Study Programme Transport Systems and Technology

11APM Applied Mathematics

Course type: compulsory

Completion: examination (zk)

Guarantor department: Department of Applied Mathematics (K611)

Lecturer: doc. Ing. Ivan Nagy, CSc.

- Random Processes and Real Problems
- Bayesian prediction model of stochastic system (distribution, equations)
- Integrated and discrete model simulation of dynamical systems
- System state, state-space model, filtering (Kalman filter)
- Estimation of model parameters Bayes' theorem, reproducibility, exponential class distribution
- Integrated and discrete model estimation statistics, on-line recalculation of statistics, point estimation
- Estimation of models with non-Gaussian or non-categorical distribution reproducibility, point estimates
- Prediction with Bayesian model
- Finite interval control, dynamic programming, Riccati equations, algorithmization
- Mixture models of distributions with integrated and discrete components, hierarchical mixtures
- Estimation of mixture of distributions model
- Mixture estimation for clustering and classification
- Hierarchical mixture estimation
- Prediction with mixture model

12DIB Traffic Engineering and Safe Sustainable Mobility

Course type: compulsory

Completion: examination (zk)

Department of Transport Systems (K612)

Teacher: doc. Ing. Jiří Čarský, Ph.D., doc. Ing. Josef Kocourek, Ph.D., doc. Ing. Tomáš Mičunek, Ph.D.

- Theory and application of single vehicle motion. Theory of motion of traffic flow.
- Methods of determining the capacity of an intercrossroads section of a road.
- Methods for determining the capacity of uncontrolled, controlled and roundabout intersections.
- Shock wave in traffic flow. Predictive traffic models (aggregated and disaggregated).
- Calibration and balancing of models. Segregation and integration of traffic on public roads.
- Conceptual documents in transport and their preparation, strategies.

- Selection of appropriate data in the analytical part of the sustainable mobility plan.
- Use of data from mobile operators for traffic analysis.
- Scenarios for the future development of sustainable mobility, vision, key measurable objectives.
- Monitoring and evaluation of transport measures and projects.
- Mobility indicators, smart cities.
- Technical expertise in transport
- Road accident analysis
- Road accident prevention

15JAA - Language - English

Type of course: compulsory

Completion: examination (zk)

Department of Languages and Social Sciences

Teacher: PhDr. Klára Lancová, Ph.D.

- Laser technology and drilling; References and citations
- Space research; Design and construction; Article structure
- Automotive and Aviation; Introduction and conclusion of the presentation
- Mechanical and Electrical Engineering; Presentation Structure
- Materials and Chemistry; Use of Voice
- Construction and Environment; Presentation Image Support
- ICT and safety; Use of facts, figures and graphs
- Logistics, health and safety; Non-verbal communication
- Employment law basics; Establishing a relationship
- Destructive and non-destructive testing; Impact techniques
- Aviation; Meetings
- Nanotechnology; Discussion management

15JAF Language - French

Course type: compulsory elective

Completion: credit (z)

Department of Languages and Social Sciences (K615)

Teacher: Mgr. Mgr. Irena Veselková

- Introductory lecture. Literature, internet sources.
- Revision of the most important grammar.
- Professional texts grammatical, lexical and stylistic peculiarities.
- Public transport. Paris x Prague.
- Metro. Trams in France.
- Rail transport. TGV record.

- Air transport. Air fleet.
- Road transport. Highways, tolls.
- Transport safety.
- Terminology of the selected field, specific terms in French.
- Translation of technical texts.
- Consultation on the presentation of the dissertation work spelling, lexical and stylistic editing.
- Written presentation of the dissertation, résumé, discussion.
- Oral presentation of a professional article in the field of transport.

15JAN Language - German

Type of course: compulsory elective

Completion: credit (z)

Department of Languages and Social Sciences (K615)

Teacher: Mgr. Eva Rezlerová

- Research, working with German search engines
- Key grammatical structures, their practical application in concrete texts verb forms, participles
- Key grammatical structures, their practical application in concrete texts sentence structure
- Stylistic and lexical peculiarities of professional language, working with texts
- Use of the passive voice in professional texts
- Working with professional texts, structuring texts, presenting professional content
- Specific linguistic components in the description of graphs
- Translation of professional texts examples from the field
- Glossary of specific professional terms, comparison of Czech and German terminology in the field
- Preparation of presentation of own professional work
- Written presentation of a dissertation in preparation
- Oral presentation of the prepared dissertation using Powerpoint
- Independent linguistic speech on a professional topic
- Summary

15JAR Language - Russian

Course type: compulsory elective

Completion: credit (z)

Department of Languages and Social Sciences (K615)

Teacher: PhDr. Marie Michlová, Ph.D.

