro + homework 5	Introduction to the chapter from the teacher. Homework 5 details - laboratory tests and road materials assessment. How to do homework. Rules and plan for presenting results by students.	PowerPoint - teacher Group discussion
11		4	Lab samples	Methods of taking samples from the road asphalt pavement- - information from the teacher.	Video recording Group discussion
12		12	Homework 5 results	Students' presentations about laboratory tests and road materials assessment (results of homework 5). Information and videos from the teacher about laboratory devices for lab-tests.	PowerPoint - teacher Video recording PowerPoint - students Group discussion
Chapter 6 - Diagnosis, assessment and pavement condition classification - students' reports					
13	Field activities	1	Diagnostic details + homework 6	Introduction to the chapter from the teacher. Homework 6 details - reportig of students' work on diagnosis, assessment and pavement classification for students' roads. How to do homework. Rules and plan for presenting results by students.	PowerPoint - teacher Group discussion
14		4	Homework 6 results	Students' report about diagnosis, assessment and pavement condition classification (results of homework 6).	PowerPoint - students Group discussion



No.	Type of classes	Hour	Short Name	Detailed description	Resource Type
Chapter 7 - Prediction of pavement condition changes over time					
15	Lecture	1	Prediction intro + homework 7	Introduction to the chapter from the teacher. Homework 7 details - methods of prediction of pavement condition changes over time. How to do homework. Rules and plan for presenting results by students.	PowerPoint - teacher Group discussion
16	Design class	5	Homework 7 results	Students' presentations about methods and models for prediction of pavement condition changes over time (results of homework 7).	PowerPoint - students Group discussion
Chapter 8 - Maintenance of road asphalt pavement - treatment methods					
17	Lecture	4	Treatment intro + homework 8	Introduction to the chapter from the teacher. Homework 8 details - treatment methods of road asphalt pavement. How to do homework. Rules and plan for presenting results by students.	PowerPoint - teacher Video recording Group discussion
18	Design class	5	Homework 8 results	Students' presentations about maintenance plan of their roads (results of homework 8).	PowerPoint - students Group discussion
Chapter 9 - Summary of the course					
19	Lecture	1	Course end	Course summary from the teacher. Interactive summary quiz.	Interactive quiz Group discussion

