POLYTECH

Peter the Great
St. Petersburg Polytechnic University

Course catalogue for exchange students 2016-2017

Content:

Institute of Humanities

Institute of Civil Engineering

Institute of Industrial Economics and Management

Institute of Physics, Nanotechnology and Telecommunications

Institute of Computer Science and Technology

Institute of Metallurgy, Mechanical Engineering and Transport
Department of Design

Institute of Applied Mathematics and Mechanics

Institute of Energy and Transport Systems

Course title	Course description	ECTS	Spring/ autumn	Program Title
History and architecture of St. Petersburg	Students will be able to speculate about the history of St. Petersburg since the foundation of the city and until nowadays. They will recognize the main architectural styles from Petrine baroque to contemporary architecture. The course provides students with a basic understanding of Russian culture, traditions, literature, national cuisine, Russian and Soviet realities.	**3-5**	**Autumn, Spring**	**Applied linguistics: language, culture, mentality**
Key concepts of Russian Realia	The course develops the student's knowledge of cultural analysis by means of a specialized focus on several cultural issues concerning Russia. These issues cover the following fields: - historical information; - education; - political system; - administrative system; - cultural heritage; - visual culture; - multiculturalism; - healthcare system; - tourism; - marketing; - media; - religion. Some of the issues can be deemed appropriate by the student in consultation with the course lecturer.	**3-5**	**Autumn, Spring**	**Applied linguistics: language, culture, mentality**
Romanov's Dynasty in the Russian History	Students will receive the conceptual, factual and historical experience for comprehension and understanding the connection between the conditions, development and existence of the Russian Empire and the emergence and evolution of the Romanovs dynasty.	**3-5**	**Autumn, Spring**	**Applied linguistics: language, culture, mentality**
Political science	Students will focus on the origin, development, and operation of political systems in Russia. They will participate in the research of political ideas in order to analyze the structure and operation of its government, policies, political trends, and related issues.	**3-5**	**Autumn, Spring**	**Applied linguistics: language, culture, mentality**
Theory and practice of modern regional studies	Studying of the subject is aimed at acquisition by the students of knowledge on laws of the processes of formation, functioning and development of the region as an integral system of political and socio-economic relations with regard for historical, national, religious and geographic specifics of the region, as well as its position and role in the process of regional and global development.	**3**	**Autumn**	**Regional studies: Russian Federation**
Methodological problems of modern social science		**4**	**Autumn**	**Regional studies: Russian Federation**
Methods of work with information		**2**	**Autumn**	**Regional studies: Russian Federation**
Political aspects of international relations	Studying of the subject is aimed at acquisition by the students of knowledge on laws of the processes of formation, functioning and development of the region as an integral system of political and socio-economic relations with regard for historical, national, religious and geographic specifics of the region, as well as its position and role in the process of regional and global development.	**3,5**	**Autumn**	**Regional studies: Russian Federation**
History and methods of complex foreign regional studies	The course is supposed to provide the student with profound adequate ideas on the history of becoming and of current problems of methodology in contemporary theories of the foreign complex regional studies. Lectures, seminars and writing tasks orient the	**2**	**Autumn**	**Regional studies: Russian Federation**

	students to learn to use theoretical knowledge acquired in a concrete analysis in regional and country studies. The objective of the course is mastering the methodology and empirical methods of studying political and socio-economic relations. In studying the subject students are supposed to acquire the following knowledge: In the field of new methods of foreign and internal political items and on the main socio-economic problems and their regional aspects			
Ethnopsycology of Russian nations	The course aims at developing a holistic view of the content of the ethno-psychological features of the nations and people of the profile of the region, including the possible patterns of formation and functioning of the national consciousness, especially ethnic and cultural patterns of conduct, the national character of ethnic stereotypes, etc among students.	**2**	**Spring**	**Regional studies: Russian Federation**
Relevant social and economical problems in Russia	The course is aimed at developing in-depth understanding of the types and models of political and socio-economic modernization of the Russian Federation, its general and specific terms. It develops the skills of complex comparative analysis of political, economic, socio-cultural processes of modernization and transformation of the society, the relations of traditional and modern, endogenous and borrow in the national strategy of the Russian Federation. The course is the development of methodologies and empirical research methods of political and socio-economic relations.	**2,5**	**Spring**	**Regional studies: Russian Federation**
Political discourse in English		**4**	**Spring**	**Regional studies: Russian Federation**
Language of specialization (Russian)	Formation of the communicative competence of foreign students needed to communicate in domestic, social, cultural, official business, educational and professional spheres in accordance with the "State educational standards of Russian as a foreign language. Second level"and professional modules. Formation of motivation to learn Russian language, interest in the traditions and cultural achievements of Russia. Preparation for testing The second certification level of Russian as a foreign language in the following aspects: vocabulary, grammar, reading, listening, writing, speaking.	**6,5**	**Autumn, Spring**	**Regional studies: Russian Federation**
Political systems and cultures of Russian Federation	Goals of the course: Getting the public speaking skills for professional and scientific topics, the ability to provide information on the political system and culture of Russian specialists and non-specialists; Getting the knowledge of political culture and political processes in Russia, the ability to use this information to participate in public policy; Getting the knowledge of basic principles of the genesis and evolution of Russian political system, the ability to develop a research program based on interdisciplinary connections; Getting the ability to properly select and apply general scientific, qualitative and quantitative research methods based on specific theoretical and practical problems; being able to conduct bibliographical work using modern computers.	**1,5**	**Spring**	**Regional studies: Russian Federation**
Regional conflicts in Asia/Europe	Purpose of studies of the subject «REGIONAL CONFLICTS IN ASIA» - preparation of well-educated, qualified specialists capable of correct and effective application of their knowledge in their field of studies. On completion of studies, the graduates supposed to be skilled and professional specialists in the chosen field. 2. Study of the subject “Regional conflicts in Europe” is aimed at education of literate, qualified specialists, who are able to use correctly and efficiently the knowledge acquired under solution of the tasks in the professional field. Study of the subject is to result in exact, skillful use of the knowledge acquired in the professional field, in practical activities, in implementation of economic, financial and organizational-administrative tasks, in official promotion.		**Autumn**	**Regional studies: Russian Federation**

Russian policy towards Asian/European countries	The course is oriented to the preparation of highly qualified specialists by the complex study of the countries of the Asian region: its people, history and ethnography, economy and culture, religion, language and literature, traditions, values oriented towards the production of science-based practical recommendations on regional policy of the Asian countries in the industrial, financial, science, education, information, culture, tourism and international relations fields with the Russian Federation. 2. Purpose of learning the discipline "The Russian Federation policy towards Europe" – prepare well-qualified specialists capable of completing challenging tasks in their professional field using well-known and mastering new methods and models; ready to illustrate the core of applied foreign policy methods and models, and justify the necessity of their application.		**Spring**	**Regional studies: Russian Federation**
Problems of modernization and transformation in Russian Federation	Forming the idea of types and models of political and socio-economic modernization in the Russian Federation on sub-regional and national levels on general and specific traits. The course develops skills of complex comparative analysis of political, economic and socio-cultural processes of modernization and transformation of the society, correspondence of traditional and modern, endogen and adopted in national development strategy of Russia		**Spring**	**Regional studies: Russian Federation**
Mathematical methods of analysis in the humanities	Study of the basic concepts, main tasks and mathematical methods and the formation of the ability to use statistical knowledge in sociological research. The goal is achieved through the the following tasks: Getting the knowledge of basic statistical concepts, basic techniques used in the study of general and special disciplines, in the practice of regional studies; Getting the ability to navigate in a special apparatus contained in the literature, to work with statistical tables, directories, statistical processing of experimental data of sociological surveys; common views on the application of statistical methods and the calculation and use of sociological indicators in the field of regional studies.		**Spring**	**Regional studies: Russian Federation**
Socio-political and philosophical thought of Asian countries	Formation of an idea of the social and political thought in the country of the region of studies.		**Spring**	**Regional studies: Russian Federation**
Socio-political and philosophical thought of European countries	Create of the professionals who can reasonably and effectively apply existing, and develop new methods, in the knowledge of social and political philosophy for Regional Studies.		**Spring**	**Regional studies: Russian Federation**

Course title	Course description	ECTS	Spring/ autumn	Program Title
Business planning in construction		**1,5**	**Autumn**	Civil Engineering; Energy efficient and sustainable buildings
Building Information Modeling (BIM)	This course is designed to cover all basic questions concerning BIM technology and main software. What is BIM, why should we use it, which software can gain us maximum performance? You would find answers on these and many other questions during this course. The main part of our training is devoted to practice questions based on actual software. 1. Getting started with BIM 2. Autodesk Revit Basics 3. Conceptual design, Mass modeling, Starting with AutoCAD drawings 4. Documentation, visualization, tips and tricks 5. Engineering systems 6. Collaboration 7. Finite elements analysis in SCAD / SOFiSTiK 8. Project coordination in Navisworks	**1,5**	**Autumn**	Civil Engineering; Energy efficient and sustainable buildings
Fluid Mechanics for Engineering	The course is aimed at providing the student with knowledge and understanding of the fundamental laws of fluid mechanics. The main object of the course is to form competent specialist, which obtain the basic notions of the fluid mechanics and are able to use existing and new methods of hydraulic calculation for energy efficient engineering systems of buildings and constructions.	**3**	**Autumn**	Civil Engineering; Energy efficient and sustainable buildings
International Communication in Construction Business	1. Construction contracts. Types of construction contracts. Concession contracts. Standard contracts of international organizations. FIDIC contracts. The structure of the construction contract. Documentation of the construction contract. Correspondence on the construction contract. Reporting on the construction contract. 2. Construction risks. Risk management. 3. The quality of construction work. Quality management. System of quality management. 4. International competitive bidding. Regulations and documents of international competitive bidding. Preparation of tender documentation. 5. Occupational health and safety. Safety management system. 6. Environmental aspects of construction projects. Key documents on environmental protection. 7. Management of construction. The structure of the building project. The implementation of the construction project.	**1,5**	**Autumn** **Spring**	Civil Engineering Energy efficient and sustainable buildings
Structural Mechanics	1. Knowledge of structural mechanics dynamical problems statements and solving methods; 2. Practical skills in dynamical analysis of structures, particularly on the base of finite element analysis (FEA); 3. Acquaintance with details of structure response on dynamical loads of different kind; 4. Notion of vibrations reduction and seismic-resistant techniques.	**5**	**Autumn**	Civil Engineering
GIS-Technologies for Civil Engineering	1. Introduction to GIS. Basic concepts. Socioeconomic challenges. Users of GIS. Understand what GIS is, what it can do, and how others are using it.	**3,5**	**Autumn**	Civil Engineering;