- Research, working with Russian search engines
- Basic grammatical structures, test materials, their practical application verb forms

- Key grammatical structures, test materials, their practical application sentence structure, flexion
- Stylistic peculiarities of professional language, working with texts
- Use of the passive voice in professional texts
- Self-presentation of professional texts practice
- Specific linguistic devices, description of graphs, lexical devices in written professional texts
- Translation of professional texts practice
- Creation of a database of specific professional terms, comparison of Czech and Russian terminology of the given field
- Syntactic and semantic structures in the presentation of professional work (prepared materials and their practical application
- application)
- Written presentation of the prepared dissertation
- Oral presentation of the prepared dissertation using Powerpoint
- Independent linguistic speech on a professional topic

15JAS Language - Spanish

Type of course: compulsory elective

Completion: credit (z)

Department of Languages and Social Sciences (K615)

Teacher: Mgr. Nina Hriscina Pushkina

- Introducción. Presente. / Introductory lecture. Present tense.
- Medios de transporte. / Means of transport.
- Futuro. Perífrasis "ir a + inf."/ Future tense. Phrase "ir a + inf."
- Transporte en la República Checa. / Transport in the Czech Republic.
- Pretérito perfecto compuesto. / Past tense complex
- Transporte en España e Iberoamérica. / Transport in Spain and Latin America.
- Pretérito perfecto imperfecto. / Past tense continuous.
- Política de transporte de la UE. / EU transport policy.
- Pretérito perfecto simple. / Past simple.
- Accidentes. / Accidents.
- Curiosidades. / Curiosities in the field of transport.
- CV. Carta de motivación. / CV. Motivation letter.
- Repaso. / Resume.
- Presentación + examen. / Presentation + written test.

16ABI Active Safety

Course type: compulsory elective

Completion: exam (zk)

Guarantor department: Department of Vehicle Technology (K616)

Teacher: doc. Ing. Jaroslav Machan, Ph.D.

- ADAS and driver assistance systems, their relation to active safety systems.
- Automated driving systems.
- Mechatronic active safety systems of vehicles.
- Electronic active vehicle safety systems.
- Predictive active vehicle safety systems.
- Cooperating active vehicle safety systems.
- Risk assessment of vehicle systems using FMEA (Failure Mode and Effect Analysis).
- Application of DoE (Design of Experiment) methods in design of experiment.
- Laboratory testing of active safety systems in a VR (Virtual Reality) environment.
- Laboratory testing of active safety with real vehicles and vehicle systems.
- Methods of tests HIL (Hardware in the Loop).
- Methods of evaluation and result interpretation of experimental work

12DRU Transport solutions in urban planning

Type of course: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Transport Engineering (K612)

Teacher: Ing. Bc. Dagmar Kočárková, Ph.D.

- Relationships and regularities between transport and territory
- Specification of linear transport structures
- Transport solutions in spatial planning
- Tools of spatial planning
- Sustainable mobility plans
- Cycling academy
- Suburbanisation
- Transit and destination traffic solutions
- Principles for addressing surplus and essential traffic
- Addressing pedestrian and bicycle traffic
- Hierarchization of communications in town
- -The principle of traffic calmed roads
- Rail transport in cities and agglomerations
- Negative effects of transport, possibilities of their elimination at the level of spatial planning

12EDS Aesthetics and Ecology of Transport Buildings

Course type: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Transport Engineering (K612)

Teacher: doc. Ing. Kristýna Neubergová, Ph.D.

