

SHORT DESCRIPTION OF MODULE «GREEN TERRA DEVELOPMENT: EU POLICY AND PRACTICES» 2019-2020

Course provider (institution)	Moscow State University of Geodesy and Cartography (MIIGAiK)
title	GREEN TERRITORY DEVELOPMENT: EU policy and practice
justification	<p>The relevance of the inclusion of the module in the curricula is due to modern trends and requirements for architectural and urban design in the creation of a favorable environment for human life. Module curricula is created at the intersection of Sciences: ecology, architecture, urban planning, sociology and economics.</p> <p>This module is designed to provide students with comprehensive knowledge in the field of sustainable territory development in order to form a "green" worldview, taking into account modern solutions in the field of land management and territory development, the principles of green economy, modern trends in the transformation and development of engineering infrastructure of urban space. The curriculum is based on the analysis of primarily European policy and trends in sustainable development, based on modern and classical research in the field of spatial planning, urban planning and architectural design. It includes 4 sections that are complement to each other providing a comprehensive and contextual approach to higher professional education. The program of the module is aimed at students studying architecture and urbanism, urban planning, territorial administration and land law, remote sensing and research of natural resources, space monitoring and ecology. The training of students is aimed at forming a systematic view on the development of territories, includes the study of the main European and world trends in urban development, the development of green technologies and green economy in the context of international sustainable development policy, the development of the international European program of global earth monitoring "Copernicus", etc.</p> <p>The study and dissemination of ideas, principles, initiatives of international and EU policy in the field of sustainable development, as well as practical solutions in the field of land management and development of territories is important for the formation of a systemic "green" worldview in higher education (development of "green" education). Prosperity and lifestyle are based on the greatest asset - people. Investments in green education of young people allow to form a young generation with a green Outlook and green skills in the profession.</p>



<p>structure</p>	<p>Discipline 1 «Sustainable territory development» 1. Sustainable development concept. European and global policies on sustainable development. Socio-economic trends. Green economy 2. Forecasting and strategic planning of sustainable development of territories 3. Urban Growth & Sustainable Development</p> <p>Discipline 2 Space monitoring of landscapes. Digitalization & GEO(Data) 1. Space monitoring of landscapes for sustainable development 2. 3D modeling and 3D cadastre 3. Smart City Planner 4. Logistics management</p>
<p>target group</p>	<p>Students - level of education - master's degree</p>
<p>Education area</p>	<p>07.04.01 Architecture (specialization "Architecture and urbanism»), 21.04.02 Land and inventories (specialization "Management of real estate and territory development»)</p>
<p>type (compulsory/optional)</p>	<p>compulsory</p>
<p>cycle (short/first/second/third)</p>	<p>Second (Master)</p>
<p>year of study, semester/trimester</p>	<p>1st year 1st & 2nd semesters</p>
<p>number of ECTS credits</p>	<p>Module – 9 ECTS: Discipline 1 – 6 ECTS, Discipline 2 – 3 ECTS</p>