	2. Introduction to ArcGIS software. Introduction to GIS and model design. Introducing ArcCatalog. Viewing data in ArcCatalog. Connecting to your data. Introducing ArcMap. Working with maps. Exploring a map. Adding a layer to a map. Adding features from a database. Changing the way features are drawn. Adding labels to a map. Working with the map layout. Saving a map. Printing a map. 3. Exploring GIS data. Vector data model. Raster data models. Vector versus raster models. Formats of feature data. 4. Conducting a GIS project. Phases of organization issues. Development of business concept and the identification of goals. Identification of users requirements. The steps in a GIS project. Planning your project. Assembling the database. Preparing data for analysis. Performing the analysis. Presenting the results. 5. Introduction to River Basin Modelling. Introduction to the MIKE BASIN modelling framework. Operational framework and water user allocation rules. Reservoir operating rules and hydropower modeling. Groundwater and river routing modeling. Detailed irrigation demand and management analysis. Hydrological modeling.	**2**	**Autumn**	Energy Efficient and Sustainable Buildings
Information Technologies for Civil Engineering	Types of computer graphics and sphere of its application. Review of the main graphic formats. 2D and 3D of visualization. Software review. Color models. Types of computer modeling.	**3,5**	**Autumn**	Civil Engineering;
		2	**Autumn**	Energy Efficient and Sustainable Buildings
In-Service Strength and Reliability of Structures	Construction materials. The main stress and strain properties of concrete and steel bars. Strain having stress and no stress origin. Creep and shrinkage. Limit state design and classification. Characteristic and design strengths and load. Limit state groups. Reinforced concrete beams and slabs. Shear reinforcement. Inclined steel bars and stirrups. Redistribution of the bending moments at formation of plastic hinges. Prestressed reinforced concrete. Prestressed cover beams and undercrane beams. Design of nuclear power plants containment, concrete tanks and silos. Crack resistance and the disclosure of cracks in concrete. Masonry, brickwork and blockwork. The main properties of stones and mortar. Limit state design. Masonry and brickwork with reinforcement.	**2,5**	**Autumn**	Civil Engineering
Building Materials	Introduction to geosynthetics. Description of geosynthetics. The use of geosynthetics in civil engineering. Classification, terms and definitions of geosynthetics. Raw materials and manufacturing processes. Geotextiles. Geogrids. Geonets. Geomembranes. Geosynthetic clay liners. Geocells. Geocomposites. The latest developments and important innovations in geosynthetics. Various economic, manufacturing and the others aspects of production and application of geosynthetics. Functions of geosynthetics. Reinforcement. Separation. Filtration. Drainage. Erosion. Application areas of geosynthetics. Retaining walls. Embankments. Foundations. Roads. Slopes. Erosion control. Landfills. Earth dams. Tunnels. Hydraulic applications. Properties of geosynthetics. Characterization and structural parameters of geosynthetics. Basic characteristics. Physical properties. Mechanical properties. Hydraulic properties. Endurance and degradation properties. Geosynthetics standards. Quality assurance for geosynthetics. Manufacturing quality control.	**2,5**	**Autumn**	Civil Engineering

	Design principles of geosynthetics. Practice in geosynthetics design. Design concepts and methodologies. Material properties for design. Requirements for geosynthetics. Durability of geosynthetics. Causes and mechanisms of degradation. Mechanical damage. Creep. Weathering, chemical and biological degradation. Accelerated testing methods. Safety factors. Service life of geosynthetics. Long-term strength. Design for residual strength.			
Math Modelling in Civil Engineering	1. Theoretical basics of solving scientific and technical problems. a. Contradictions and Problems. Scientific and technical problems solving as a way for professional development and growth for future engineers. Approaches in solving technical problems. Administrative conflicts. Technical Difficulties. Physical Limitations. Heuristic value of the differences. Overcoming obstacles in resolving of problematic situations. b. Theory of solving scientific and engineering problems. Theory of scientific and engineering concepts. Compromises. Information repository of standard solutions. Problem solving techniques. Resources to eliminate conflicts. 2. Methodology for solving scientific and technical problems. a. Methods of solving scientific and engineering problems.Fundamentals of designing scientific and technical systems. Material object-field (obfield) analysis. Alternative approaches. Method of trial and error. Brainstorming. Synectics method. Morphological analysis. Method of focal objects. Method of test questions. b. Stages of solving scientific and technical problems Formulation of problems. Analysis of model of the problem. Finding a principal solution of the scientific and technical problem. Evaluation of solution for scientific and technical problems. c. Modeling as means of experimental research and analysis. Physical modeling. Practical methods of scientific and technical creativity. Heuristic analogy. Heuristic inversion. Heuristic complex.	**2,5**	**Spring**	Civil Engineering; Energy Efficient and Sustainable Buildings
Teamwork and Self-management	Discipline is devoted to the development of professional teaching competencies Master program students, preparing them to realize teaching. This discipline is focused on the development of social and personal competencies of learners, which they would need in their further professional activities. Discipline is one of the basic for such disciplines as project management, research methodology, Scientific and Research Students Work and Business English.	**1,5**	**Spring**	Civil Engineering; Energy Efficient and Sustainable Buildings
Real Estate Economics	Bases of the real estate management: concept of the real property, signs of the real estate, markets of the real estate, issues relating to land use, including wider social issues such as the impact and sustainability of new build. Budget of property objects: structure of profits and incomes, concept of rent and rent contract, financial assets, composition and structure of operational expenses, reversion. Tax system: various forms of taxation in relation to property investment and development, income tax, profit tax, capital gains tax, depreciation allowances, land tax, water tax. Operational and tactical: primary foundations of real estate management, structure of real estate model, operational and tactical management levels. Property finance sources and types of property finance: debt equity, financing techniques, evaluation techniques, risk management. Property valuation: aims and tasks of valuation, principles, methods and technologies of valuation, valuation of machines and	**4**	**Spring**	Civil Engineering

	equipment, valuation of buildings and constructions, valuation of non-material assets and intellectual property, the best and more effective utilization property analysis.			
Construction Technologies	The course considers the modern construction technologies and equipment: – Earthworks; – Strengthening of soil foundation; – Various types of foundations; – Concrete and installation works; – Waterproofing works; – The production of works in the winter, etc.	**4**	**Spring**	Civil Engineering
Building Structures	Construction materials. The main stress and strain properties of concrete and steel bars. Strain having stress and no stress origin. Creep and shrinkage. Limit state design and classification. Characteristic and design strengths and load. Limit state groups. Reinforced concrete beams and slabs. Shear reinforcement. Inclined steel bars and stirrups. Redistribution of the bending moments at formation of plastic hinges. Prestressed reinforced concrete. Prestressed cover beams and undercrane beams. Design of nuclear power plants containment, concrete tanks and silos. Crack resistance and the disclosure of cracks in concrete. Masonry, brickwork and blockwork. The main properties of stones and mortar. Limit state design. Masonry and brickwork with reinforcement.	**4**	**Spring**	Civil Engineering
Inspection of Buildings and Construction	The objective of course “Inspection and testing of buildings and constructions” is to learn the basics of inspection of buildings and constructions, specificity, methods and devices for different constructions. Students will get preliminary skills to estimate an actual technical state of structures by visual inspection. Also students perform checking calculations and concrete strength tests at laboratory work.	**4**	**Autumn**	Civil Engineering; Energy Efficient and Sustainable Buildings
Project Management	1. Introduction to Project Management and the Project Cycle. 2. Organizational Structure and the Role of the Project Manager. 3. Project Phases. Project Management Process Groups. 4. Organizational Influences on Project Management. 5. Project Integration. Teambuilding and Leadership. 6. Project Scope. Project Requirements. Project Breakdown Structure. 7. Project Communications. Project Schedule. 8. Budgeting and Cost Control. Project Quality. 9. Project Human Resources. Project Reporting and Management. 10. Project Risks. Project Procurements.	**3**	**Autumn**	Civil Engineering
Energy Efficient Buildings and Structures	The course includes legislative regulation of energy efficiency in Russia and in the World, as well as priority technical aspects of the energy efficiency of buildings and structures: 1. Using a new up to date materials in the construction will reduce the heat losses in the walling, as well as use the natural sun exposure and innovation architectural solutions. 2. Improving energy efficiency in engineering systems of the individual and the public buildings, including electrical networks, heating networks, air-conditioning systems, of water supply and canalization.	**4**	**Autumn** **Spring**	Civil Engineering Energy Efficient and Sustainable Buildings