- Traffic routing. Transport route management in the territory
- Evaluation of the impact of transport structures on the environment. Environmental Impact Assessment process
- (EIA).
- Multi-criteria evaluation of road routing options.
- Risk analysis methods
- The impact of a transport route on the landscape character
- Impact of the traffic route on natural protected areas. Conflict with protected areas of the system
- NATURA 2000, nature reserves, protected landscape areas or national parks.
- Greenery along transport routes. View from the point of view of transport safety.
- Greenery along traffic routes. Aesthetic and ecological aspects.
- Noise barriers and their effect on the aesthetics of the environment and the psyche of the inhabitants. Construction options, used materials, applications high or low noise barriers.
- Aesthetic design, impact on the environment and the psyche of passengers and residents.
- The role of transport in the process of suburbanisation.
- The impact of the construction of residential units on the transport system in the surrounding area.
- Impacts of commercial development along transportation routes. Land take by transport infrastructure.
- Induction of traffic. Suburbanisation and transport examples and case studies

12KOD Rail transport

Type of course: compulsory elective

Completion: examination (zk)

Guarantor Department: Department of Transport Engineering (K612)

Teacher: doc. Ing. Instructor: Prof. Lukáš Týfa, Ph.D.

- Rail transport systems their characteristics, advantages and disadvantages, optimal area of application.
- Operational aspects of individual rail systems, basic vehicle parameters and their relation to
- infrastructure.
- Interfaces between individual rail systems and conditions of mutual compatibility (dual systems).
- High-speed rail transport possible approaches, parameters, possible applications, examples from around the world.

- Increasing the attractiveness and profitability conditions of rail transport systems basic principles of economic
- assessment.
- Geometric parameters of the track modern elements, different shapes of crossing points and risers and their
- characteristics, advantages and disadvantages.
- Geometric parameters of track derivation of parameters and determination of lengths of non-linear transitions and
- risers, derivation of the curvature of the refraction of the level.
- Selection of the optimal solution in rail transport available tools (risk and multi-criteria
- analysis, tools system analysis, operational research tools).
- Selection of the optimal solution option in rail transport examples of application.
- Transfer terminals for public passenger transport tools for determining their optimal design.
- Modelling of passenger movement in transfer terminals.
- Combined transport systems using rail transport technical and operational solutions.
- Transport potential in passenger and freight rail transport available static data, transport capacity
- surveys, transport forecast.
- Interoperability of rail transport in Europe and categorisation of railway lines according to Czech law and their impact on operations and construction of railway systems.

12REX - Traffic Management and Traffic Excesses

Course type: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Transport Engineering (K612)

Teacher: doc. Ing. Josef Kocourek, Ph.D.

- Introduction, course overview
- Fundamentals of vehicle driving dynamics
- Theory of traffic flow
- Traffic modelling and simulation of real traffic events
- Management of urban agglomerations in a hierarchical arrangement (traffic hub, traffic area and department)
- Control methods in saturation and queuing theory
- Management of linear roads motorways
- Traffic accidents their evolution
- Driver behaviour, micro sleep, aggression
- Preventive tools to improve road safety
- Accident vs. congestion type traffic excesses
- Theoretical basis of methods for early identification of accident phenomena and congestion
- Theory of cooperative systems
- Revision, test information

12TIR2 Traffic Flow Theory II

Course type: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Transport Engineering (K612)

Teacher: Ing. Zuzana Čarská, Ph.D.

- The course deals with the traffic flow on roads in the intramural and extramural areas. They are discussed
- in detail traffic flow parameters, their interrelations and methods of their evaluation data pre-processing,
- filtering, transformation and reduction methods.
- Point and roadside measurement methods are presented. Traffic flow capacity and in detail various influences on traffic flow capacity are discussed.
- The next section focuses on macroscopic traffic models, discontinuities in traffic shock waves and
- acceleration noise in the traffic flow.
- As a basis for discrete modelling of traffic flow, statistical models are discussed to describe
- traffic parameters integrated (speed) and discrete (intensity) and the corresponding distributions.
- Microscopic models are discussed in detail as deterministic models basic theory and possible applications
- for traffic simulations, including examples of applications.
- The last session is an introduction to modern traffic flow physics and queueing theory.

12VPE Selected problems of ecology in transport

Course type: compulsory elective

Completion: exam (zk)

Guarantor Department: Department of Transport Engineering (K612)

Teacher: doc. Ing. Kristýna Neubergová, Ph.D.