name of teacher(s)	<p>Discipline 1 "Sustainable territory development"</p> <ol style="list-style-type: none"> 1. Dr. Kamynina N. R., Doctor of Economics, academic coordinator of the module 2. Dr. Kuznetsova G. D., PhD, associate Professor, Department of space monitoring and ecology 3. Dr. Blagovidova N. G., PhD, Professor of the Department of architectural design 4. Ms. Khachatryan K. O., senior lecturer, Department of architectural design 5. Dr. Kutsenko S. Yu., Ph. D., associate Professor of real estate management and territory development 6. Ms. Snezhinskaya E. Yu., senior lecturer of the Department of real estate management and territory development <p>Discipline 2 "Space monitoring of landscapes for sustainable development (digitalization and GEO(Data))"</p> <ol style="list-style-type: none"> 1. Dr. Belenko V. V., Ph. D., associate Professor of space monitoring and ecology Department; 2. Dr. Serebryakov S. V., Ph. D., associate Professor of digital cartography Department
name of invited experts	<ol style="list-style-type: none"> 1. Dr. Tkachenko L. Ya., Ph. D., Advisor of the General Director of State Autonomous enterprise of the Moscow region "Research and design Institute of urban planning», Deputy Director for research and coordination of territorial planning; 2. Prof. Fesenko D. E., corresponding Member of the International Academy of Architecture, member of the Board of the Union of Moscow Architects, Advisor of the Russian Academy of Architecture and Construction Sciences, editor-in-chief of the journal "Architectural Bulletin» 3. Bulatov A.V., Head of the representative office of the government of Nizhny Novgorod region under the Government of the Russian Federation
mode of delivery; number of contact hours	<p>Face-to-face, self-study Total number of contact hours: 106 Discipline 1, number of contact hours: 72 Discipline 2, number of contact hours: 34</p>
language of teaching	<p>Russian</p>
learning outcomes	<p>Discipline 2 (in accordance to FSES RF) Knowledge: Basic theories and concepts, content and focus of research trends at the intersection of ecology and sustainable development, architecture and urban & transport planning; acute environmental problems, settlement at the global, regional</p>



and local levels; estimate features in the long-term planning of territory development in perspective of sustainable development;
Agenda 2030 and the main European approaches defining the sustainable development policy;
Main terms of the "International recommendations on urban and territorial planning" prepared by the UN human settlements programme, the EU Territorial agenda 2020;
The essence of the concepts "green outlook", green education", "green" economy, "circular" economy, "green" growth", features, objectives and state (government) role in the sustainable development, problems and prospects in European countries, in the world, in Russia;
The main methods and specifics of pre-project research; Integrated approaches to urban planning (architecture design) based on the principles of sustainable development; the main European trends in socio-cultural and engineering solutions in architectural design and territorial planning (including energy-efficient technologies) with the so goals of sustainable development; European countries experience in territory renovation and revitalization, development and redevelopment; actual European and world approaches to the organization and transformation of urban landscapes taking into account functional, ecological, psychological, aesthetic and compositional aspects.

Is Capable:

To use the basic laws of natural sciences in professional activities;
To carry out a comprehensive analysis of project tasks, to interpret and compare the results, to apply the sustainable development goals to development of new architectural solutions and planning of territorial development;
To correlate architectural concept and reconstruction planning of the city to the ecological foundations and territory settlement;
Analyze, generalize and apply innovative European practices and approaches in accordance with the principles of sustainable development in the development of conceptual architectural/urban design; Evaluate the effectiveness of urban solutions of different scales from a sustainable development perspective.

Discipline 2 (in accordance to FSES RF)

Knowledge:

The structure of the environmental monitoring system, thematic modules of geospatial data sources as well as their opportunities for sustainable development of territories; Theoretical basis for the production and processing of space images and their mathematical interpretation for the sustainable development of territories; Technical capabilities of the satellite imagery system Sentinel (Copernicus); Copernicus services and their use for research for sustainable development;



	<p>Basic methods and specificity studies using GEODATA and the application of methods of space monitoring; The main types and methods of pre-project studies in urban planning in EU countries with the so - called sustainable development of territories using GEODATA; The concept, methods of creation and scope of 3D geoimages; the Concept of 3D cadastre, methods of its formation and maintenance; The concept of "Smart City", BIM, CIM and "Big Data", digital democracy; Criteria for classifying settlements as "Smart City", methods of creation and scope of BIM, CIM and Big Data; Modern navigation positioning systems, their fields of application; Concepts and methods of use in transport of geoinformation and telematics systems to ensure its effectiveness;</p> <p>Is Capable:</p> <p>To apply computer technologies of spatial GEODATA search, primary processing, analysis and interpretation for thematic research and substantiation of accepted design ideas and approaches to solving problems in the context of sustainable development of territories; To apply and adapt innovative European practices and approaches in the design of original and non-standard architectural solutions, as well as in the planning of a favorable urban environment using geospatial data in accordance with the principles of sustainable development; When developing a conceptual project to correlate the results of environmental monitoring with the architectural planning and reconstruction/ renovation/ redevelopment of cities; To evaluate the effectiveness of urban different scale planning solutions based on the analysis of Big Data; To analyse, summarize and apply foreign experience of using 3D-cadastre, to estimate the prerequisites and possibilities of its introduction in the Russian Federation; To apply methods of spatial GEODATA integration for solving applied problems in the context of sustainable development of territories; To analyze and evaluate 3Dl geoimages in the context of the development of urban planning and architectural projects; To estimate the effectiveness of the interaction of urban transport systems (in complex).</p>
<p>module content</p>	<p>Discipline 1</p> <p>1. Sustainable development concept. European and global policies on sustainable development. Socio-economic trends. Green economy</p> <p>1.1. Global environmental problems and the concept of sustainable development. Climate change and low-carbon development. EU climate policy.</p>