	3. Using renewable energy sources for independent electricity and heat supplying, including solar photovoltaic modules, solar collectors, heat pumps and wind turbines. In practice students makes a project of energy efficiency building, using independent renewable energy sources.			
Construction Ecology	Environmental considerations in the application of materials in construction. – Urbanization and the basic functions of a city. – Environmental management principles. – Introduction to life cycle assessment. – Evaluation for sustainable urban planning, design and construction. – Building and rebuilding sustainable cities. – Sustainable urban management with reference to environment, buildings, and inhabitants. – Supplier selection, certification and development, international sourcing.	**4,5**	**Autumn**	Civil Engineering; Energy Efficient and Sustainable Buildings
Water Facilities	Raw water resources. Water contaminants and potable water quality regulations. Water supply systems: types and components. Drinking water treatment plant: components and processes. Equipment and constructions on pipelines. Waste waters: types and contaminants. Sewerage systems: types and components. Peculiarities of sewage and rainfall pipelines. Waste water treatment plant: components and processes.	**4,5**	**Autumn**	Civil Engineering; Energy Efficient and Sustainable Buildings
Research Methodology	The purpose of the course is preparing students to conduct scientific research, the result of which is the writing of the final qualification of scientific work, containing the solution of the problem as a significant variable for the corresponding branch of science - the thesis.	**4**	**Spring**	Civil Engineering; Energy Efficient and sustainable buildings
Modes of Renewable Energy Using	1. Classification of modes of various renewable energy systems. 1.1. Classification of modes. Types of modes (normal, emergency, before - and after emergency), modes of consumption, transfer and electric power generation, mode parameters. 1.2. Normal and emergency operation of energy systems. Definitions of modes. The parameters characterizing modes of different types. Types of modes' operations. Quality criteria of modes. Power indicators based on modes of power plants. Expense indicators modes based of energy resources. 1.3. Modes of a reservoir usage of hydroelectric power stations. Basic purpose of a reservoir of hydroelectric power station. Useful, reserved, and dead (still) volumes of a reservoir. Static and dynamic characteristics of a reservoir. Water losses from reservoir. Modes of a reservoir of hydroelectric power station based on various indicators. Complex use of water resources. 2. Optimization of operating modes of various renewable energy systems. 2.1. Modes of various renewable energy systems. 2.2. Methods of coordination of modes of renewable energy systems with modes of traditional power plants in electric systems. Methods of calculation of power consumption. Electricity consumption schedules. Daily, weekly, seasonal, and annual production schedules and their indicators. 2.3. Problem of optimization of modes of renewable energy systems. 2.4. Criteria of optimization of a mode for planning based on various intervals of time. Regime restrictions and entry	**4,5**	**Spring**	Civil Engineering

	conditions to be considered. Methods of solution of optimization problems of operating mode of renewable energy systems. 3. Planning of an operating mode of power electric systems in terms of the electric power market, demand and capacity. 3.1. Market Structure of electric power and capacity. 3.2. Market structure of electric power and capacity, stages of development and specifics of operation. 3.3. Effective correction of modes of hydroelectric power station. 3.4. Contract agreements on electric power delivery and capacity. Commercial dispatching. Effective correction of modes of hydroelectric power stations based on integral water and power restrictions for conditions of the balanced market. 4. Special modes of various renewable energy systems. 4.1. Operating modes of solar and wind power stations. General problem setting and methods of solution of optimization problem of operating modes of solar and wind power stations and power complexes. 4.2. Assessment of modes of various renewable energy systems based on reliability factors. Specific assessment of vibration and temperature modes, technical diagnostics of equipment conditions and construction of power installations and power plants.			
Heat and Mass Transfer Theory	1. Natural, forced and complex heat transfer. The main definitions. The convective heat transfer equations. Examples of the complex heat transfer problems. 2. Engineering method of heat transfer problem solving. Classic analytical solutions. Empirical correlations. Similarity equations. 3. Two-phase flows. Mathematical description of boiling and condensation. Empirical correlations. Examples of actual engineering two-phase problems. 4. Numerical methods of heat transfer problems solution. Spatial and time discretization of equations. Turbulence modeling. 5. Analysis and post-processing of numerical simulation results. Verification of results by comparison with experimental data.	**4,5** **3,5**	**Spring** **Autumn**	Civil Engineering; Energy Efficient and Sustainable Buildings
Economics and Management of Construction	Bases of the construction objects economics and management: concept of the construction industry as the whole sector of activity concerned with the production of the built environment. Budget of construction objects: structure of profits and incomes, concept of rent and rent contract, financial assets, composition and structure of operational expenses, reversion. Tax system: various forms of taxation in relation to property investment and development, income tax, profit tax, capital gains tax, depreciation allowances, land tax, water tax. Operational and tactical management: primary foundations of construction object management, structure of management model, operational and tactical management levels. Finance sources and types of construction objects finance: debt equity, financing techniques, evaluation techniques, and risk management. Economic efficiency of investments into construction objects: an estimation of investment projects efficiency, criteria of investment projects efficiency, analysis of investment projects stability.	**2,5**	**Autumn**	Energy Efficient and Sustainable Buildings

English for Technical Communication	1. Technology and Society. Branches of technology. Technology and work. Technological innovations. 2. Design and CAD systems. The design process. Famous designers. Principles and advantages of CAD. Modern CAD systems. 3. Manufacturing. Modern manufacturing processes. Machine tools and process planning. 4. Power Machines. Different types of power machines. Design and field of application. 5. Transport. Different forms of transport (1and, sea and air transport). Safety and efficiency of transport. 6. The Future of Technology. Predictions and future developments in technology.	**1,5**	**Autumn**	Energy Efficient and Sustainable Buildings
Russian Language	1. Stylistic differentiation of modern Russian 2. Genres scientific style 3. Fundamentals of scientific and business rhetoric	**1,5**	**Autumn**	Energy Efficient and Sustainable Buildings
Energy Audit of Buildings and Constructions	Introduction to the course is an acquaintance with legal and regulatory framework documents for the heat loss calculation and energy audit of buildings and structures. This course includes detailed study of modern energy-efficient materials and technologies in enclosure structures and engineering systems of buildings and structures. Methods for determining irrational energy sources and unjustified loss of energy are considered in detail. Measures to prevent them are analyzed. Preparing of energy passport according to the results of building`s audit is studied. In practice students examine thermal calculation of various designs, as well as the calculation of payback in order to various measures of energy efficiency improvement. It is planned to study modern scientific and technical literature in this course, as well as attending conferences, workshops and exhibitions dedicated to energy-efficiency. Training of enclosure structures thermal performance analysis is conducted as outdoor experiments with the use of modern testing equipment. For participants in a course it is planned to organize meetings with representatives of companies connected to energy audit and energy efficient technologies.	**3,5**	**Spring**	Energy Efficient and Sustainable Buildings
Energy-Efficient HVAC System	The principal components of the course are as follows: – Ventilation systems overview. Types of ventilation systems. Sanitary requirements of air environment. – Basic properties of humid air. – Air exchange calculation. Air distribution in premises. Air diffusers constructive solution. – Basic elements of ventilation systems. Ventilation equipment selection. – Ducts, ventilation channels. Aerodynamic calculation of ventilation systems. – Basics of air conditioning. Chiller principle of operation. Types of air conditioners. Heat load calculation. – Ventilation systems fire safety. Smoke protection in case of fire. – Energy efficiency. Energy saving in ventilation systems. Ventilation equipment with heat recovery. – Practical training includes ventilation system design, air exchange calculation, equipment selection, drawing presentation.	**4,5**	**Spring**	Energy Efficient and Sustainable Buildings

Modes of Renewable Energy Using	Introduction: Energy: Past, Today, Future Current Energy Demand in the World Energy from Fossil Fuels Energy and Environmental Wind Energy Historical Background Wind Resources Wind Turbines Status of Wind Energy in the World Environmental Impact Basic Calculations Geothermal Energy Geothermal Resources Geothermal Technologies Solar Energy Basics of Solar Energy Application of Solar Technology Solar Photovoltaics Energy Storage Methods Basic Calculations Hydropower History of Hydropower Hydropower Plants Basic Calculations Energy from Biomass Biomass as a Fuel Heat and Electric Power from Biomass Gasification, Pyrolysis, Torrefaction Anaerobic Digestion Solid Fuels from Biomass Bio-SNG Production Basic Calculations Economic Analysis of Renewable Energy Technologies	**4,5**	**Autumn**	Energy Efficient and Sustainable Buildings
Energy Efficiency and Conservation in Industry	Relevance of Energy Efficiency in the World and Russia Major terms and definition in the field of energy saving and energy efficiency. Energy balances. Prices for primary energy resources in the world and Russia. Environmental factors that contribute to the relevance of energy efficiency and energy saving in the world and Russia. Energy Efficient Management and Policy Measures in Industry Legislation in energy efficiency and energy saving in the world and Russia Ecological taxation Institutional and informational approaches Cogeneration Integrated resource planning Technical Solutions in Order to Raise Energy Efficiency in Industry Energy Audit in Industry Manual for industrial energy audit Inventory and measurement of energy use Energy performance analysis Identification of energy efficiency opportunities Cost-benefit analysis of energy efficiency opportunities Energy audit report	**4,5**	**Autumn**	Energy Efficient and Sustainable Buildings
Energy-Efficient Building Materials		**4**	**Autumn**	Energy Efficient and Sustainable Buildings
Energy Efficient	Main types of engineering equipment and buildings. Heating	**4**	**Spring**	Energy Efficient

Heating System	system. Construction of central heating systems. Domestic water supply. Water meters. Pumps and pumping systems. And quarterly in-house hot water system. Sewerage systems and schemes. Sewage networks. Ventilation and air conditioning. Ductwork of HVAC systems. Fans. Start, commissioning and testing of ventilation systems and air conditioning. Power supply for residential and public buildings. Electrical safety in residential and public buildings. Modern energy-saving technologies in construction. Methods of operation and energy audit tool maintenance. Development of energy certificates and recommendations on the choice of energy saving measures			and Sustainable Buildings