- Transport noise issues, general principles and current legislation
- Noise sources, measures leading to noise reduction
- Field measurements with the NOR 140 sound analyser
- Evaluation of measured values
- Air and environmental pollution
- Individual pollutants from transport
- Impact of transport on global climate change
- Measures to reduce traffic pollution, current legislation
- Traffic-immission models, their historical development, types, possible applications, examples of outputs from the series
- international studies and projects
- Landscape fragmentation and its consequences

- Implementation of appropriate measures to reduce the barrier effect and their effectiveness
- Legislative framework and examples of solutions from the Czech Republic and abroad
- Transport in the framework of sustainable development, sustainable mobility
- Legislative framework, examples from the Czech Republic and abroad

12BZD Transport safety

Course type: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Transport Engineering (K612)

Teacher: doc. Ing. Josef Kocourek, Ph.D.

- Introduction current legislation related to road transport
- Traffic psychology
- Development of traffic accidents in the Czech Republic and abroad
- Examples of traffic accident processing and their applicability in practice
- Road inspections rehabilitation of accident sites
- Road safety audit
- Examples of audits carried out on the TEN-T network
- Method of monitoring traffic conflicts
- Road safety inspections
- Surveillance of traffic conditions
- Safety of restraint systems Arresters
- Safety in tunnels
- The process of approving traffic solutions by the PCR, authorization of the engineer
- Scientific approaches addressing road safety issues

14ITV Information technology in transport

Course type: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Applied Informatics in Transportation (K614)

Teacher: Ing. Jana Kaliková, Ph.D.; Ing. Jan Krčál, Ph.D.

- Flight planning with the support of planning software
- EFB
- Use of information technologies for performance calculations
- Electronic loadsheet
- Information technologies used for pre-flight and flight analysis
- Airline Management Software
- Use of Eurocontrol online tools
- Systems used in the CDM process
- Information technology used during aircraft and passenger check-in

- ACARS and its applications
- Air Traffic Management Control
- Flight watch systems
- AFTN, SITA and their applications
- Information systems used to enhance safety

16AT Automation of transport and construction technologies

Course type: compulsory elective

Completion: examination (zk)

Guarantor Department: Department of Air Transport (K621)

Teacher: prof. Ing. Prof. Věra Voštová, CSc.

- Systems of transportation of lump, bulk and liquid material. Automated construction management systems
- for the construction of highway and airport surfaces and the use of automated systems in the construction of underground structures, or railway superstructures.
- Use of optoelectronics, ultrasonics, total stations and GPS. Road repair and maintenance. Material recycling.
- Logistics of construction technologies and automatic control of ground moving machines. Economic evaluation of the use of
- of automation in transport construction.
- Road, rail, ship and air transport
- Transport of passengers, bulk, liquid and liquid bulk materials
- Transport of earth materials
- Conveyors with and without towing element
- Continuous and cyclical vehicles
- Vertical transport
- Basics of optoelectronics, lasers transmitters and detectors
- Ultrasonic systems
- Total stations and GPS
- Overhead and underground line structures, their construction, maintenance, repair and recycling
- Use of modern control methods in the construction of roads, motorways and airfields, or airport lines
- Control of ground moving machines in the construction of linear structures
- Logistics of construction technologies
- Economic evaluation of the use of modern control methods

17TRDL Transport theory

Course type: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Smart Cities and Regions (K617)

Teacher: doc. Ing. Denisa Mocková, Ph.D.; doc. Ing. Dušan Teichmann, Ph.D.

- Paths on non-oriented graphs
- Paths on oriented graphs
- Construction tasks
- Creating round trips (TSP, VRP, heuristic methods)
- Flows on networks
- Planarity of graphs
- Graph colouring
- Trees
- Assignment problem
- Location and allocation problems
- Discrete location problems
- Continuous location problems
- Discrete optimization problems and their solutions
- Application of genetic algorithms to discrete optimization problems
- Selected chapters on advanced applications of mathematical transport theory

16DVZ Dynamics and computational methods in vehicle design and testing

Type of course: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Vehicle Technology (K616)

- Teacher: doc. Ing. Petr Bouchner, Ph.D., Ing. Josef Mík, Ph.D., Ing. Jan Plomer, Ph.D.
- Principles of vehicle dynamics solutions
- Combined vehicle dynamics
- Tests of driving characteristics (dynamics) of vehicles and their evaluation
- Evaluation of driving comfort and ergonomics
- Approaches to passive safety, biomechanics issues
- Mathematical and theoretical tools for experimental work
- Mechatronic vehicle systems
- Numerical methods used in vehicle dynamics
- Software packages used to solve vehicle mechanics and dynamics, calculations, their outputs,
- validation and identification

17EDTD Economics of Transport and Telecommunications

Course type: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Smart Cities and Regions (K617)

Teacher: doc. Ing. Dušan Teichmann, Ph.D.

