20SSR Solutions of Smart and Resilience Cities

Compulsory course

Lecturer: prof. Dr. Ing. Miroslav Svítek, dr. h.c.

Doc. Ing. Tomáš Horák, Ph.D.

The course is taught at Faculty of Transportation Sciences

The aim of the course is to present a systemic view of the issue of smart cities (Smart Cities) so that the resources used (land takeover, energy, etc.) are minimized and existing infrastructure (transport, energy, data, etc.) is maximized. The course will describe the sub-components of smart cities (intelligent transport systems, smart grids, smart buildings, smart lighting, e-governance, etc.) and will show the methodology of their mutual integration according to existing standards so that synergies between individual sectors occur and a reasonable quality of life is achieved for all categories of city residents. Emphasis will be placed on the resilience of cities, for example to natural disasters or terrorist attacks.

- Introduction to the issue of smart and resilient cities (historical development, basic terminology, organizations dealing with the issue of smart cities and their contribution to the development of the whole field)
- System description of a smart and resilient city (functional and information architecture, identification of sub-components, interface specifications, definition of strong processes, technical standards - CEN, ISO, IEEE, etc.)
- Smart city data platform (data collection, transmission and processing, sensor networks, Internet of Things - IoT, ontological data model of smart city, open data, sample of existing data platforms of cities)
- Smart city hall (data-driven decision-making, creation of the city's knowledge base, simulation models of strong city processes, smart tools for project preparation and management, including participatory models for communication with citizens)
- Smart buildings (sustainable buildings, BEMS - building energy management systems, BAS - building automation systems, KNX standards, BIM - building information modelling, BIM extension to CIM - city information modelling, demonstration of individual types of smart buildings - school, hospital, factory)
- Smart mobility (SUMP - Sustainable urban mobility plans, MaaS - Mobility as a service, C-ITS - Cooperative intelligent transportation systems, , new types of means of transport, smart city logistics)
- Smart energy (smart meters, EaaS - Energy as a service, smart grids - smart energy networks, renewable energy sources, smart appliances, smart energy storage, electromobility
- Smart lighting (categorization of illuminated urban infrastructure, minimization of energy costs and maintenance costs of city lighting, lighting as the backbone communication and sensory infrastructure of a smart city, integration of lighting and other functions - SOS, charging infrastructure, camera system, etc.)
- Smart street, square, district (example of integration of sub-components including evaluation of economic costs and benefits)
- Resilience and security of cities (safety, security, territorial resilliency, cyber attacks, resistance to natural disasters)

- Human dimension of a smart city (HMI interface, use of virtual and augmented reality, communication issues with users of smart solutions, new economic models)
- Legislative issues of smart city (Personal data protection - GDPR, Intellectual Property Law - IPR, determination of liability - liability, responsibility)
- Smart City Rating (Smart City Index according to ISO 37210, sample of smartness rating of individual cities)
- Examples of smart city implementation (EU, China, India, Africa, USA)

D05SMC Smart Cities in Context of Contemporary Thinking

The course is taught at Faculty of architecture

Compulsory course

Lecturer: Mgr. Vladan Klement, Ph.D., Mgr. Jiří Tourek, Ph.D.

The course extends the understanding of Smart Cities in a society-wide context. It is structured as a seminar primarily based on the critical analysis of texts on the border of contemporary philosophical and sociological thinking, approaches reflecting our society, technologies, but also the environmental aspects of this issue, including the ethical context of technologies. One of its goals is to develop critical thinking and thus enable a deeper understanding of smart cities in a broader context, based on an interdisciplinary approach to the issue. Thematically, the course will be structured by the following areas:

- Smart Cities in a broader context: ecological crisis, environment and sustainable development
- Between Ontology and Anthropology: The Limits of Man – The Limits of Technology
- Ethics techniques
- Philosophy of the city and the concept of Smart Cities
- Smart Cities in a Sociological Perspective

15JAA Foreign language – English

Course tutor: PhDr. Klára Lancová, Ph.D.

Compulsory

The course is taught at Faculty of Transportation Sciences.