Course title	Course description	ECTS	Spring/ autumn	Program title
Methodology of scientific research	The course introduces the essence of the scientific method and theoretical thinking as well as develops the basic skills of designing research and reposting the results.	**2**	**Spring**	Finance and Economic Analysis
Corporate finance. Advanced course	The objective of "Corporate Finance (advanced course)" is to develop a comprehensive theoretical foundation for the applied corporate finance methodology and its instruments, in order to design and implement corporate financing strategies under risk and uncertainty, as well as in the age of global changes in the financial markets.	**3**	**Spring**	Finance and Economic Analysis
Financial markets and financial institutions	The goal of the course is to provide an understanding the theory of financial instruments, markets and financial intermediary and the basics of practical functioning of financial markets and institutions.	**3,5**	**Spring**	Finance and Economic Analysis
Quantitative methods for decision making	The course introduces the decision-making theory in the financial sector and application of mathematical models in the optimization of economical problems.	**2**	**Spring**	Finance and Economic Analysis
Bank management	The main objective of the course is to give students core principals in bank management, basic theory and practice of lending process in a bank and creditworthiness analysis.	**3**	**Spring**	Finance and Economic Analysis
Applied micro-econometrics	The course introduces students to the main empirical strategies that are typically used for causal inference. At the end of the course, students will be able to choose the adequate empirical tools in order to address real-life questions relevant either for public policy or for business context.	**2**	**Spring**	Finance and Economic Analysis
Enterprise Architecture	The main objective of the course is to understand the integration between functional and business needs of the company and IT capability. The aim of this course is to give students an insight into modeling and managing the enterprise architecture. It leads to understanding of the basic models and approaches to the description of the elements of the enterprise architecture as well as principles, standards and guidelines that provide the integrity of the architecture description. It focuses on modeling business processes, organizational structures, informational flows, IT systems and technical infrastructure as a whole system. The course provides understanding of organizational issues related to the management of the process of formation and development of the enterprise architecture.	**5**	**Spring, Autumn**	Modern business technologies
Process Management	The main objective of the course is to know the basics of process management, to understand the importance of transition from a functional to a process approach, to understand the stages of a typical reorganization project. The focus of the course is on the basic concepts of process management, on description of the preparations for process modeling, development of a coherent process structure, modeling as it is and as it should be, the formation of the organizational structure, the implementation project, reengineering business processes.	**5**	**Spring, Autumn**	Modern business technologies

Project Management	The main objective of the course is to understand the project management approach as an effective management tool while facing unique business challenges, implementing changes and innovative solutions. The course contains following topics: project management within the enterprise architecture; project management vs business as usual; project management principles, aspects and processes; tools and standards of project management; features of project-oriented companies; projects, programs and portfolios. Also the course includes discussion about features of different types of projects (IT projects, business process reengineering projects etc.).	**5**	**Spring, Autumn**	Modern business technologies
Enterprise Information Systems	The main objective of the course is to understand the contents and features of enterprise information system, to introduce to economic, management and production technologies implemented in the enterprise information systems and its application for enterprises. The course contains the following sections: IT within the enterprise architecture; the role of information in business management; basic types, purpose and possibilities of enterprise information systems; problems of implementation and using of enterprise information systems; application of knowledge for choosing the appropriate IT solution.	**5**	**Spring, Autumn**	Modern business technologies
IT Service Management	The course enables the learners to understand how an integrated ITSM framework can be utilized to achieve IT business integration, cost reductions and increased productivity. The course contains the following sections: core concepts of IT Service Management; concepts of quality Framework; core concepts of Service Management System; Service delivery processes; the main processes and their relationships: resolution processes, relationship processes and control processes; operational issues of implementing IT Service Management Best Practices; standards for IT Service Management: ISO 20000 and ITIL.	**3**	**Spring, Autumn**	Modern business technologies
E-business	The main objective of the course is to understand the existing solutions for creating e-commerce enterprises, the basics of designing of an effective infrastructure for e-commerce enterprises, to get skills of e-business elements development. The course contains following topics: basics of e-business. Ways of development of e-society. Digital economics. Virtual company. Main clusters of e-business (Consumer Relations Management, Selling-Chain Management, ERP, Supply Chain Management, E-procurement, Knowledge-Tope Apps) and their possible use. E-commerce. Categories of e-commerce (B2B, B2C, P2P, B2G, etc.). Information and referral system. E-government. Technical, economic and other constraints. E-stores. Marketing and advertising on the Internet. Telecommuting and distance learning. Distance education resources. Electronic financial market structure and legal aspects of e-business. Virtual banks. Payment systems. Credit cards, electronic checks, electronic money. Existing standards of the transactions on the Internet. Data protection in e-business. Planning and organization of e-business. The efficiency of e-business enterprises.	**5**	**Spring, Autumn**	Modern business technologies
Business Intelligence and Data Warehouse	The main objective of the course is to preparing data for enterprise-ready BI solutions. The focus of the course is on the basic concepts and technologies used to successfully deploy Business Intelligence projects. Defining business requirements for BI projects in organizations of any size. Design of data warehouse with using DBMS MS SQL Server. Extract, Transform and Load (ETL) technologies. Data presentation with OLAP tools (Qlik tools) for enterprise-ready BI solutions.	**5**	**Spring, Autumn**	Modern business technologies

Strategic management of an innovative organization	The course contains information on the following topics: types of strategies, strategy pyramid, corporate strategy, tools for corporate strategy choice, business strategy; definition of innovative organizations, innovative business idea evaluation and business definition; Russian business environment analysis: approaches and modern tools for strategic analysis; process of strategic management; practice in innovative organization's mission formulation, strategic goal-setting, SWOT analysis, development of professional tools for SWOT analysis; SWOT analysis for innovative organizations, questionnaires and check lists; strategy choice and implementation; strategy of growth for innovative organization; strategy implementation and typical organizational structures of Russian companies; competitive strategies in the context of innovative organization: cost leadership, focus and differentiation; examples of Russian and international innovative companies strategic choice; peculiarities of strategic leadership and decision-making process in Russian companies; Russian peculiarities of delegation; theoretical and practical aspects, barriers for delegation in Russia; relationship between manager and subordinates: Russian managerial practices and Russian managerial mentality.	**5**	**Spring, Autumn**	International economics: innovative technological development
International financial management	The course focuses on the following topics: The role of international financial management in the management system; International foreign exchange market, typical currency operations, arbitrage, exchange rate, interest rate parity, purchasing power parity. International banking of today, banking offices, banking system, interbank financial market, capital adequacy standards, eurocurrency markets. International bond markets, types of foreign bonds, Eurobonds. International equity markets, market capitalization, liquidity, cross-listing of shares, factors affecting international equity returns. Options markets, currency options, valuations of options. Currency and interest rate swaps	**5**	**Spring, Autumn**	International economics: innovative technological development
International marketing	The course examines foreign companies' entry into the Russian market and Russian companies' entry into foreign markets. This requires an insight into the theory and its application to the development of strategies and tactics of international marketing. The first part of the course is Strategic Marketing involves discussions of the concept and the content of a marketing strategy, the algorithm of its creation and realization. In the practical part of the course we examine strategies of Russian and foreign companies. The second part of the course includes a theoretical and practical overview of the principles and methods of Operational Marketing. We consider the cross-cultural aspects of marketing, differences in marketing activities in Russia and other countries; we analyze the impact of globalization on marketing.	**5**	**Spring, Autumn**	International economics: innovative technological development
Investment management and innovative activity	The course gives an insight into the methodology and modern methods of investment feasibility studies. A particular attention is paid to the choice of funding sources, their impact on project performance indicators, a joint project justification of financing and investment and building an investment portfolio. The problem of excluding real options when deciding on the feasibility of projects, the impact of inflation, and risk assessment methods are addressed during the course.	**5**	**Spring, Autumn**	International economics: innovative technological development

Risk management in international trade	The course covers several major topics. It starts with the general overview of financial markets, financial instruments, and risks classification. The course focuses only on those risks that can be estimated, controlled, and reduced. The second part is fully dedicated to economic risk and its subtype known as operational risk. Here the influence of exchange rates on the day-to-day operations and overall cash flow is examined. The third part deals with transaction risk and different ways of its minimization: forward hedging, capital market hedging and option hedging. The final part concerns translation risk, its origins and the ways of reducing it. Practical examples are considered when examining types of risk.	**5**	**Spring, Autumn**	International economics: innovative technological development
TNC in the global economy	The course gives the students skills of analysis threats and opportunities of production transnationalization for the world region and country economy development. The course introduces the practice of analysis of TNC foreign operations and TNC role in the world economy based on basic indicators of the global economy and production transnationalization, such as: Global product growth; volume of world production and speculative capital; Dow Jones Industrial Average (DJIA); Standard&Poors 500 Index (S&P500); world unemployment rate; world export and import growth rate; gold and oil barrel price; transnationalization index (TNi). Case-studies give opportunities to analyze and collect different types of applied TNC global strategies; and estimate external and internal factors which affect global strategy choice of company.	**3**	**Spring, Autumn**	International economics: innovative technological development
Socio-economic and industrial development of regions in Russia	The course contains information on the following topics: territorial structure of Russia; different kinds of regions in Russia; main socio-economic indicators of regions; quality and quantity of regional recourses (including human resources); historical aspects of allocation social and economic objects; differences between East and West parts of Russia; Macro areas of Russia, their structure and peculiarity; special features, potentials, perspectives and disproportions in development of Russian regions; regional socio-economic policy and its effectiveness; regional business environment and risks.	**3**	**Spring, Autumn**	International economics: innovative technological development
Characteristics and perspectives of Russian industries	The course considers the main Russian industries and their development in the process of transition from Soviet-type system to market–oriented economy. This process has arguably been the most important development in the last quarter of the twentieth century. The nature and the implication of this transition continue to preoccupy policy markers around the world and represent a major theme of academic research. To one degree or another all lectures address the effects of historical and especially Soviet legacies on the relevant aspects of Russian economy and describe its current state and future prospects. The following topics are going to be discussed: Russia's Dependence on Resources; The Russian Oil Sector; The Russian Natural Gas Sector; The Russian Electricity Market; The Economics of Mineral Resources.	**3**	**Spring, Autumn**	International economics: innovative technological development
Entrepreneurship	Students will better understand an entrepreneurship and its role in economy; understand the features of Small and Medium Sized Enterprises (SME'S); metamorphose their ideas to commercial projects. Students must have be ready to: evaluate the role of the entrepreneur in the economy; assess entrepreneurial opportunities; identify ways through which entrepreneurship is manifested; evaluate the ethical issues.	**5**	**Autumn**	Innovative Entrepreneurship, International Business Development