- Transportation in the national economic system
- Macroeconomic models
- Transport infrastructure, transport and telecommunication traffic
- Multiplier effects of transport constructions
- Trade in transport and telecommunications products
- Costing, pricing and tariffs
- Qualitative factors of transport systems
- Economic and energy aspects of transport systems
- Transport and environment, theory of externalities
- Infrastructure operation, public sector theory
- Services in the public interest
- Principles of transport service provision
- Transport and telecommunications companies, choice of company type, establishment and operation
- Economic principles of transport project evaluation

17MTP Modelling of technological processes

Course type: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Smart Cities and Regions (K617)

Teacher: prof. Dr. Ing. Otto Pastor, CSc.

- General approach to modelling in transport, specifics and breakdown of models
- Discrete choice theory as a basis for decision models in transport
- Logistic models, model inputs and outputs
- Modelling traffic flows as a typical transport modelling task
- Specifics of public passenger transport and its modelling
- Transport of dangerous goods by road modelling of routes
- Simulation models in road transport creating a simulation model
- Traffic behaviour model VISSIM model
- Railway transport infrastructure models procedures, methodology
- Railway timetable stability and its verification
- Collection and distribution tasks models, methods of solution
- Collection and distribution tasks in practice

17TZEL Railway transport technology

Course type: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Smart Cities and Regions (K617)

Teacher: doc. Ing. Vít Janoš, Ph.D.; Ing. Michal Drábek, Ph.D.

- Research methods of causal relationships of demand elasticity on supply planning in railway transport
- Organization and management of technological processes in passenger and freight railway transport
- Operational modelling of freight transport routes, stochastic control
- AVV, interaction of AVV and ETCS systems
- Operating intervals points of possible mutual danger, factors influencing the length of operating intervals
- Methods for determining track capacity, collision point theory, railway performance
- of the system as a whole
- Methods of optimising capacity and throughput, relationship between capacity and quality of service
- Timetable elements, UIC methodology, route heterogeneity
- Arrangement of simple tactical junctions
- Stability of the timetable, critical section for determining stability, solution options for
- insufficient timetable stability
- Methods for optimising operational processes in relation to infrastructure capacity
- Methods of solving the interaction between traffic, infrastructure and means of transport
- Operational management of railway traffic, optimisation methods, strategies and disposition objectives
- Modelling of technological processes on available and proposed transport infrastructure

18APP Applied flexibility and strength

Course type: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Mechanics and Materials (K618)

Teacher: prof. Ing. Prof. Ondřej Jiroušek, Ph.D.

- 3D elasticity equations. Elasticity. Plane deformation. Axisymmetry.
- Coordinate transformation. Walls. Derivation of the wall equation. Differential equation of the wall principles
- solution.
- Plates. Kirchhoff's theory of thin plates. Mindlin's theory of thick plates.
- Plate equations numerical methods of solution. Solution by the method of networks.
- Shells. Rotationally symmetric shells. Membrane and bending theory of shells.
- Nature of failure of materials and strength criteria.

- Plasticity introduction to the mathematical theory of deformation description. Tensor calculus.
- Plasticity. Conditions of plasticity, notation, incremental theory of plasticity.
- Numerical methods of solution. Direct method of stiffness. Solution of strut structures.
- Numerical methods overview. Variational principles in mechanics and dynamics.
- Finite element method. Principle of the method, principles of spatial and temporal discretization, convergence
- methods.
- Types of FEM elements, overview. Stiffness matrix and element mass matrix, construction.
- Non-linear problems and methods of their solution. Principles of iterative methods.

18BME Non-contact measurements in experimental mechanics

Course type: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Mechanics and Materials (K618)

Teacher: doc. Ing. Daniel Kytýř, Ph.D.; doc. Ing. Petr Zlámal, Ph.D.

- Limits of contact methods and sensors.
- Design elements of optical systems.
- Optical microscopy, interference and confocal microscopy.
- Optical interferometry, stereoscopy.
- Optical methods for measuring displacements and deformations (digital image correlation)
- Electron microscopy for topographic imaging, defectoscopy and material analysis.
- Methods of image data processing.
- Radiographic methods, computed tomography and its applications in experimental mechanics.
- Non-contact measurement of vibrations and velocities of moving objects

18BBC Biomechanics and human safety in transport

Type of course: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Mechanics and Materials (K618)

Teacher: doc. Ing. Daniel Kytýř, Ph.D.