- Laser technology and drilling; Referencing and citations
- Space research; Design and construction; Article structure
- Automotive industry and aeronautics; Opening and closing in presentations
- Mechanical and electronic engineering; Presentation structure
- Materials and chemistry; Using voice
- Civil engineering and environment; Visual presentation support
- ICT and security; Using facts, figures and graphs
- Logistics and health and safety; Nonverbal communication
- Elements of labour law; Rapport building
- Destructive and non-destructive testing; Impact techniques
- Aviation; Meetings
- Nanotechnologies; Leading a discussion

15JAF Language - French

Course tutor: Mgr. Irena Veselková

Compulsory

- Introductory lecture. Literature, Internet sources.
- Revision of the most important grammar parts.
- Professional texts – grammatical, lexical and stylistic characteristics.
- Public transport. Paris x Prague.
- Underground. Trams in France.
- Rail transport. Records of TGV.
- Air transport. Air fleet.
- Road transport. Motorways, toll.
- Transport safety.
- Terminology of the selected study area, specific terminology in French.
- Translation of professional texts.
- Consultation for the presentation of doctoral thesis - spelling, lexical and stylistic arrangement
- Written presentation of doctoral thesis, summary, discussion.
- Oral presentation of a professional article from the area of transport.

15JAN Language – German

Course tutor: Mgr. Eva Rezlerová

Compulsorily facultative

The course is taught at Faculty of Transportation Sciences.

- Research, work with German search engines.
- Main grammatical structures, their practical application in particular texts – verb forms
- Participle.
- Main grammatical structures, their practical application in particular texts – sentence structure.
- Stylistic and lexical features of professional language, text work.
- Usage of passive in professional texts.
- Work with professional texts, text structure, presentation of professional contents.
- Specific language means in description of graphs.
- Translation of professional texts – examples from the study area.
- Vocabulary of specific professional terms, comparison of Czech and German terminology of the
- given study area
- Preparation of presentation of student´s own doctoral thesis.
- Written presentation of the doctoral thesis.
- Oral presentation of the doctoral thesis in PowerPoint.
- Individual presentation with a professional topic
- Summary

15JAR Foreign Language – Russian

Course tutor: Mgr. Marie Michlová

Compulsory

The course is taught at Faculty of Transportation Sciences.

- Research, work with Russian search engines.
- Main grammatical structures, test sources, their application – verb forms.
- Main grammatical structures, test sources, their application – sentence structure, inflection.
- Stylistic features of professional language, text work.
- Usage of passive in professional texts.
- Individual presentation of professional texts – practice.
- Specific language means, graph description, lexical means of written professional text.
- Translation of professional texts – practice.
- Creation of database of specific professional terms, comparison of Czech and Russian
- Terminology of the given area
- Syntactic-semantic structure with presentation of a professional work (prepared sources and practical application).
- Written presentation of the prepared doctoral work.

- Oral presentation of the doctoral work in PowerPoint.
- Individual presentation with a professional topic.

15JAS Language – Spanish

Course tutor: Mgr. Nina Hriščina Puškina

Compulsory

The course is taught at Faculty of Transportation Sciences.

- Introducción. Presente. / Introductory lecture. Present simple.
- Medios de transporte. / Transport means.
- 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 perfect.
- Transporte en España e Iberoamérica. / Transport in Spain and Latin America.
- Pretérito perfecto imperfecto. / Past tense continuous.
- Política de transporte de la UE. / Transport politics in the EU.
- Pretérito perfecto simple. / Past simple.
- Accidentes. / Accidents.
- Curiosidades. / Interesting facts in transport.
- CV. Carta de motivación. / CV. Letter of motivation.
- Repaso. / Repetition.
- Presentación + examen. / Presentation + written test.

11SM Smart Mobility

Compulsory elective

Vyučující: prof. Ing. Ondřej Přibyl, Ph.D.; prof. Dr. Ing. Miroslav Svítek, dr. h. c., FEng,

Ing. Michal Matowicki, Ph.D.

The course is taught at Faculty of Transportation Sciences.

- Course introduction
- Project assignment
- Smart mobility and accessibility
- Analysis and Design process and methodologies, UML, SysML diagrams
- Smart city building blocks (explore a SC application in UML/SysML)
- Complex systems, Artificial intelligence for smart cities
- Project mid-term review
- Introduction to modeling SW AnyLogic
- Multiagent simulations in AnyLogic
- Traffic and urban simulations (travel demand and land use cycle)
- Traffic simulation Tools
- Different dimensions in simulation of smart cities (traffic, energy, people, ...)
- Project consultation
- Final presentation of projects

11MMA Mathematical Methods of Data Analysis

Compulsory elective

Lecturers: doc. Ing. Ivan Nagy, CSc.; doc. Ing. Evženie Uglickich, CSc.; Ing. Pavla Pecherková, Ph.D.

The course is taught at Faculty of Transportation Sciences.

