TOPICS OF COURSES FOR FINAL STATE EXAMINATIONS OF MASTER'S DEGREE PROGRAMME

(for CTU in Prague Faculty of Transportation Sciences students)

Master's Degree Programme:
N 3710 – Technology in Transportation and Telecommunications

Study Field 3708T009 – IS – Intelligent Transport Systems

1st compulsory course: INTELLIGENT TRANSPORT SYSTEMS AND THEIR COMPONENTS

1. Telematics
   - What is meant by telematics.
   - Definition of telematics.
   - Standardization in telematic area – standardization bodies.
   - Most important telematic applications.
2. Telematic systems in general
   - Hierarchy of telematic systems.
   - Telematic systems architecture.
3. Telecommunication technologies used in telematics
   - DSRC.
   - IEEE 802.11.
   - IEEE 802.15.
   - IEEE 802.16.
   - IEEE 802.20.
4. Electronic fee collection
   - Principles.
   - Reasons for introducing.
   - Situation in Europe, in the Czech Republic.
5. Electronic fee collection – technologies
   - DSRC.
   - GNSS / CN.
   - LSWA.
   - ANPR.
6. E-call
   - What is meant by e-call.
   - How does e-call work.
   - What is Public Service Answering Point (PSAP).
   - Position of e-call in Europe.
7. RDS-TMC
   - Dynamic navigation.
   - Technology used for RDS-TMC.
   - Traffic information structure in RDS-TMC.
   - What are Location tables, Catalogue of events.

8. Global navigation satellite systems – principles, technologies, differential global positioning systems, EGNOS
   - Basic principles of GNSS and their performance parameters
   - Systems in operation or under development – GPS, GLONASS, GALILEO, COMPASS – basic information.
   - Differential global positioning systems, EGNOS.
9. Applications of global navigation satellite systems
   - Navigation.
   - Security applications.
   - Vehicle preference applications.
   - Electronic fee collection applications.
   - Vehicle applications using GNSS.
   - Transport modelling.
   - Fleet management.
   - Examples of applications for various means of transport.
10. Cooperative systems
    - Principles – C2C, C2I, C2X.
    - Applications.
    - Possible telecommunication technologies.
11. Railway systems
    - ERTMS.
    - ECTS levels.
    - GSM-R.
12. Telematic applications in air and water transport
    - Automated identification system in water telematics.
    - Vesel Traffic Management and Information Services.
    - Advanced Surface Movement Guidance & Control System.
    - ATM Master Plan, ATM levels.
13. Basics of project management aspects
    - What is a Project, what are the main characteristics of the Project? What is Project Management?
    - What are the key characteristics of successful project manager? Provide the reasoning for the characteristics you have chosen.
    - What is Work-Breakdown-Structure? What is the purpose of WBS? Who decides or contributes to the decision on the WBS in the Project?
    - What is time-plan? What are the milestones? What is their purpose?
    - What is risk? Why is it worth to register and monitor the risks in the Projects? How is the risk evaluated, recorded and monitored?
14. Basics of the testing aspects
    - What is the purpose of testing within the Project? When within the Project lifetime is the testing usually performed?
    - What types of tests are usually run within the Project? What is their scope and logical order?
    - What is environment (in relation to the testing)? What types of environment are used for the purpose of testing?
15. Basics of the evaluation aspects
    - What does effectiveness, efficiency and performance stand for? Describe the difference and the way they could be measured.
    - What is KPI? How is it specified? Towards what are they specified? What are the main characteristics of KPI? Who usually does specify KPI?
    - Describe on an example what is an effectiveness of an implementation of an ITS application (choose your own).

2nd compulsory course: TRAFFIC FLOW THEORY AND MODELLING

1. Traffic stream
   - definition of traffic stream; what are influencing factors; linear or non linear, basic flow-density diagram; the basic features of traffic stream
2. Basic traffic parameters
   - definition of basic parameters, L-t diagram and trajectories of vehicles – linking to measurement of parameters, average annual daily / weekday traffic, average daily traffic, peak hour factor
3. L-t diagrams
   - definition time mean speed, space mean speed, relation between both speeds, travel time explanation; measurement of headway
4. Density and occupancy
   - definition of density; how to measure density in praxis, meaning of occupancy; relation between density and occupancy
5. Measurement of traffic parameters
   - traffic sensors and traffic surveys, real and historical model, examples of traffic parameters measurement; O-D measurement; section speed measurement
6. Traffic models
   - basic categories of models; deterministic and stochastic models (examples of applications); term of micro and macro simulation
7. Fundamental traffic model
   - plot relation between q, k, v; explain LOS
8. Microscopic and macroscopic models
   - principles of micro simulation, tasks solved by micro simulation; principle of macroscopic model, application on highways, RLTC principles
9. Shock waves
   - definitions, examples, relation to macroscopic a microscopic models, waves of discontinuity, shock waves in bottlenecks, stop & go principle
10. Traffic sensors
    - intrusive and non-intrusive detectors – examples, principles of inductive loops, basic forms of inductive loops
11. Traffic sensors – measurement of speed
    - detectors measuring speed; measurement by one inductive loop; how presence of vehicles in parking places is measured; WIM
12. Video detection and public transport priority
    - principles of video detection, limitations of applicability; priority detection of buses and trams
13. Statistical models
    - arithmetic mean, dispersion, median; examples of discrete and continuous variables; discrete and continuous distributions of traffic parameters
14. Macroscopic models
    - speed-density models: Greenshields, Greenberg, Underwood, generalized and multiregime models; flow-density models: parabolic, logarithmic; speed-flow models; definition of LOS
15. Automated incident detection
    - traffic excess: 1st and 2nd type; principles of pattern recognition algorithms and prediction algorithms; meaning of detection rate, False alarm rate, detection time, California algorithm, MEX algorithm