Global problems: definition, nature and sources. Global environmental problems. Natural disasters and human impact. Ozone depletion (Montreal Protocol, 1987). Reduction of biological diversity (UN, Climate change Convention on the conservation of biological diversity, 1992). UN Climate change Convention, 1993; Kyoto Protocol, 1997-2005). Desertification, pollution and soil depletion, deforestation (reduction of forest cover). Scarcity and depletion of natural resources. Solid waste. Air pollution. Water pollution (rivers, lakes, ocean, groundwater). Global resource problem. The concept of “zero growth”. The global problem of worsening of population health. Anthropocentric consciousness VS ecocentric consciousness. The concept of sustainable development. Natural-scientific approach to sustainability in the environmental aspect. Analytical approach. Socio-humanitarian, economic and environmental aspects in their relationship. Problems of science and education in the transition to sustainable development. Sustainable development indicators. World+2C, World +4C. Climate migration. International climate policy. EU climate policy: basic principles. Trends in global CO2 emissions. Market mechanisms to promote low-carbon development. European emissions trading system. Corporate social responsibility. International support to developing countries: the EU as a key donor. Climate investment funds.

1.2. International cooperation in the field of sustainable development. European contribution to sustainable development policy.

2030 Agenda (UN, RIO+20). The future we want to live in. European contribution to the development of world policy of sustainable development (in historical retrospect). EU contribution into shaping of 2030 Agenda and SDGs. EU sustainable development strategy. The EU Environmental Implementation Review: Common challenges and how to combine efforts to deliver better results Suggested actions on better environmental implementation. (Brussels,2017)

1.3. Environmental activities in Russia and the EU.

States experience in development of National SD Strategies. The investment plan for Europe. Cross-cutting policy. Financial and economic instruments. OECD environmental indicators. European action for sustainability (Strasbourg, 2016).

1.4. Socio-economic changes and green economy: concept, principles, General characteristics, problems and development strategy.

Socio-economic background. The green economy: an umbrella structure, which includes elements of the “circular economy” and “the concept of the bioeconomy”. Circular economy – as an alternative to the classical linear model of production. The main principles of the circular economy: the renewal of resources, processing of secondary raw materials, the transition from fossil fuels to the use of renewable energy sources. Green economy strategy. Green economy indicators. Principles and directions of implementation of the green strategy (agriculture, fisheries, water, forestry, industry,



energy, construction, transport, tourism, waste management). Implementation of green economy strategy – international organizations, EU, USA, Japan, China, Korea. Green investments. Environmental technologies and assistance to developing countries as necessary conditions for the green economy implementation. Objective problems (technological restructuring of the economy, the energy sector, the consequences of innovation in agriculture, etc.). Subjective problems (political, “green” protectionism, etc.). Barriers to the development and transfer of green technologies.

1.5. Assessment of natural resource potential and efficiency.

Main resources in national wealth of the EU and Russia. Characteristics of land (soils), water, forest, energy resources, nature reserves and protected areas, etc. The problems of exhaustible resources. The threat of certain resources types depletion. Russia as a global environmental donor. Ecosystem services and the problem of payments.