- Introduction of basic notions: system, model
- Stochastic model and its estimation (Bayes rule)
- Normal and categorical models, estimation
- Prediction with dynamic categorical and normal models
- State filtration, Kalman filter
- Basics of the dynamic programming method for minimization of quadratic criterion
- Control of dynamic system with normal and categorical model
- Estimation by the method Naive Bayes
- Logistic and Poisson regresion
- Clustering (data separation, fuzzy clustering, density clustering, hierarchical clustering)
- Classification (K-nearest neighbour, Support vector machines)
- Decision trees and their use for classification
- Recollection and repetition

D05TSD Theory of Spatial Development

Compulsory-Elective

The course is taught at Faculty of Architecture

Lecturer: prof. Ing. arch. Karel Maier, CSc.

Informations on the theoretical background and concepts of urbanism and spatial planning, their reflection in the systems and methods of planning cities and regions in some countries and in the relations between urbanism - spatial planning and public administration. Theoretical currents and schools in spatial planning. The intellectual sources of discipline: utopia and social reform. Origin and development of complex planning and regional planning. Schools and theories of political analysis, transactive planning, radical planning, critical theory of progressive planning. Neoconservatism, liberalism, postmodernism and the new legitimization of planning. Contemporary fragmentation of urban planning concepts and its practical manifestations. Identity, contextualism, lay planning, leverage, public-private cooperation.

Content of lectures / discussions:

- Overview of the directions of planning theories
- Rational Theory of the 1st Half of the 20th Century – Howard, Geddes, Wright, Faludi
- Carrying capacity in the area – Chicago school, lessons from ecology

- The Theory of the Good City – Stein, Mumford, Lynch, Whyte
- Criticism of Expert Planning – Arnstein, Jacobs, Alexander
- Planning as a social and political process – incrementalism, advocacy planning, communicative planning
- Neoliberalism
- Postmodernism, feminism – Sandercock
- Space of Flows – Castells
- Digital urbanism?
- Contemporary planning topics – sustainable development, competitiveness, resilience and flexibility – Fischer, Newman, Beatley

D05RM Research Methodology

Compulsory-Elective

The course is taught at Faculty of Architectue

Lecturer: doc. Ing. arch.Jakub Vorel, prof. Dr. Ing. Martin Pospíšil, Ph.D., Mgr. Tomáš Hoření Samec, Ph.D. prof. Dr. Henri Hubertus Achten, prof. PhDr. Pavel Kalina, Ph.D.

General methodology of research, ethics of scientific research work.

- Research methodology in social sciences and humanities.
- Research methodology in technical and natural sciences.
- Interdisciplinary and multidisciplinary research, blending research from different areas of the scientific spectrum.
- Theoretical conception of the city – the city as a complex social, economic, ecological system
- Application of research methods in smart city planning
- Overview of selected modelling methods, scenarios, forecasting; social and political context
- Examples of modelling and smart management in the field of transport
- Examples of modelling and smart management in the field of water / energy management
- Consultation and discussion on the research concept of the dissertation from the point of view of the multidisciplinarity of research

17SCL Sustainable Cities ad City Logistics

Compulsory elective

Lecturer: doc. Ing. Tomáš Horák, Ph.D.; prof. Ing. arch. Karel Maier, CSc.

The course is taught at Faculty of Transportation Sciences.

• Ancient cities, technology and spatial planning: Greece, Rome. Technologic aspects of sustainability of ancient
empires.
• Mediaeval European cities: transformation of Roman assets, colonization of peripheries, settlement pattern

adjusted to technology.
• Ideal towns of Renaissance and their fortress implementation. Man-made landscapes (The Netherlands, Central
Europe). Managing crowds: Rome, Prague.
• 19th century urban challenges of industrialization – urban hygiene, overcrowding. Technological and planning
solutions.
• 20th century concepts of a good city - garden towns, neighbourhoods, zoning, new towns. Charter of Athens. City
as industrial product.
• Welfare cities. Planning solutions creating new problems. Concept of sustainable development vs neo-liberal
planning.
• Sustainability as a concept, sustainable cities and regions, resiliency, role of transportation
• Introduction to logistics, basic terms, supply chain, evolution of logistics
• Supplies in logistics, deterministic and stochastic models, ABC and XYZ analysis
• Logistics technologies, JIT, JIS, Hub & Spoke, Cross-Docking, Lean Manufacturing, Industry 4.0
• Logistics centers, logistics sprawl, IT in logistics, automatic identification of goods
• City logistics - traditional approach, first and last mile, Gateway
• City logistics - new approach, trends and concepts, impact of sharing economy
• Beyond cities and regions, global supply chains, 3PL, impact of geopolitics

17PO Modeling for Territory Development

Compulsory elective

Lecturer: doc. Ing. arch. Jakub Vorel, Ph.D.; Mgr. Jiří Čtyřoký, Ph.D.

The course is taught at Faculty of Architecture.