Management of investments		**5**	**Autumn**	Innovative Entrepreneurship, International Business Development
Modern strategic analysis	The course provides the coverage of strategy analysis tools, implementation issues, leadership, corporate governance, structures and controls, and strategic entrepreneurship. Key features of the course include: a balanced emphasis on the resource-based and industrial organization perspectives; analysis of how firms use strategic management tools, techniques and concepts developed by leading contemporary scholars; expanded coverage of the strategic management process, exploring how firms can sustain above-average returns through strategic renewal and learning. Exploration of the European and Russian approaches to management and leadership will be provided through analysis of Russian case studies and international case-studies.	**5**	**Autumn**	Innovative Entrepreneurship, International Business Development
Intercultural management	Students will have a close understanding of the various cultural mindsets, intercultural business connections as well as an increased awareness of foreign cultures and behavioral patterns. Students will be able to assess the influence of the cross-cultural differences in the international business relationships and adequately prepare for the new intercultural situations. Students will obtain confidence and competence in negotiations, intercultural sensitivity and persuasiveness.	**4,5**	**Autumn**	Innovative Entrepreneurship, International Business Development
International human resource management	Students will be able to reasonably and effectively use existing methods of human resource management in solving problems in their professional field (they will know the nature of labor relations in different countries, the influence of trade unions on the establishment of labor relations, main areas of human resource management in international companies).	**4,5**	**Autumn**	International Business Development
Personal skills and leadership		**4,5**	**Autumn**	Innovative Entrepreneurship
B2B marketing	Student should explore the role of marketing in the management of industrial enterprises and the strategic management of industrial marketing, know the tools of marketing of for industrial purposes and approaches to assessing customer value product, its use in the marketing mix elements, know the scientific and practical basis relationship marketing, be able to study the behavior of consumers in industrial markets, including procurement processes and the use of industrial products.	**3**	**Autumn**	Innovative Entrepreneurship, International Business Development
International standards of production management	Students will gain knowledge how to develop planning system for industrial enterprise on strategic, tactical and operational levels; to develop planning and control processes. Students will be able to plan manufacturing activities and to understand planning and scheduling methods. Stu-dents will familiarize themselves with internationally recognized manufacturing management practices.	**5**	**Spring, Autumn**	Innovative Entrepreneurship, International Business Development
Export and international sales management		**5**	**Autumn**	International Business Development

Corporate finance	Students will obtain skills and knowledge in the field of corporate finance. After studying this discipline, students will obtain theoretical and practical skills and will be able: to make a rational choice of investment instruments depending on macroeconomic indicators, risk factors, legal environment and other factors; to form a personal financial plan and determine a rational structure of personal financial flows; to apply techniques of financial and managerial accounting data analysis for making financial decisions and evaluating the financial condition of the organization; to carry out operations in foreign exchange and stock markets and assess their risk and profitability.	**5**	**Spring, Autumn**	Innovative Entrepreneurship, International Business Development
International purchasing and supply chain management	Students will gain an understanding of Supply Chain Management principles and concepts on strategic, tactical and operational levels. They will be familiarized with supply chain planning and inventory management, with sourcing procedures and supplier selection processes. Students will be able to analyze sources of supply internationally.	**5**	**Autumn**	Innovative Entrepreneurship, International Business Development
International market research	Students will develop basic knowledge and skills in international market research: problem formulating, research method choice, data collecting, analysis of obtained results, interpretation and usage of research results. All this is aimed to prepare students for work in real conditions.	**5**	**Spring, Autumn**	International Business Development
International marketing management	The objectives of the course are: Product and pricing policy in foreign markets. Standardization and modification. Global and multinational branding. International marketing strategic planning. Situational analysis of the international market. Considering differences in the socio-cultural environment for promoting the product to the foreign market. Problems of product modification, communication and branding adaptation. Specificity of the control distribution	**3**	**Spring**	International Business Development
Organization theory and organizational behavior	Students will be provided with theoretical knowledge of functioning of different types of organizations in the current market conditions. They will become familiar with the principles of human behavior in organizations, the principles of group dynamics and behavior of the organization as a whole, will gain practical skills in key areas of management the behavior of employees.	**3**	**Spring**	International Business Development
Managerial economics	Students will be able to plan and organize enterprise activity in Russia and abroad, as well as the ability to evaluate alternative options for running international business.	**3**	**Spring**	Innovative Entrepreneurship, International Business Development

International controlling	Students should acquire knowledge of: - modern concepts and principles of controlling; - content and characteristics of the divisions forming the international controlling information system; - cost management system; - schemes and techniques of international controlling. Based on this knowledge, students should be able to: analyze the possibility of achieving competitive advantages, use tools of international controlling for the effective enterprise management (economic value added model, a system of KPI, BSC system, etc.). Students will become aware of modern methods and tools of the enterprise management system based on the concept of controlling, as well as acquire the skills to use those tools to ensure the effective management of an enterprise. During the course, students will be able to master the methods and tools of effective enterprise management on the basis of the controlling concept and acquire skills of quantitative and qualitative analysis for management decision making.	**5**	**Spring**	International Business Development
International financial reporting standards and taxation	The objective of the course is to educate specialists, who will be able read, analyze, and interpret financial accounting data to make informed business decisions, and who will be familiar with the major types of taxation systems and corporate taxes and be able to apply this knowledge in solving real business problems.	**5**	**Spring**	International Business Development
Innovation product management		**5**	**Spring**	Innovative Entrepreneurship
Marketing of innovation		**5**	**Spring**	Innovative Entrepreneurship
Consumer behavior in Russia		**3**	**Spring**	Innovative Entrepreneurship
Innovation management		**2**	**Spring**	Innovative Entrepreneurship
Economical English	The lectures would concern the current business-related language and terminology: an awareness of basic business communication and the stages of a deal (arranging a meeting; negotiating a deal; making an offer; etc.); a familiarity with the common formats and the key language of presentations, conferences, meetings, negotiations; a familiarity with basic corporate structures; a familiarity with basic financial terms (making payments; basic accountancy terminology and documents); a familiarity with general business documents and terminology (mission statements; company reports; stocks/shares; SWOT analyses).	**4**	**Autumn**	Master program: Business development and innovation in international context
Innovative Business development tools. Case studies	The purpose of the course is to make students aware of modern digital tools used to build and maintain marketing and business relations with clients, stakeholders and other parties involved in company activities. Main goals of the course are: to introduce student to all available variations of digital marketing technologies and their interconnection; define company digital marketing strategy and ways to set goals relative to business objectives; acquaint with modern state of Russian market; provide in-depth introduction to affiliate marketing and it's encompassing nature in digital marketing. Practical works are to be carried our using computer with publicly available software.	**3**	**Autumn**	Master program: Business development and innovation in international context

Innovation Management	This course presents a contemporary and comprehensive examination of innovation and its management at the firm (micro-foundation) level, and in a broader global (macro-economic) context.	**4**	**Autumn**	Master program: Business development and innovation in international context
Negotiation and Presentation skills	The lectures and hands-on practical classes provide students with expertise of successful negotiators, powered with up-to-date presentation skills and tricks. These are the must-have competences of a promising professional today. Course includes use of varied media formats for presentation support, verbal and non-verbal negotiation techniques, psychological aspects of business mediation, rhetorics.	**2**	**Autumn**	Master program: Business development and innovation in international context
Methodology, math methods and modern problems of Science	The course provides a comprehensive understanding of Mathematical methods applied in Economics and Business. The students will study how to apply quantitative mathematical modeling to decision making in a business management context and emphasizes not only the role of data in drawing conclusions, but also the pitfalls of undiscerning reliance of software packages that implement standard statistical procedures. The following methods will be discussed: hypothesis testing, correlation and regression, forecasting and time-series analysis, linear programming and network analysis. The course outlines the necessary tools to make smart and successful business decisions and meets the requirements of the latest professional syllabuses.	**6**	**Autumn**	Master program: Business development and innovation in international context
Human Resource Management	The course refers to Human resource management (HRM) as one of the most important parts of corporate management, which defines the main directions of a company's policy towards labor relationships among employees. The course refers in detail to major developments of HR practice in the last two or three years such as e-learning and talent management. Reference is also made to a number of significant research projects conducted recently, for example, on CIPD research project on strategic human resource management.	**2**	**Autumn**	Master program: Business development and innovation in international context
Managerial Economy	The main purpose of teaching of the discipline is mastering by the students the knowledge economy and enterprise development, the place and the role of the enterprise in a market economy. This discipline allows students to acquire the necessary skills and the ability to perform specific economic calculations, to choose the most rational ways of realization of business solutions. The students acquire the basic knowledge in the field of economy and organization of production at the enterprises, the economic efficiency of production. Students acquire tools for the practical uses of economic theory to solve the real problems of the organization.	**4**	**Autumn**	Master program: Business development and innovation in international context
International Management + basics of IFRS	As a result of the course, students would have: - theoretical knowledge of how to manage an international company, - the skills to analyze the status of international companies acting on the global market; - the skills of developing strategies on international markets via BSC; - knowledge of the system of IFRS – how to analyze and improve international business on the base of the IFRS.	**3**	**Autumn**	Master program: Business development and innovation in international context
Business Simulation Game	Business simulation games are built on a powerful, stable and highly scalable online platform that allows instructors to run their courses from one centralized interface. After the introduction, the teams familiarize themselves with the decision-making process via a practice round. The practice round results will not have any influence on the actual game results.	**3**	**Autumn**	Master program: Business development and innovation in international context