1.6. The European strategy for the development of the green economy. Barriers and national support. RF policy of transition to the “green” economy.

EU development strategy until 2020. The concept of “smart, sustainable and inclusive” development. Cycling Economy. Bioeconomy as the European way. European Strategy For Bioeconomy. Bioeconomics and circular economy: increasing the value of biological waste, by-products and resource flows. Fundamental 3R-principles of circular economy – reduce, reuse, recycle: prevention of waste generation, reuse and recycling. “A European Strategy for Plastics in a Circular Economy”. Advantages and prospects of the Russian Federation in the context of a closed cycle economy. Concepts, strategies, target programs of social and economic development. Formation of environmental legislation. Macroeconomic policy. Legal and institutional mechanisms in the field of environmental management and protection (greening the policy of state and municipal procurement, the introduction of eco-labels, etc.). “Green” education.

2. Forecasting and strategic planning of sustainable development of territories

2.1. Global and European trends in spatial planning.

United Nations Human Settlements Programme 2015. Spatial planning in Europe, basic documents. 10 principles of sustainable spatial development policy for Europe and 9 types of priority territorial units. „The territorial agenda of the European Union until 2020”. EU directives – environmental impact assessment, strategic environmental assessment. Brief comparative characteristics of territorial planning systems in Western Europe and the Russian Federation. The latest trends in the development of territorial planning system in foreign countries of European countries, Russia, USA, Canada and China (in comparison).

2.2. Fundamentals of territorial planning in Germany, France and the UK. Analysis of territorial governance trends in European countries in the context of sustainable development .



Legal regulation of territorial planning. Building code of Germany, Federal Law on Regional planning. German sustainable development strategy (key indicators, annual monitoring and updating, inter-Ministerial conferences). Berlin and Brandenburg strategic documents (Berlin & Brandenburg Territorial Development Plan, digital territorial model, Agreement on joint territorial planning). Strategic documents. Land use plan, landscape program, the Concept of urban development of Berlin until 2030. French Urban Planning code and main national territorial planning documents. Features at regional, inter-municipal and local levels. Examples of an integrated approach to the development of territories at different levels and a system of indicators. Local urban plan of the city of Paris (features, basic schemes and indicators). General scheme of the region Ile-de-France -SDRIF 2030 (objectives, content, basic schemes, tools for environmental assessment to explain the options for the development of the region in order to reduce the negative impact and create favorable living conditions for the population). The scheme of territorial compliance of the Lyon agglomeration for the period up to 2030 Reform of instruments and development of legal framework (Fundamentals of national planning policy, Specially protected natural areas and landscapes at the national level, Policy of devolution of powers to the field, change of urban planning management system in the reforms of 2011).An example of an integrated approach to the development of the territory .Strategy of spatial development of Greater London and its system of indicators (London development Plan (The London plan. March 2016) until 2036, objectives, content of the main scheme, monitoring system and key indicators).

2.3. Mega(Giga)policies / agglomerations / region-economies VS small towns and rural settlements. The concept of spatial development of small and medium-sized cities.

XX century: two types of mega-projects – Roosevelt’s and Mitteran’s – and their connection to the history. City structure. Evaluation of the territory potential. Determination of the urban agglomeration boundaries (monocentric and polycentric). Modern forms of urban settlement – „Push&pull Migration”, „bidonville”. Population indicators. Indicators of economic efficiency. Regional innovative climate indicators. Ecological indicators. Individual consumption indicators. Infrastructure development indicators. Comparison of the Russian and European experience in the development of small and medium-sized cities. The role of the architect in sustainable development and increasing the territory investment attractiveness (for example, the program development of small towns, the project yard-street). Russian and European examples.