- Anatomy of the human musculoskeletal system.
- Mechanical properties and deformation behaviour of tissues.
- Experimental biomechanics.
- Dynamics and factors of injury processes, injury criteria.
- Modern imaging and diagnostic methods in medicine.
- Principles of rehabilitation, regenerative medicine and tissue engineering.
- Protective equipment and safety measures to reduce the consequences of injury.

• Numerical simulations of dynamic processes leading to injury

18MKD Materials for structures in transport

Course type: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Mechanics and Materials (K618)

Teacher: Ing. Jaroslav Valach, Ph.D.

- Material Informatics, Selection diagrams, material properties database, material maps,
- optimal material selection procedure, examples of application of the procedure to model situations, information, Internet resources full-text databases of technical articles. Continuous learning process
- Open courses e.g. MIT.
- First principles, Atomic models, properties of potentials, calculations of material properties from first principles, computational methods, optimization methods inspired by nature (Monte Carlo, neuronal networks, simulated annealing), simulations of the behaviour of materials and their defects, analysis of simulations, linking atomic models with finite element calculations.
- New trends, New trends in "classical" structural materials (steels for automotive industry,
- super alloys for jet engines, self-healing materials, biodegradable polymers, materials
- for roads and linear structures = pipeline transport, pressurisation of gas pipelines).
- Materials for high temperature superconductivity and magnetic levitation. New technologies
 3D
- printing.
- Principles of composite materials design, fibre materials and their parameters,
- recyclable composites, fatigue and vibration damping; porosity and moisture penetration; study of
- degradation due to temperature, UV light, study of impact, oscillation,...
- Practical examples of the evaluation of impact tests; degradation ; the question of electrical conductivity; icing issue; practical implementation of calculation of effective properties from SEM images of cross-sections of carbon fibres.
- Degradation and fractography, effect of extreme conditions and environment, durability and reliability, reliability design, degradation mechanisms (fatigue, leak, corrosion, radiation embrittlement), "Black Chronicle" - lessons learned from past disasters (bridges, Liberty ships, ...)
- The lecture will be combined with direct observation of different types of damage on SEM (brittle,
- ductile and fatigue fractures, counting of striae in a fatigue break).
- Smart materials, inteligent materials and sensors. Principles and applications. Functional and graded materials. Metamaterials shapes for electromagnetic "invisibility", for choosing the Poisson number, auxetic materials, anti-reflective surfaces, non-wetting surfaces. Internet of things, autonomous sensors, drawing energy from the environment. Materials for batteries, hydrogen propulsion, alternative energy storage. Active and passive safety materials, e.g. foams, Newtonian fluids for retarders.

 Recapitulation of the effect of defects on ultimate strength and implications for the design of new materials. Future development of materials, major trends, expected breakthroughs (tough ceramics, 2D - graphene, 1D materials), strength limits of materials from theoretical principles. Lift to the stars.

18NMMD Numerical methods of mechanics and dynamics

Course type: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Mechanics and Materials (K618)

Teacher: prof. Ing. Prof. Ondřej Jiroušek, Ph.D.

- Direct stiffness method. Application to strut structures. Drawn/compressed member. Solution of strut structures.
- Variation formulation of the drawn-compressed member.
- Variation formulation of a bent strut.
- Bent strut with shear effect (Timoshenko). Bent strut on elastic substrate (Timoshenko-Winkler).
- strut loaded with M+N+T combination.
- Isoparametric elements. Natural coordinates.
- Isoparametric elements. Triangular and quadrilateral elements. Linear and quadratic elements T3 and T6, Q4 and Q8.
- Plane stress cases. Plane deformation, plane strain.
- Plane deformation, plane strain. Elements for plane problem.
- Plane strain, plane strain. Derivation of element stiffness matrix.
- Spatial elements. Summary of 2D and 3D elasticity in FEM. Use of symbolic algebra tools.
- Linear dynamics and FEM. Hamilton's variation principle. Consistent and diagonal mass matrices.
- Solution of the FEA natural oscillation. Method of stiffness constants.
- Time integration of the equations of motion. Implicit and explicit methods. Newmark's method.
- Numerical integration. Solution of nonlinear problems.