Entrepreneurship	The course provides getting knowledge of the process of entrepreneurship from the self-evaluation as entrepreneur, setting personal goals up to the presentation of business ideas in groups. The learning is based on the Timmon's entrepreneurial model. Students will be engaged in team building activity via one of the psychometric instruments – Belbin's theory as an example. The next stage of the learning process is dedicated to ideation – methods and tools of generating ideas. There also will be business planning as the basis for structuring entrepreneurial ideas. Specific traits of Russian entrepreneurs are included. The last part of the course - Rocket pitch, lies in presentation skills of entrepreneur's ideas warranted on business planning.	**3**	**Autumn**	Master program: Business development and innovation in international context
Corporate Finance	This course is for managers working in different areas of business organizations, and covers issues necessary for the development of all business professionals. The aim of the course - to help students to understand the theoretical principles of the practical tools of financial decisions. At the end of the course students will be able to evaluate the investment projects, working with debt securities, to measure the cost of capital, to identify an optimal capital structure, learn the basic techniques of identification and evaluation of firm value and risk.	**4**	**Autumn**	Master program: Business development and innovation in international context
Organizational theory and organizational behavior	Objectives of the subject: - to study the theory of organization, integrating economic, philosophical and sociological knowledge; - to study the experiences of the successful (competitive) companies, so to understand the main components of their success and effectiveness; - to form general ability to make managerial decisions in critical circumstances; - to achieve an understanding of the causes and development of the evaluation criteria of human behavior in organizations; - to train students' ability to analyze human behavior in a social group.	**3,5**	**Autumn**	Master program: Business development and innovation in international context
Quantitative techniques	The lectures would concern the following scientific methods: the generation of models, theories and hypotheses; the development of instruments and methods for measurement; experimental control and manipulation of variables; collection of empirical data. Each lecture would include real examples of using the methods in business process description.	**3**	**Autumn**	Master program: Business development and innovation in international context
International Business	The lectures would concern the following questions: the nature of multinational enterprises, the environment of international business, international business strategies, corporate strategy and national competitiveness. Each lecture would include real-world examples of international business issues to provide insight and perspective. One real case would review at the end of each lecture. These cases proved students with an opportunity to apply lecture material to real-world situations.	**3**	**Autumn**	Master program: Business development and innovation in international context
Business English	The objective of the course is to enable the students to develop a better understanding of the basic business concepts and practices as well as to improve their skills in Business English.	**3**	**Autumn**	Bachelor program: International Business
Philosophy	The purpose of teaching "Philosophy" is to prepare students for understanding and comprehension of the characteristics and problems of the world and the realization of man's place in it.	**2,5**	**Autumn**	Bachelor program: International Business
Higher mathematics	The purpose of discipline - to present the necessary mathematical apparatus and give bachelors skills of its use in the solution of engineering-economic problems.	**5,5**	**Autumn**	Bachelor program: International Business

Informatics	The purpose of discipline - to give students the necessary knowledge in the field of computer science and skills of information technology in various sectors of the economy.	**6,5**	**Autumn**	Bachelor program: International Business
Public speaking skills	Purpose of the discipline - to assist in the further mastering the science and art of speech; student learning effective speech effect.	**2,5**	**Autumn**	Bachelor program: International Business
Russian language	The aim of the course - the formation of the modern linguistic identity, increase the overall students speech culture, develop the skills of generating statements in accordance with the communicative, regulatory and ethical aspects of the culture of speech.	**6,5**	**Autumn**	Bachelor program: International Business
Documentation management	Formation of theoretical knowledge and practical skills to work with office documents necessary to the manager of any part. Preparation of highly qualified specialists in the field of the requirements for the compilation of business documents, the organization of the office.	**2**	**Autumn**	Bachelor program: International Business
Introduction to the international economy	This course aims to develop an understanding of international economic issues and policies in open economies. The course will provide a general body of knowledge on topics such as gains from trade; patterns of trade; effect of trade on welfare; exchange rate policy regimes; international organizations; financial crises; and the effect of government policies on trade and the exchange rate. You will get exposed to economic modeling and learn analytical tools that can be applied to understand the changing world economy and analyze problems in international economic policy. You are encouraged to explore the potential and limitations of international economics in dealing with real-world problems. This course will assist you in improving your economic writing skills as well as your ability to read critically and understand discussions on international economic issues in the press.	**2,5**	**Autumn**	Bachelor program: International Business
Concepts of modern science	The main goals are to study the economic and societal impact of most important scientific discoveries.	**2**	**Autumn**	Bachelor program: International Business
Life Safety	The purpose of the discipline - the formation of the professional culture of safety, which is defined as the willingness and ability of the individual to use in professional work acquired a body of knowledge and skills to ensure safety in the area of professional activity, the nature of thinking and values in which security issues are considered as a priority.	**2**	**Autumn**	Bachelor program: International Business
Informational sytems and technologies	The purpose of the course is to form a holistic view of modern information systems and their role in economic activities; to reveal the possibilities of hardware and software of computer science and to generate sustainable skills in the medium of computer technology in solving typical problems in their chosen specialty	**4,5**	**Autumn**	Bachelor program: International Business
Corporate social responsibility	The purpose of teaching "Corporate Social Responsibility" is the mastery of modern concepts of management of the company from the perspective of people-oriented management and marketing, methods of analysis and evaluation of corporate social responsibility.	**3**	**Autumn**	Bachelor program: International Business
Legal environment of international business	The aim of the course: a comprehensive study of the fundamentals of law and basic legal structures and institutions that are important for international business. The main attention is paid to the legal institutions as organizations, including having different legal forms, employment contracts, property and resources of the organization, contracts, and tax organizations.	**2,5**	**Autumn**	Bachelor program: International Business

Macroeconomics	The purpose of the course "Macroeconomics" - the formation of students of scientific economic outlook, the ability to analyze and predict the economic situation at different levels of behavior of economic agents in a market economy.	**3,5**	**Autumn**	Bachelor program: International Business
Probability theory	This course provides an elementary introduction to probability with applications. Topics include: basic probability models; random variables; discrete and continuous probability distributions; calculation mathematical expectation and variance; independence; sampling distributions. Simulations about probability are also included.	**4,5**	**Autumn**	Bachelor program: International Business
International corporations in conditions of globalization	This course examines multinational enterprises (MNEs) and foreign direct investment (FDI) from a number of perspectives, including motivations for international expansion, the economic impact of such expansion on home and host countries, and the political economy of MNEs. By the end of the course, students should understand why MNEs exist, under what conditions they can cause economic benefit or harm, and the complex interaction between MNEs and home and host country governments.	**3**	**Autumn**	Bachelor program: International Business
Business correspondence	The purpose of the course is to prepare the student for practical professional using business correspondence technologies. Students should understand the importance of communication process or exchange of information in a written format for the process of business activities. Business correspondence can take place between organizations, within organizations or between the customers and the organization.	**3**	**Spring**	Master program: Business development and innovation in international context
Research methods in management	The main objective of the course is to develop understanding of the research process suitable for the management discipline. The course provides an overview of the research process and fosters capacity to understand the appropriate method of research to undertake. Students will be encouraged to become critical of the use of different techniques and methods applied in the research field.	**3**	**Spring**	Master program: Business development and innovation in international context
Information management	Familiarizing with the theory and practical skills in area of decision-making related to information flow managing, acquiring the knowledge about the process of creation the information and technology governance, corresponding to sphere of material production and services; studying the principles and methods of managing information resources and technologies concerning with operating activities of an enterprise, as well as getting practical skills of IT- and corporate -level information strategy implementation to achieve the organization strategic goals.	**3**	**Spring**	Master program: Business development and innovation in international context
International economics	The first aim of the course is to show how the development of international economic theory has traditionally been shaped by the need to understand the changing world economy and analyze actual problems in international economic policy. The second aim is to communicate to students the exciting intellectual advances in this dynamic field. An up-to-date and understandable analytical framework for illuminating current events and bringing the excitement of international economics is provided; the grand traditional insights are communicated with the newest findings and approaches. To help the student grasp and retain the underlying logic of international economics, the theoretical development at each stage is motivated by pertinent data, case studies and policy questions.	**3**	**Spring**	Master program: Business development and innovation in international context

Modern strategic analysis	The course provides the coverage of strategy analysis tools, implementation issues, leadership, corporate governance, structures and controls, and strategic entrepreneurship. Key features of the course include: a balanced emphasis on the resource-based and industrial organization perspectives; analysis of how firms use strategic management tools, techniques and concepts developed by leading contemporary scholars; expanded coverage of the strategic management process, exploring how firms can sustain above-average returns through strategic renewal and learning. Exploration of the European and Russian approaches to management and leadership will be provided through analysis of Russian case studies and international case-studies.	**3,5**	**Spring**	Master program: Business development and innovation in international context
Cross-Cultural Management (Advanced level). Case studies	The course examines the nature of culture, key elements of culture, cultural and attitudinal dimensions and the role that culture plays in strategic international management. The main objectives are to demonstrate problems and methods of examining cultural environments; to describe human physical characteristics that may vary among countries and introduce ways in which these characteristics affect business practices worldwide; to present the most important culturally related concepts that affect the strategic management decisions of international enterprises.	**2**	**Spring**	Master program: Business development and innovation in international context
Public speaking	This course will give you the opportunity to develop and strengthen skills in preparing and presenting public oral presentations in a variety of situations. It should also sharpen your skills in critical listening. While theoretical foundations for the methods taught will be included, this is a practice-oriented course. Speaking clearly and comfortably in public is a valuable and often essential skill to possess. This course aims to provide you with a basic background in the theories and principles of public speaking, as well as practical experience with the basic types of speeches. Although some of you might find the emphasis on performance frightening or frustrating, the rewards for acquiring public speaking skills are many.	**2**	**Spring**	Master program: Business development and innovation in international context
Business English	The objective of the course is to enable the students to develop a better understanding of the basic business concepts and practices as well as to improve their skills in Business English.	**3**	**Spring**	Bachelor program: International Business
Sociology	Assimilation of systematic knowledge and the formation of scientific concepts about the basic problems of social development, the historical development of sociological thought and contemporary approaches to solving urgent problems of society.	**2**	**Spring**	Bachelor program: International Business
Law	The purpose of discipline "Law" is the mastery of the students' knowledge of the law, the formation of respect for the law, civic maturity and high social activity.	**2**	**Spring**	Bachelor program: International Business
History of economic thought	The purpose of the course - to form students' understanding of the basic stages of the evolution and trends of economic thought, an intellectual biography and content of the major works of prominent scientists and economists about the main trends, trends in the development of economic theory.	**4**	**Spring**	Bachelor program: International Business
Higher mathematics	The purpose of course - to present the necessary mathematical apparatus and give bachelors skills of its use in the solution of engineering-economic problems.	**4,5**	**Spring**	Bachelor program: International Business
Introduction to regional studies	The purpose of the course is to familiarize students with the basic issues of regional studies, mastering theoretical knowledge and practical skills in the field of applied regional analysis on domestic and foreign material; understanding of the theoretical foundations and methods of Area as a sphere of scientific knowledge.	**2**	**Spring**	Bachelor program: International Business

