

Solutions of Smart and Resilience Cities

Compulsory course

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

Doc. Ing. Tomáš Horák, Ph.D.

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 resiliency, 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)

Smart Cities in Context of Contemporary Thinking

Compulsory course

Teacher: Mgr. Martina Sedláková, M.A., 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

Urban Construction

Compulsory-Elective Course

Lecturer: prof. Ing. arch. Jan Jehlík

Lectures with discussion of key moments of urbanism:

- urbanism and urban construction in relation to architecture and spatial planning
- city environment, basic functions, attributes and development, city – landscape
- place as determining factor, morphology, topography, delimitation, size
- city organization, composition, growth, centers, boundaries, models
- city structure, parts of the city, hierarchy, relations, amenities
- city building, building stones, typology, public space, matter – space – events
- infrastructure, transport equipment, technical equipment
- tools and methods of creation, relationships, scale, proportions, density, environmental changes
- regeneration of the environment, transformations and stability, degradation, maturation and valorization, conversion
- current topics, density, multifunctionality, public space, habitability, urban sprawl
- Assignment and presentation of the semester work on the topic of analysis of attributes of objectively high-quality real environment – selected Prague locations using selected methodology and theoretical basis (e.g. "Map of Urbanism").

Integration of Urban Systems

Compulsory-Elective Course

Lecturer: doc. Ing. arch. Akad.arch. Irishman. Jiří Klokočka, Ing. Richard Železný, Ph.D., M.Sc.

Lectures and thematically oriented discussions aim to familiarize doctoral students with the concept of the urban organism as a whole, here understood as a system created by the mutual interaction of its individual spatial and functional components. In this case, these urban structures are seen both in the dimension of the static, physical environment, i.e. from the point of view of the architecture of the city and urban space, and as functioning interactions and process links. Particular emphasis is placed on the urban transport component, especially taking into account the role of public, cycling and pedestrian transport, within the smart city, understood as desirable alternatives to car transport.

Topics of lectures and discussions:

- Urban structure of the city and the prevailing system of transport services – a look into the historical context
- Spatial and urban planning aimed at supporting rail and non-motorized transport
- Concept and design of intermodal transfer stations and public transport hubs
- Transferia and their influence on the development of the urban structure of the immediate surroundings and historical centers
- Artistic and spatial-compositional principles in the architecture of the city and public space
- Smart cities as a product of the synergy of information technologies and other approaches

Research Methodology

Compulsory-Elective

Lecturer: prof. Ing. Karel Maier, CSc.; Assoc. Prof. Dr. Ing. Martin Pospíšil, 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 multidisciplinary of research

Theory of Spatial Development

Compulsory-Elective

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

Modeling for Territory Development

Compulsory-Elective Course

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

The course will acquaint 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, QGIS, PYTHON, space-time data cubes, GTFS data, 3D GIS data
- Urban and landscape spatial metrics and space syntax: software FRAGSTATS, QGIS, depthmapX
- Spatial statistics: ArcGIS software, QGIS, GeoDaSpace
- Micro simulation of urban processes: Anaconda software, UrbanSim

- Modeling of complex phenomena in the territory: netLogo and Repast agent models

Students will familiarize themselves with the selected topic by self-study of recommended literature and, in cooperation with the teacher, apply tools to pre-prepared tasks or to the issue of their dissertation.

Learning path:

- Introduction to individual topics, choice of topic, handover of study materials, software installation
- Consultation of study materials and software and prepared tasks
- Assignment of the application of the tool with regard to the focus of study of the doctoral student
- Consultation of data and methodology of application of the tool
- Consultation of preliminary results
- Finalization of outputs
- Presentation of the results of the application of the tool

Data Mining and Big Data

Compulsory-Elective Course

Lecturer: doc. Dr. Ing.

- Basic terms such as database, relational database, SQL, big data
- Predictive analytics, Text mining, Data mining
- Introduction to basic methods of working with large data – Hadoop, Spark
- Empirical data analysis using Scala, Python, or Java
- Statistical analysis of large data in R*
- Processing of large data using Deep learning ANN Caffe, TensorFlow
- Symbolic regression and creation of other types of models using genetic programming algorithms
- Introduction to data, pre-processing, modeling and interpretation of results
- The doctoral student chooses one of the above chosen approaches with regard to the area of his doctoral thesis and applies it in his seminar work