**“Intelligent Vehicle Technologies & Smart Mobility”**

**Syllabus SCA.07/3**

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Version 1

# Name of the course

# Communications and Information Systems in Smart Transportation - UNIZA

# ECTS credits

6 Credits, (45H Theory; 30H Lab), 3rd semester

In educational process within this course, students will obtain knowledge needed for transportation practice. This lecture provides students with basic knowledge in the field of transport issues and detail information about use of intelligent transport systems, communication and information systems. The lectures should acquaint students with ITS technologies using in transport processes, teach to use the most widely used ITS tools and prepare students for implementation of ITS tools in practice. Students become familiar with current development of ITS, and communication and information systems.

# Objectives

The main objectives of this lecture are following:

* Information and communication systems – definition of an information and information systems, national system of transport information, application of communication and information systems.
* Navigation systems – history, basic terms and concepts, using of navigation systems in practice.
* ITS in cities – management of traffic hubs, networks and traffic flow, parking management.
* Application of information systems in public transport – passenger check in and check out systems, information and managing system in public transport including a preference of public passenger transport.
* Intelligent communication and information systems in vehicles.
* Information and managing systems of highways, tunnels, intelligent road communications.

# Learning outcomes

The general expectation regarding the knowledge to be provided/acquired is as follows:

* independent analytical work in the field of intelligent transport systems;
* provide qualified look at solutions of transport issues using communication and information systems;
* applications of ITS to improve quality and permeability of transport and reduce a number of traffic accidents and their consequences;
* using communication and information systems to provide real time information to all users of road network;
* Familiarize with information systems in vehicles and systems affecting traffic flow.
* Familiarize with support software PTV Map and Guide Internet uses in freight transport management.

# Contents

# **Information and communication technologies**

## What does information mean?

## Definition of information systems

### Elements of information systems

### Structure of information system

### Information systems in road transport

### Information systems within traffic flow

### Information systems implemented in vehicles

## National system of transport information

## Collecting and processing of static and dynamic information

### Sensors

### CCTV – camera systems

### Road users, emergency services, police corps

## Communication technologies

### INMARSAT – satellite system

### Information broadcasting technologies used in road transport

#### GSM (Global System for Mobil Communication)

#### RDS/TMC (Radio Data System/ Traffic Message Channel)

#### DSRC (Dedicated Short Range Communication)

#### TPEG

### Wireless networks

# Navigation systems

## History of navigating and basic terms

## Types of navigation systems

## Global Positioning System (GPS)

### Satellite navigation system GLONASS

### Galileo

### BeiDou

## Extensions GNSS

# Intelligent vehicles and information and communication systems

## Intelligent vehicles in road transport

## Definition and basic terms

## V2V and V2I communication

### V2V communication using ZigBee protocol

### V2V communication using Wi-Fi

### V2V communication using Bluetooth and GPS

## Autonomous vehicles

### Definition and history

### How does an autonomous vehicle work?

### Selected projects of autonomous vehicles in real traffic

#### Tesla Motors

#### Volvo Cars - ,,Drive Me”

#### Google automobile

#### Project AdaptIVe and K-City

#### Autonomous Buses

#### Autonomous Trucks

# Telematics systems in cities

## Traffic management system of a city

## Basic parts of traffic management – a principle of transport management

### Traffic light signalization system

### Detection system of transportation

### Variable message signs

### Meteorology information system

### Communication systems

### Dispatch centre

# Parking systems

## Solutions of parking depending on urban character of an area

## Technical equipment of parking system

## Vehicle navigation to free parking lots

### Static navigation of vehicles

### Dynamic navigation of vehicles

# Public passenger transportation

## Information systems in public transport

## Passenger check in/out systems in public transport

## Public transport preference

### Passive preference

### Active preference

### Technical base of public transport preference

### Intelligent communication – radars, Wi-Fi networks

# E-Call

## History and definition

## How does E-Call work?

# Intelligent road communications

## Intelligent junctions

## Intelligent pedestrian crossings

## Intelligent traffic signs

## Intelligent highway

## Intelligent solar pavement

# Control and coercive means

## Transport policy and legislative measures

## Objective responsibility

## Controlling systems

# Information systems in freight transport management

## Legislative requirements of information systems in companies

## Software support for freight transport planning as a part of information system

###  PTV Map and Guide Internet

###  Databanks of loads and free vehicles

###  EcoTransit – emission data and energy consumption calculation

###  Electronic Fee Collection System

#  Excercises

## Getting acquainted with PTV Map and Guide Internet - basic operations.

## Data input – defining a transport from origin to destination, vehicle parameters, type of goods (loading/unloading), defining restrictions (legislative, real time traffic conditions, and weight limitations).

## Calculation results – route from origin to destination, environment impacts of transportation, emissions and energy consumption.

## Project elaboration – every student will elaborate own project with defining an origin and destination of transportation by lecturer. Students will make this project with lecturer assistance for better understanding of each part of modelling specified transportation relation in PTV Map and Guide Internet.

# Teaching method

Lectures, case studies, tutorials/exercises

* Study materials are available for students via Moodle system. During lectures the full contents of each presentation is systematically explained by the Lecturer.
* Presentations include various exercises with solutions, good practice applications in abroad as well as short videos presenting these applications in practice for the good understanding of the content of each chapter. A discussion of lecturer and students about each chapter is recommended for better understanding.
* Several exercises are proposed by the Lecturer to be solved by students as projects. This should help to test the self-learning potential of students.

# Assessment method

Mid-term and final oral and/or written examination, exercises from case studies.

# Textbooks – Selected relevant links

**Textbooks**

* Samuel Morgan: Intelligent Transportation Systems – Technologies and Applications, ISBN-13: 978-1632403148.
* Ignacio Julio García Zuazola, Enrique Onieva, Unai Hernandez-Jayo, Asier Perallos: Intelligent Transport Systems, ISBN: 9781118894781.
* **Picone**, M., **Busanelli**, S., **Amoretti**, M., **Zanichelli**, F., **Ferrari**, G.-L.: Advanced Technologies for Intelligent Transportation Systems, ISBN 978-3-319-10668-7.
* Aleksander Sładkowski,Wiesław Pamuła: Intelligent Transportation Systems – Problems and Perspectives, ISSN 2198-4190, ISBN 978-3-319-19150-8.
* Wenli Yang, Xiaojing Wang, Xianghui Song, Yun Yang and Srikanta Patnaik: Design of Intelligent Transportation System Supported by New Generation Wireless Communication Technology, DOI: 10.4018/978-1-5225-5643-5.ch028.
* John Black: Urban Transport Planning, ISBN 9781351068598

**Selected relevant links:**

* <https://mginter.mapandguide.com/v6.5/>
* <https://www.timocom.co.uk/>
* <https://www.ecotransit.org/>
* <https://www.sciencedirect.com/science/article/pii/S0377221703000262>
* <https://civitas.eu/measure/public-transport-communication-system>
* <https://www.motorolasolutions.com/content/dam/msi/docs/en-xu/transport/next-generation-transport-communication-systems.pdf>

**Software**

**OPNET – free software for universities**

**MATLAB TAH FULL SUITE**