3rd course – compulsory-optional (student chooses one of the final state exam courses listed below – the topics are based on compulsory or elective study courses):

A. GEOGRAPHICAL, LOCALIZATION AND NAVIGATION SYSTEMS

1. Introduce Geographical Information Systems (GIS). Main functions, technologies etc.
2. What is model and GIS modeling? What steps are involved in the GIS modeling process? What are some examples of various types of models?
3. Describe the fundamentals of map projection in an earth coordinate system.
4. What are some differences between the Raster data and vector data?
5. What are the fundamental graphical components of spatial data in a GIS?
6. Describe relationships between GIS system and a Database system.
7. Describe three different ways to create and / or edit attribute table data.
8. Describe Topology data model for linear feature class. Why we store the Topology model?
9. What is the meaning of the following terms and acronyms and how are you familiar with the concepts involved in use of these terms and abbreviations in the context of GIS: GPS, DGPS, vector data, geodatabase, raster data, TIN, DEM, DRG, spatial reference, Geographic and projected coordinates, spheroid, WGS 84, attribute table, topology, data exploration vs. data analysis, query.
10. What is the minimum number of GPS satellites needed to determine the position of the receiver? Explain why this number of satellites is necessary and what role does the altitude play regarding to this number?
11. Describe fundamentals, principles and functions of Global Navigation Satellite System (GNSS). What is „Ephemeris" and „Almanac"?
12. What is the GPS constellation (placement)? Describe. How many operable satellites were originally active at the launch of the GPS system and why? Are there any other satellites besides the active ones? Regarding to the GPS system, how many satellites can be maximally visible in one moment?
13. What is DGPS (Differential GPS) and how does it work? Describe principle.
14. Explain, describe or draw WAAS (Wide Area Augmentation System) structure. Describe its principle and present purpose of the system.
15. GPS satellite signals and codes (describe structure of the navigation message, channels and types).
16. GPS accuracy (civil vs. military use). Explain differences.
17. Explain differences between usage of localization and navigation data in real-time mode and post processing mode. What is it post processing?
18. What is PDOP (Positional Dilution of Precision) and what does it presents? What can affect PDOP? Give examples.
19. Describe GPS trilateration principle. What is it used for navigation and localization systems? Is there any connection to triangulation?
20. Constellation 3Di as „indoor GPS". Describe principle and its usage.
21. What are the GPS error sources and what do they cause? Give examples.

B. INTELLIGENT VEHICLE

1. definition of passive and active safety
2. main research areas in vehicle safety
3. vehicle safety and legislation
4. test methodology for frontal and lateral crash
5. EuroNCAP vehicle assessment – principles
6. accidentology, data mining, statistics
7. pre-crash vehicle dynamics
8. active systems in pre-crash dynamics
9. vehicle braking, brake assistant and ABS
10. control loop for anti-lock brake system
11. preview control, automatic systems
12. drive assistance systems, radar and infra-red systems
13. ACC (adaptive cruise control)
14. car body design principles
15. crashworthiness of car body
16. deformation of vehicle in case of frontal crash
17. deformation zones design parameters
18. occupant dynamics during crash
19. injury biomechanics
20. injury mechanisms
21. AIS – abbreviated injury scale
22. restraint systems in vehicles
23. safety belt with pretension system
24. airbag system design, control loop and sensing
25. airbag dynamics and thermodynamics
26. pedestrian protection strategy
27. active systems in pedestrian protection
28. motorcycles safety and crash tests
29. safety of bus – rollover test
30. truck safety systems
31. compatibility of vehicle accidents
32. integrated safety systems
33. e-call system principles, post-crash rescue

C. SAFETY OF TRANSPORTATION SYSTEMS

1. The basic scheme of diagnostic system.
2. The structural scheme of diagnostics system.
3. Classification of diagnostic systems.
4. Diagnostics model – principle of progress design.
5. The description of subsystem of diagnostics systems.
6. The methodology of prognosis.
7. The influence of human on diagnostics system.
8. The explanation of failure.
9. The kind of failure.
10. The explanation of expectation of trouble-free operation, expectation of failure, density expectation of failure, intensity of failure, middle time of trouble-free operation.
11. The explanation intensity of failure and processes of degradation.
12. The area of acceptability, the area of tolerance, the live curve of system.
13. Production yield, price.
14. Open and close system, live curve of system.
15. Prediction of live curve.
16. Explanation of sensibility, the calculation of sensibility on topologic structure of net.
17. Certification, accreditation.
18. Life cycle of product, historical stage of quality.
19. Interaction human-machine interface, decrease of attention – origin, reasons.
20. Drivers training, states of human.
21. Electroencephalography and the next reasons detection of decrease of attention.
22. The basic types of neuron nets and their usage.

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