18ZKM Test methods of structures and materials

Course type: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Mechanics and Materials (K618)

Teacher: doc. Ing. Daniel Kytýř, Ph.D.; doc. Ing. Petr Zlámal, Ph.D.

- Design of experimental procedures and assessment of their reliability, measurement errors.
- Measurement of mechanical characteristics of materials in laboratory conditions.

- Tensometric methods for measuring deformations and residual stresses.
- Measurement and evaluation of deformation processes on real structures, realization of long-term
- measurements.
- Hybrid methods combination of experimental methods and simulations.
- Diagnosis of structural elements and systems, evaluation of defects in materials and products.
- Monitoring of the mode and development of damage, determination of residual lifetime period.

22MPN Modelling causes and processes of traffic accidents

Course type: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Forensic Experts in Transportation (K622)

Teacher: doc. Ing. Tomáš Mičunek, Ph.D.; doc. Ing. Prof. Drahomír Schmidt, Ph.D.

- Software simulations and modelling in DN analysis overview, processing procedures, accuracy, systems, licensing, general principles of use, explanation of terms. Comparison of procedures, limitations and advantages of different expert of suitable software for DN analysis, types of models
- Comparison of procedures, limits and advantages of different expert software suitable for DN analysis, types of models
- Control of simul. software (working with vehicles, working with models, modelling geometry changes and physical properties)
- Modelling of interactions with geometry and physical properties modification
- Simulation and modelling of simple ellipsoid assemblies
- Modelling of accident processes
- 3D models of environments and active elements for simulation environments custom creation, scanning, libraries
- Modelling of processes in 3D environment models analysis of the real environment on the accident process
- Accident reconstruction based on accident data (EDR)
- Modelling of selected crash tests 1 (verification, validation of models)
- Modelling of selected crash tests 2 (verification, validation of models)
- Solving real crash situations 1
- Solving real crash situations 2
- Issues of insufficient evidence

22PRI Reverse engineering procedures in transport

Course type: compulsory elective

Completion: examination (zk)

Guarantor department: Department of Forensic Expertise in Transport (K622)

Teacher: doc. Ing. Drahomír Schmidt, Ph.D.

- Introduction to reverse engineering
- Scanning principles, technology, digitization, technical equipment
- Scanning vectorization, scanning of samples, scan inspection
- Parametric modelling 1 principles, physical dimension material properties material definition,
- modelling components, creating technical documentation from parametric modeller environment
- Parametric modelling 2 modelling assemblies, complex projects, principles of adaptive modelling,
- parametric models and calculations FEM linear loading of structures, modelling of measured sample according to manufacturing documentation
- Photogrammetry overview, procedures
- Photogrammetry methodology, algorithms
- Basic processing of measured data working with point cloud, cleaning
- Basic processing of measured data building models, processing procedures, polygonization
- Processing of measured data algorithmization, model simplification
- Processing of measured data input information geometric fidelity preservation issues
- Verification and comparison of processed models (samples) 1
- Verification and comparison of processed models (samples) 2
- Exchangeable data formats data transfer between graphic systems, prototype 3D prints, production, CNC

12BIM Building Information Models

Course type: compulsory elective

Completion: exam (zk)

Guarantor department: Department of Transport Engineering (K612)

Teacher: doc. Ing. Lukáš Týfa, Ph.D.

- Modelling of individual projects and parts of transport infrastructure.
- Definition of building information modelling (Building Information Modelling or Building
- Building Information Management (BIM), advantages and disadvantages.
- Preparation of information models and procedures related to these models in transport
- construction.
- Legislative and non-legislative documents related to BIM.
- Information flow processes in BIM.

- The use of BIM in the different phases of the life cycle of a transport construction project and their continuity design, construction.
- The use of BIM in the individual phases of the life cycle of a transport construction project and their follow-up management and maintenance.
- Department of Transport systems and their relation to BIM.
- Analysis of data from information models construction collisions, construction procedures (schedule construction).
- Analysis of data from information models statements of work and budgets, change sheets, evaluations variant scenarios.
- Use of digital technologies in transport infrastructure and their links to information
- models.
- Working with three- and multi-dimensional programs for analysis and preparation of information models.
- Current situation in BIM in the Czech Republic and Europe, working groups for BIM support, problems solved.
- Practical examples of BIM application to transport construction