Basics of international business	The purpose of discipline - the study of the basic laws of international business development, the features of its political, legal, technological, social and cultural environment, forms and methods of conducting international business, methods of organization and management of international business.	**4**	**Spring**	Bachelor program: International Business
Russian language	The aim of the course - the formation of the modern linguistic identity, increase the overall students speech culture, develop the skills of generating statements in accordance with the communicative, regulatory and ethical aspects of the culture of speech.	**2**	**Spring**	Bachelor program: International Business
Microeconomics	The purpose of the study of microeconomics - to form specialists able reasonably and effectively use existing and develop new methods of microeconomic analysis and microeconomic models for solving problems in the field of international management, capable of economically well-being to explain the methods and models and justify the need for their use.	**3,5**	**Spring**	Bachelor program: International Business
Introduction to the international economy	This course aims to develop an understanding of international economic issues and policies in open economies. The course will provide a general body of knowledge on topics such as gains from trade; patterns of trade; effect of trade on welfare; exchange rate policy regimes; international organizations; financial crises; and the effect of government policies on trade and the exchange rate. You will get exposed to economic modeling and learn analytical tools that can be applied to understand the changing world economy and analyze problems in international economic policy. You are encouraged to explore the potential and limitations of international economics in dealing with real-world problems. This course will assist you in improving your economic writing skills as well as your ability to read critically and understand discussions on international economic issues in the press.	**2,5**	**Spring**	Bachelor program: International Business
History	The main objective of study the discipline "History" is to help young students develop historical thinking, development accumulated by previous generations of world and national historical experience (both positive and negative), and the historical understanding of the features of Russia's place in the world community.	**2**	**Spring**	Bachelor program: International Business
Statistics	The purpose of discipline - is the formation of theoretical knowledge about the statistical nature of economic laws and practical skills of processing and analysis of statistical data.	**3,5**	**Spring**	Bachelor program: International Business
Management	The purpose of discipline is to develop in students a systematic presentation on the basic principles and methods, methods and forms of modern management to ensure the efficiency and competitiveness of Russian companies.	**4**	**Spring**	Bachelor program: International Business
Public relation	A theoretical approach to the principles of the field of public relations in corporate, non-profit, and agency applications. The role of public relations in the overall organizational communication structure.	**3,5**	**Spring**	Bachelor program: International Business
Enterprise economics	The purpose of the discipline - the mastery of theoretical knowledge and practical skills on legal and economic aspects of the enterprise in the market environment, the economic mechanism of interaction and management.	**4**	**Spring**	Bachelor program: International Business

International relations	An introduction to contemporary analysis of international relations. Students will learn major theories of international relations and apply them to understand international situations and issues in the modern world. Emphases are on clearly comprehending the relationship between international conflicts and cooperation and on recognizing the shift from “internationalization” to “globalization”. Extensive use of internet information, articles from professional journals and newspapers will enable students to update information about imminent international issues today and to think about them critically.	**3,5**	**Spring**	Bachelor program: International Business
Mathematical methods in management	This module presents the mathematical methods that are used widely in economics, including logarithms, exponential functions, differentiation, optimization, constrained optimization, and an introduction to dynamic analysis. The mathematical material is presented in the context of economic applications and examples that illustrate the bridge between mathematics and economics.	**2,5**	**Spring**	Bachelor program: International Business
Documentation management	Formation of theoretical knowledge and practical skills to work with office documents necessary to the manager of any part. Preparation of highly qualified specialists in the field of the requirements for the compilation of business documents, the organization of the office.	**2**	**Spring**	Bachelor program: International Business

Course Title	Course Description	ECTS	Spring/ Autumn	Program Title
Basics of Telecommunication Systems	Fundamental principles of analog and digital modulation methods in communication systems. Amplitude modulation methods. Amplitude demodulation methods. Frequency modulation and demodulation. Analog-digital and digital-analog conversion principles and limitations. Sampling and reconstruction of analog signals. Pulse-code modulation and demodulation. Bandwidth limiting in communication channels. Restoration of digital signals. Basic shift keying methods (ASK, FSK, BPSK, QPSK). Noise influence in digital communications. Eye diagram and constellation diagram.	2	Autumn	Microelectronics of Telecommunication Systems
Digital Signal Processing	Sampling signals. Linear Systems. Spectrum of sampled signals. Discrete and Fast Fourier Transform. Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) digital filters. Sample rate conversion, decimation, interpolation. Signal averaging.	3	Autumn	
Object-oriented Programming	C++ basic types and operations. Input/output streams. Operations with files. Files streams. Classes. Inheritance. Templates. Exception handling. The Standard C++ Class Library.	2	Autumn	
Optimization Methods in Integrated Circuits Design	Requirements for the application of optimization methods in engineering, optimality criteria; Functions of a single variable; region elimination methods; polynomial approximation or point estimation methods; methods requiring derivatives; Functions of several variables; direct-search methods; gradient-based methods; Constrained optimality criteria; Lagrange multipliers; Kuhn–Tucker conditions and theorems; second-order optimality conditions; Transformation methods; penalty concept; Constrained direct search.	2	Autumn	
Optoelectronic Devices	Optoelectronic devices. Properties and characteristics of the optical radiation. Physics of quantum interaction of radiation with matter. Main types of optical radiation sources. Lasers types and characteristics. Photoelectric radiation receivers. Optical methods of information storage. Fiber optic systems.	2	Autumn	
Optimization Methods in Integrated Circuits Design	Requirements for the application of optimization methods in engineering, optimality criteria; Functions of a single variable; region elimination methods; polynomial approximation or point estimation methods; methods requiring derivatives; Functions of several variables; direct-search methods; gradient-based methods; Constrained optimality criteria; Lagrange multipliers; Kuhn–Tucker conditions and theorems; second-order optimality conditions; Transformation methods; penalty concept; Constrained direct search.	2	Autumn	
UNIX based Operational System	The course consists of five parts. The first part introduces the history, main terminology of Linux OS and explains mining of “copyleft” licenses. The second part explains architecture of Linux OS including basics of kernel structure, drivers, services, libraries. The third part is focused on filesystem. It introduces filesystem object types, explains permissions and ownership. The fourth part introduces the basics of administering Linux OS and includes user, group and root account management, basic networking, software management, backup fundamentals. The fifth part covers basics of shell scripting. It starts from overview of shells and explains how to set up environment. After that main parts of the shell scrits are examined, such as, preset and standard variables, wildcard expansions, conditionals operators, loops, functions.	2	Autumn	

Computer Simulation of Integrated Circuits Components	Model of passive components; Models of active components; The Gummel-Poon BJT Model; MOSFET SPICE model of MOSFET; MOSFET BSIM model; MOSFET small-signal model; MOSFET high-frequency model. MOSFET noise model; Temperature effects in MOSFET; Component simulations based on MOSFET.	3	Autumn	
Design of Microelectronics Analog and RF Circuits	Main principles and fundamentals of system design: top-down design approach, digital and analog modulation, transceiver architectures, design considerations of system level design, system level simulation; Transistors and technologies; Main analog and RF building blocks: basic stages, operational amplifiers, transconduction amplifiers, current amplifiers, low-noise amplifiers, wide band amplifiers, mixers, VCO; power amplifiers, auxiliary circuits; Physical design and physical verification.	3	Autumn	
Design of Microelectronics Digital Circuits	MOS transistor model and equivalent circuit; Combinational circuits; logic design with MOSFETS, CMOS inverter, static and switching characteristics, switch models; logic functions, fundamental logic operators, Boolean algebra, binary arithmetic; definition of combinational circuits, truth table, realization from truth table; Quine-McClusky's tabular method of logic minimization, logic minimization using K-map, minterms and maxterms; CMOS static logic gates NAND and NOR, realization of basic gates using universal logic gates; complex CMOS logic gates; multiplexers, XOR, and AOI, pass-transistor logic; adders; Sequential circuits; state transition diagram and state transition table; RS and CRS latches; T, D, DRS, and JK flip-flops; parallel registers; shift registers; parallel serial registers; serial parallel registers; binary counters; asynchronous and synchronous up/down counters; sequential counter with irregular sequences; ring counters and Johnson's counter; SRAM; DRAM; flash memory; Propagation delay, dissipation power and power-delay product; Presentation of course projects.	2	Autumn	
Microelectronics Filter Design	Throughout the course the following topics will be covered: Approximation problem (The Butterworth approximation, The Chebyshev approximation, The Bessel-Thomson approximation, The Cauer (elliptic) approximation); Reactance transformation; Sensitivity problem, Sensitivity invariants; Cascade design; Element simulation method based on Bruton transform; Operational simulation method; Switched capacitor technique; Discrete signal presentation and Z transform, Analysis of SC-circuits in time and Z-domain, Charge equation method, Lacker models; Transconductance amplifier based filters, tuning systems	4	Autumn	
Organic and Functional Microelectronics	Physical principles of functional acoustoelectronics, organic electronics, semiconductor electronics and optoelectronics; Instruments and devices of functional microelectronics	5	Autumn	