3. Urban growth & Sustainable development

3.1. Theoretical concepts of urban development of the 20th-21st centuries. The growth of cities and their sustainability potential



Analytical review of the theoretical concepts of urban planning and familiarity with urban development, from its very origins, until the beginning of the 21st century. Global population density map. The influence of natural and geographical factors on the processes of settlement and town formation. Ideal shapes for a compact urban layout. Theoretical models of satellite cities location. Eliel Saarinen: the scheme of "Organic decentralization of the city. Garden cities (E. Howard). Industrial city (T. Garnier). Le Corbusier "Three forms of settlement" . Theoretical model of the "city of the future". Trends in urban development.

3.2. City: structure and metabolism. Engineering infrastructure of cities. Green technology.

The city structure and layout . 4 indicators for the formation of urban models: the metabolism, the intensity, urbanism and neopatrimonialism. Classification of European cities by 22 parameters (from population density to life expectancy). Indicators of density, compactness, rhythm of life. Moscow as one of the most intense cities in the world. The reach of the city center, the availability of housing, public space, open areas for creativity, etc.. Neopatrimonialism. Matching infrastructure changes to the new needs of a growing city. On the example of European cities Stockholm, Oslo, Barcelona, Paris, Budapest, Bucharest. 7 key points of Russian global urbanism. The effects of climate change, the revision of the strategic position of cities, transport, metabolic efficiency, mobility, innovation. Current trends in the transformation and development of urban engineering infrastructure: Analysis of data on the use of energy resources in the European Union. Efficient building. The concept of Passivehouse, the concept of Activehouse, the use of concepts of energy-efficient buildings and structures in modern Russia: country features and implemented cases, the use of alternative and non-traditional energy sources: Solar energy, wind, small hydropower, low-potential heat of groundwater and surface water, air, secondary energy resources in production and everyday life (heat production and domestic waste water, ventilation systems, etc.). Recycling and recycling of domestic and industrial waste: reduction of the output and volume of waste to be disposed of, reuse of part of household waste, recycling and converting them into secondary raw materials, the introduction of a clean production strategy based on the use of environmentally friendly and waste-free technologies, waste incineration in specialized plants and thermal power plants, the most promising from the point of view of reducing negative impact on the environment, technology, the destruction of household waste is plasma gasification pyrolysis processing ,development of water supply, sanitation and wastewater treatment: nanofiltration, photocatalysis, roller machines – new water treatment; desalination electric current, ferropeniclase (wastewater treatment); UV-irradiation, copper-zinc technology, septic tanks of aerobic post-treatment (GARDEN),the device of separate Sewerage systems (collection of storm water and further use),the creation of buildings with a closed water cycle.



3.3. The city as an urban ecosystem.

Definition of urban ecosystem. The main problems of the city as an urban ecological system: accumulating and non-equilibrium ecosystem, and at the same time, the result of creative and destructive activities. Problems of energy saving, production, transport, social and economic. Solutions to environmental problems through a combination of two ideologies: environmental protection and sustainable development, involving self-restraint and optimization of the development of the city. N.Reimers – the three principles of ekopolis organization. The basic principle of greening in Ecopolis is not "green in the city", but "city in the green". Hammarby, Stockholm's eco-district, an example of a comprehensive solution to environmental problems. The basic principles of eco-settlements. Ecosystem services. Principles of design of urban areas adjacent to specially protected areas.