The course acquaints students with advanced tools of spatial analysis of phenomena in the territory
and with computer models designed for experimental research of settlement systems and tools
supporting spatial development planning. Based on the focus of their dissertation, students choose
one of the following topics:

• Advanced spatial data processing: ArcGIS, QGIS, PostgreSQL, PYTHON software, use of public
administration data, use of open data and social network data
• Advanced spatial data analysis: ArcGIS software, QGIS, PYTHON, spatiotemporal data cubes,
GTFS data, 3D GIS data
• Urban and landscape spatial metrics and space syntax: FRAGSTATS, QGIS software, depthmapX
• Spatial statistics: ArcGIS software, QGIS, GeoDaSpace

- Microsimulation of urban processes: Anaconda software, UrbanSim
- Modeling of complex phenomena in the territory: agent models NetLogo and Repast

Students are familiarized with the selected theme of self-study of recommended literature and in
cooperation with the teacher apply the tool on the issue of their doctoral theses.

14DMB Data Mining and Big Data

Compulsory elective

Lecturer: doc. Dr. Ing. Tomáš Brandejský

The course is taught at Faculty of Transportation Sciences

- Basic terms as databases, relational database, SQL, Big data
- Predictive analytics, Text mining, Data mining
- Introduction into basic methods of Big data processing – Hadoop, Spark
- Empirical data analysis in Scala, Python, or Java languages
- Large data statistical analysis in R*
- Large data processing using Deep learning ANN Caffe, TensorFlow
- Symbolic regression and development of other kinds of models using genetic programming algorithms
- Introduction into data pre-processing, modelling and interpretation of results
- PhD student will chose on of above listed approaches with respect to the subject of its PhD study and applies it in seminar work

20TSN Technology and Security of Sensor Networks

Compulsory elective

Lecturer: doc. Ing. Zdeněk Lokaj, Ph.D.

The course focuses on the security of data collection in the areas of sensor networks, sensors and communication technologies. It deals with the principles of sensor networks, the use of sensors of electrical and non-electrical quantities, interfaces for connecting sensors, communication technology for sensor networks such as SigFox, LoRa, NB-IoT, IoT technologies and SmartCity. Also trends in IoT and Smart City, data collection and data fusion technologies belongs to the area of interest.

· Sensors, signals and systems, data acquisition chains, sensor types (passive, active and semi-passive) and their application areas ·
Basic terms in sensor technologies (units, transfer functions, non-linearity, accuracy and range, hysteresis, saturation, etc.

· Sensing principles - overview (electric charge, magnetism, resistance etc.), sensor connections to the system, interfaces (A/D converters, amplifiers, excitation circuits, converters), safety measures in sensors.
· Occupancy and motion, velocity and acceleration sensors · Force, mechanical stress, pressure and tactile sensors
· Position, level, flow, temperature and humidity sensors · Acoustic sensors, light and radiation detectors, electrochemical sensors
· Data transmission - wired, buses used, characteristics, safety precautions · Data transmission - wireless, limitations and noise, safety precautions
· Sensor networks - introduction, evolution of sensor networks, transition to IoT technologies.

14TMS Traffic Microsimulation

Compulsory elective

Lecturer: Ing. Jan Krčál, Ph.D.

The course is taught at Faculty of Transportation Sciences

• Introduction to traffic simulations • Traffic analysis tools • The procedure of the design traffic microsimulation models • Introduction to the specific microsimulation software • Control systems in microsimulation model • Obtaining (online) data from a microsimulation model • Proposal of simplified Road Line Traffic Control (RLTC) • Proposal of dynamic traffic signal control systém (pedestrians) • Proposal of dynamic traffic signal control system (vehicles) • Proposal of public transport preference • Seminar work

D05UC Urban Construction

Compulsory elective

Lecturer: doc. Ing. arch. Jana Zdráhalová, Ph.D.

The course is taught at Faculty of Architecture.

A. Lectures with a discussion of key moments of urbanism:
• urbanism and urban planning in relation to architecture and spatial planning
• city environment, basic functions, attributes and development, city - landscape
• place as a determining factor, morphology, topography, definition, size
• city organization, composition, growth, centers, borders, models
• division of the city, part of the city, hierarchy, relations, facilities
• city construction, building blocks, typology, public space, matter - space - events
• infrastructure, transport equipment, technical equipment
• tools and methods of creation, relationships, scale, proportions, density, changes in the environment

• environmental regeneration, changes and stability, degradation, maturation and recovery,
conversion
• current topics, density, multifunctionality, public space, habitability, urbansprawl
B. Assignment of written paper and presentation of the paper on the topic of analysis of attributes of
objectively high-quality real environment - selected Prague localities using selected methodology and
theoretical basis (eg "Map of urbanism").