3.4. Innovations in European urban planning.

Aspects and components of socially sustainable habitat. Public space improvement. Ian Gale and his method of public space in the metropolis. Public space as the nodes of the pedestrian framework of the city. Goals and objectives: creating a comfortable urban environment, neighborhood communication, community development, pedestrian accessibility and safety. Working with existing urban space: revitalizing urban areas through the implementation of public space projects. On the ruins of the past, the European experience: the revitalization of former industrial areas and cultural heritage. European cases of public space improvement. Pedestrian and Bicycle corridor Baana (Baana Pedestrian and Cycling Corridor), city planning Department of Helsinki, Helsinki, Finland, The linked valley (The Braided valley), Elka, Spain, Grupo Aranea. Opening Rainsky Wetlands (Opening of Rainham Marshes) Peter Beard LANDROOM, near London, UK. Strap With instant success gradual development, Eindhoven, the Netherlands. New city: space of hope and unification, Amersfoort, the Netherlands. North oil (NDSM): from the wasteland to public space, Amsterdam, Netherlands. R-Urban, Colombes, Tasinge Square Denmark, Remodeling of Velenje's promenade (Slovenia), Przelomyb Centre for Dialogue in Solidarnosc Square (Poland), Hamburg, renovation of port areas. Experience in designing eco-neighborhoods, eco-districts and eco-cities in Europe and the world. United Kingdom: Whitehill-Gordon, Hampshire, St Austell and Clay Country, Cornwall, Rackheath, Norfolk, North West Bicester, Oxfordshire. Germany: Am Lockdepot – residential complex Bureau Atel-ier Loidl, 2016. Example of integration of natural and urban environment in yards, terraces and on the roof. Renovation of blocks with panel construction, the seal construction, the quarterly parks Friedrichsfelde. The Garden Living —residential complex, project TOPOTEK 1, 2016. Residential complex Marthashof. Architectural Bureau Grüntuch Ernst, 2012. 129 apartments, total area 12 000 sq. m. Sample of modern architecture and the object of criticism for the planning decision. The Oerlikon, zürich, District Rieselfeld, Freiburg, District Vauban, Freiburg im Breisgau, apartment complex Fünf Morgen, Berlin. Italy: Residential building Bosco



Verticale, a New project of City Life, Residential district, San Felice, Social housing Cascina Merlata, a Residential district of Milan 2, the Project Porta Nuovo (Milan).Finland: Viickki, Russia: Sky-ekovil, China Tianjin, architect – Dongtan; Chongming island; the city of Tianjin, UAE: Mazdar city, NV. Foster.

3.5. Renovation of industrial zones.

Solution of environmental problems of industrial zones: closing and withdrawal of polluting industries from the city, creation of green sanitary zones between industrial and residential buildings; re-profiling; modernization of technological processes. The requirement for modern industrial buildings is the adaptability of space-planning and design solutions to multiple changes of technologies and equipment. The problem of sanitary protection zones (reserve of urban land for development and transport). Solution of environmental problems: technological means, revitalization and renovation. Examples of renovation of production areas: Likhachev Factory (Russia). From factory to residential area with Park, Duisburg (Germany). Xintiandi Factory is a multifunctional complex in the old factory. Mestre, Italy. University village. Winery, Moscow, Russia. Contemporary art center. The Zollverein Coal Mine Industrial Complex, Essen, Germany. Cultural and creative center. Dismantled warehouses at the shipyard, Nantes, France. The Isle of Nantes machines.The Lainate, Italy. Office complex in the caramel factory. Provence, France. Art gallery in the railway workshops. San Francisco, California, USA. Trampoline center in the aircraft hangar. Guangzhou, China. Xintiandi Factory is a multifunctional complex in the old factory.

3.6. Transport in the city.

The role of transport in the city. A variety of modes and types of transport. Fundamentals of transport planning. Evolution of mobility (by Blinkin). Changing the concept of transport in the concept of "sustainability". The third stage mobility paradoxes. The Downes-Thompson paradox, the Braes paradox, the Lewis-Mogridge postulate. Development of alternative mobility. Car sharing/taxi, road diet, Parking management, Bicycle infrastructure, walking distance — plus and minus.

Creating quality public transport (PT): a century of trials and errors. Modern methods of PT planning. Seven criteria of quality public transport (Walker): the level of strategic planning of urban development — to avoid "dead ends", the level of integrated planning of individual parts of the city (Transit-oriented development), the level of individual streets — dedicated lanes, isolation, the correct selection of modes of transport, the level of stops — pedestrian accessibility. Swiss experience.

3.7. Urban forestry and urban greening.

Natural landscapes types. New formats of urban landscapes. Restoration of biodiversity in modern megacities as a new paradigm of humanization of the urban environment. Flora and fauna of the urban environment. Spatial analysis of green

	<p>areas distribution in the urban environment. Characteristics. Species composition of green spaces. Biodiversity as an ecosystem of urban services. The impact of green infrastructure on city comfort. Green city space and human health. New formats of urban landscapes. Green walls of Patrick Blanca – from idea to implementation in different countries. The history of the "green" walls. Modern technologies of vertical gardening. Cities-forests of Stefano Boeri. City-Shijiazhuang forest (China), Nanjing, Milan, Lausanne (vertical gardens). Projects of the Belgian architect and futurist Vincent Callebaut. Underground gardens. City farms.</p> <p>3.8. Natural revitalizing landscape design role.</p> <p>Landscape organization of coastal areas taking into account functional, ecological, psychological, aesthetic and compositional aspects. Potential and identity of the place. Restoring the balance between natural and artificial. The formation of open spaces of large-scale man with the creation of conditions for a comfortable stay. The Park Rio Madrid. Modern approaches to the formation of Park space. Park image. The construction of the composition. Visual Park environment code and space symbols. Modern interactive technologies in the Park environment. The preservation of natural habitats. Flexible models of Park environment space. (Ariel Sharon Park (Israel), ParkingHouseLüdersinNordhavn Park (Copenhagen), MAX IV LaboratoryLandscapeParK (Sweden).</p> <p>3.9. Greening of public consciousness and involvement of the population in environment transformation. Ecological consciousness and ecological activity of the architect. Ecological and social "games" as a method of formation of public ecological consciousness. Performance criterion. Tactical urbanism.</p>
	<p>Discipline 2</p> <p>1. Space monitoring of landscapes for sustainable development</p> <p>1.1.Environmental monitoring systems.</p> <p>Monitoring as a research method for sustainable development of territories. Types, levels, methods. Landscape natural components as an object of monitoring. Monitoring of the atmosphere. Basic monitoring. Biological monitoring. Monitoring of the impact on the environment. Monitoring of the hydrosphere. Global monitoring. Space monitoring. Land monitoring. Forest monitoring. Monitoring of objects of urban planning activity. Monitoring of the natural environment. European program Copernicus - the European global system of remote sensing of the Earth. The main goals and objectives of the Copernicus program. Sentinel earth remote sensing satellites. Land and marine environmental measurement systems, 8 platforms. Russian space systems for Earth monitoring.</p> <p>1.2.Spatial GEODATA and their equipment.</p> <p>Spatial data as research object for sustainable territory development. Methods of obtaining spatial data; space survey; aerial photography (unmanned aerial vehicles, aircraft and helicopters); thermal imaging; laser scanning; cartographic</p>



materials; the results of geodetic and topographic studies. Need for comparable territorial data: opportunities for improvement. Methods of spatial data processing: software; hardware and software systems; visualization systems. The complete set of spatial data. Sectoral solutions for the use of spatial data on the basis of European and domestic experience of scientific and applied research.

1.3.Primary processing of spatial GEODATA for case studies for sustainable territory development.

Basics of color image processing. Vectorization of raster image geometric correction of the images based on the desired map projection, interpretation. Display GEODATA. Spatial GEODATA formats. Automation of GEODATA processing. Spatial analysis of GEODATA. Spatial geodatabases. The development of spatial geodatabase. Computer digital image processing.

1.4.The sources of the spatial geodatabase.

Cartographic materials: maps, plans, atlases, diagrams. Remote sensing data: optical-electronic and radar space images, navigation space data. Field survey data (application of geodesic and global satellite communication devices GPS, GLONASS, Galileo). Statistics. European and national geoinformation services in spatial geodatabase.

1.5.European international program "Copernicus".

Goals and objectives of the Copernicus programme. Atmosphere monitoring service. Marine environment monitoring service. The monitoring service of the earth. Climate change service. Security service. Emergency management service. Sentinel information and products service for the Arctic. Space segment "Copernicus". Examples of research projects. Marketing reports.

1.6.Industry sector solutions for spatial GEODATA for sustainable development of territories.

European and domestic experience in spatial GEODATA applying. Municipal economy: monitoring of construction, monitoring of road transport infrastructure. Forestry: mapping of forest lands, inventory of forest lands, monitoring of logging activities, monitoring of compliance with the rules of logging, monitoring of areas covered by fires and windstorms, forest pathology monitoring. Oil and gas complex: monitoring of oil spills, radar monitoring of displacements in the oil field, the system of space monitoring of trunk pipelines. Environmental activities: study of the structure and dynamics of natural complexes; monitoring of unauthorized economic activities. Geology and mining: environmental monitoring of the territory of mineral development. Environmental monitoring: monitoring of solid waste storage sites; identification of local sources of pollution; assessment of the region ecological state. Water management monitoring.

	<p>2. 3D modeling and 3D cadastre The concept of 3D in modern GIS systems, CAD, BIM; 3D maps; the difference between 2D, 2.5 D, 3D, 4D; digital elevation models (concept, views (raster, TIN, etc.) and terrain; methods of obtaining DEM; methods of representation of objects in 3D modeling (frame, surface, solid, nemnogoobraznoe, voxel); fundamentals of compositional design of 2D-geo-images; scope of three-dimensional modeling; implementation of three-dimensional modeling in different classes of software. Global and European approaches. 3D-cadastre, prerequisites and possibilities of its introduction in Russia.</p> <p>3. Smart City Planner Smart city: background, terminology, characteristics; BIM: concept, terminology, basic principles and stages; Problems of "end-to-end" implementation of the BIM concept at all stages of the facility life cycle. The concept of SIM (city information modeling). Levels of detail of objects in BIM and GIS; Basic strategies for creating 3D models of cities (with parameters). Big Data: sources, methods of analysis, advantages. Software solutions used in the implementation of Smart City, BIN, COM. Global and European examples of implementation of elements of the Smart City. Criteria for classifying settlements as "Smart city", methods of creation and scope of BIM, BIM and "big data". Intelligent EU cities.</p> <p>4. Logistics management The analysis of transport networks: terminology, objectives, methods, solutions and tools for their implementation. Concepts and methods of geographic information and telematics systems in transport management. World and European solutions in transport logistics.</p>
<p>planned learning activities and teaching methods</p>	<p>Mixed approach to learning, "Face to face", self- study</p> <ol style="list-style-type: none"> 1. Lectures (including invited experts); 2. Practical classes (seminars, presentations, discussions, debates, business/ role games; case studies, pre-project research, closure sketchers); 3. Participating in round tables, conferences, exhibitions. 4. Self-study, inverted class.
<p>assessment methods and criteria</p>	<ol style="list-style-type: none"> 1. The Express poll ("briefing"); 2. Game methods of assessment; 3. Abstracts/presentations; 4. Survey & Observation; 5. Self-rating; 6. Conversation (general discussion, discussion, summing up), etc.



	7. Presentation of the report on pre-project research, course project; 8. Publications; 9. Publish activity.
special features of the module	Invitation of external for meetings, presentations, lectures and discussions
	Relation to the design and research module
	Presentation of final course works at round tables, conferences, exhibitions

Developed by:

1. Dr. Kamynina N. R., Doctor of Economics, academic coordinator of the module
2. Dr. Kuznetsova G. D., PhD, associate Professor, Department of space monitoring and ecology
3. Dr. Blagovidova N. G., PhD, Professor of the Department of architectural design
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6. Ms. Snezhinskaya
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8. Dr. Serebryakov S. V., Ph. D., associate Professor of digital cartography Department

Advised by:

Dr. Tkachenko L. Ya., Ph. D., Advisor of the General Director of State Autonomous enterprise of the Moscow region "Research and design Institute of urban planning», Deputy Director for research and coordination of territorial planning

Evaluated by:

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