Nanomechanics of Materials and Systems	1. Nanomechanics of materials. 1.1. Introduction. 1.2. Formation of nanosystems in sold states. 1.3. Mechanical deformation and strain in thin films. 1.4. Instability and self-assembly on the surface of thin films. 1.5. Elastic properties of nanoinclusions. 1.6. Dislocations in planar nanoheterostructures. 1.7. Dislocations in nanowires and nanoinclusions. 1.8. Microscopic theory of strength in nanostructures. 2. Nano-electro-mechanical systems 2.1. Nanosensors of temperature, pressure, acceleration, and gas fluxes. 2.2. Nano-gears, optical and electronic nano- and microsystems. 2.3. Nano-liquid valves, pumps, and biomedical systems.	4	Autumn	Mesoscopics and Advanced Materials
Dimensional Quantization Phenomena	1. Introduction to the course. Wave functions, matrix elements, quantum transition probabilities 2. Quantum wave interference and diffraction in nanostructures 3. Semiconductor superlattices 4. Planar optical waveguides 5. Disturbed total internal reflection 6. Dimensional quantization of phonons in nanofilms 7. Dispersion of phonons 8. Physics of whiskers	4	Autumn	
Superconductivity	The course aims at giving the students the basic knowledge on superconducting materials like crystals, ceramics, and thin films. The course includes some theoretical issues concerning physical processes leading to the superconductivity. The course also reviews the practical applications of superconducting materials.	4	Autumn	
Physics of disordered nanosystems	This course provides students with basic concepts and theories in the physics of disordered nanosystems, such as doped semiconductors, amorphous bodies, conjugated conducting polymers (organic semiconductors), nanocomposites, ensembles of quantum dots, amorphous or polycrystalline graphene, and system of carbon nanotubes.	3	Autumn	Mesoscopics and Advanced Materials
Quantum many-body theory	The course presents the modern methods of many-body theory and its applications to describe the structure, dynamic properties and processes in many-particle systems like atoms, molecules, atomic clusters, nanostructures, condensed matter. 1. Introduction. Systems of independent particles: bosons and fermions, and their statistic. 2. Many-body systems with weak interaction. Bose–Einstein and Fermi-Dirac statistics. 3. Single-particle approaches: Thomas-Fermi method, the local density approximation (LDA), Hartree-Fock approximation 4. Field theory methods in many-body theory: second quantization, interaction representation, field operators, Greene functions. 5. The diagram technique. Many-body perturbation theory. 6. Interaction of many-body systems with electromagnetic field. Scattering of particles.	3	Autumn	

Optical properties of nanostructures	The aim of the course is the study of phenomena related to the interaction of optical radiation with semiconductor nanostructures and physical principles of modern optoelectronic devices (lasers and photodetectors) based on low-dimensional structures. The different optical phenomena arising in semiconductor nanostructures are described in the course. As an introduction, the main principles of size quantization are presented. Further, the various mechanisms of light absorption in nanostructures with quantum wells and superlattices associated with the carrier transitions between subbands of size-quantization are described in detail in the framework of quantum mechanical perturbation theory. The effective mass approximation is used. The processes of interband and intraband light absorption and the effects of various factors such as the Coulomb interaction, collective and multiparticle phenomena, nonparabolicity of the band spectrum, the external electric field, etc. are considered. The drag effect and the principles of optical spin orientation related to the interaction of circularly polarized light are described. Application of optical phenomena in nanostructures is demonstrated for photodetectors based on intersubband carrier transitions in quantum wells, injection lasers with quantum wells and quantum cascade lasers.	3	Autumn	
Trends in Modern Science - HORIZONS	«Trends in modern science - HORIZONS» is an interactive integral multidisciplinary course. Fundamental knowledge from physics, mathematics, chemistry, biology, medicine is desirable for students. The goal of the course is to help students with adaptation to international scientific environment at conferences, with synthesis of knowledge from different fields of science and with development of analytical point of view to scientific problems. The information base of the course is articles from international journals (Nature, Science, Applied Optics, Materials today, Nanomedicine, etc.) and weekly Internet alert issues (Biomedical News, Materials Today, Optics news).	5	Autumn	Molecular and Cellular Neurobiology
Seminars in Electrophysiology	The course is based on seminar type discussions. Students prepare presentations on the basis of scientific publications, after which the entire audience takes an active part in discussions on a given topic. The course aims to develop student's ability to make the presentation of their own results and data of other authors, and participate in the discussion. The discipline sections: 1. Bioelectricity, 2. Patch Clamp, 3.Instrumentation for Measuring Bioelectric Signals from Cells, 4.Properties of Ion Channels, 5.Advanced Patch Clamp Techniques, 6.Low Noise Recording, 7.Data Acquisition and Analysis.	5	Autumn	
Theory of Telecommunication Systems and Networks	Structure of data networks and traffic switching technology. Layered architecture of the data network, the fiber-optic system model and the TCP.Physical layer of network architectures, channel organization principles in plesiochronous and synchronous digital channel hierarchy. Adaptation procedures of level protocols: partition into data blocks, error detection and correction, ARQ methods, data stream control. Link-layer protocols, multiple access protocols, IEEE 802.x networks. Network services functions, queue management algorithms. Internetworking, routing algorithms. TCP / IP networks, architecture and protocols. Switched networks, ATM technology.	3	Spring	Microelectronics of Telecommunication Systems

Integrated Circuits Design for Wireless Transceivers	Basics of Radio Frequency Design, Transceivers architecture, CMOS-technology, Low Noise Amplifier, Mixer, Oscillator, Power Amplifiers.	4	Spring	
Physics of Integrated Circuit Technology	Basic operations of planar technology; Thermal oxidation; Methods for doping; Epitaxial technology; Lithography; Technology of bipolar and CMOS integrated circuit structures; Three-dimensional integrated circuits; Perspective materials of microelectronics.	5	Spring	
Programmable Digital Device	The history and architecture of microcontrollers and FPGA devices; basics of assembler/C language and VHDL/Verilog languages; main practical aspects of programming techniques; basics of DSP techniques, such as digital filtration, data conversion. Every topic is illustrated by numerous examples during theoretical and practical parts of the course.	2	Spring	
Physics of condensed matter	The course provides basic knowledge on condensed media of different types. The course also considers the atomic and molecular interaction, as well as interactions between quasiparticles in the systems of different dimensions. 1. Condensed matter types 2. Atomic interaction and transfer of energy in condensed media 3. Quasiparticles in solids 4. Electronic states and optical properties of condensed media	4	Spring	Mesoscopics and Advanced Materials
Fundamentals of modern techniques to study nanomaterials and nanostructures	The course is to provide understanding of the physical fundamentals and principles of modern characterization techniques: X-ray Diffraction (XRD), Transmission Electron Microscopy (TEM). Scanning Electron Microscopy (SEM), Scanning Tunneling Microscopy (STM), Atomic Force Microscopy (AFM).	4	Spring	
Spectroscopy of atoms, molecules and clusters	The course provides the basic knowledge on interaction of light with matter, in particular with atoms, molecules, clusters, and solid state defects. 1. Quantum mechanics of multi-electron atoms and molecules. 2. Quantum theory of interaction of light with matter. Nonlinear processes. 3. Properties of laser radiation, types of lasers. 4. Modern trends in spectroscopy of atoms, molecules, and clusters.	4	Spring	
Plasmonics	The course gives the students a base knowledge of plasmons: the collective free electron oscillations. It focuses on plasmon fundamental properties and their applications. 1. Electromagnetics of metals 2. Surface plasmon polaritons (SPP) at metal/insulator interfaces 3. Excitation of SPP at planar interfaces. 4. Imaging of SPP propagation 5. Application of SPP. 6. Localized surface plasmons (LSP) 7. Methods of LSP observation. 8. Application of LSP in sensoring and spectroscopy.	3	Spring	

Trends in Modern Science - HORIZONS	«Trends in modern science - HORIZONS» is an interactive integral multidisciplinary course. Fundamental knowledge from physics, mathematics, chemistry, biology, medicine is desirable for students. The goal of the course is to help students with adaptation to international scientific environment at conferences, with synthesis of knowledge from different fields of science and with development of analytical point of view to scientific problems. The information base of the course is articles from international journals (Nature, Science, Applied Optics, Materials today, Nanomedicine, etc.) and weekly Internet alert issues (Biomedical News, Materials Today, Optics news).	5	Spring	Molecular and Cellular Neurobiology

Course title	Course description	ECTS	Spring/ Autumn	Program
Business operations research and management science	Objectives: The course introduces modern approach to practical modelling of optimization problems in management. Content: The course gives a complete overview of different types of modern optimization techniques which are important to deal with a company problems: cooperative genetic algorithms, linear fractional programming, application map planning, navigation planning. Students will acquire theoretical knowledge and practical skills in the following aspects: • Algorithms of forecasting in econometric research based on neural networks (traditional approach to supervised neural networks; genetic search for neural network weight optimization; flexibility in the criteria choice ; forecasting future directions of share market prices; research and practical applications) ; • Catastrophe theory algorithms for investigation of economic systems structural adaptability (dynamic processes; degenerate and non degenerate critical points; transversality and structural stability; normal, splitting and conflicting factors; attractive surface; 2- and 3 -parameter models of structural instability; successful applications); • Cluster method in a company activity modelling (the construction and use of input-output models; cluster identification techniques using employment and input- output data; modelling of agglomeration forces; geographical and functional dimensions of specific cluster identification; empirical approach to specific cluster identification; practical applications).	**2,5**	**Autumn**	Advanced information technologies for enterprises
Internet programming for enterprises	Objectives: The objective of this course is to provide students with the knowledge of methodology and philosophy of the Internet programming. Practical applications are presented with the Java programming language for business processes modelling. Content: The Java language fundamentals. Objects, classes, fields, methods and access modifiers. Platform independent and native methods. Primitive type and object references converting and casting. Exception classes and exception processing. File input and output. Streams, readers and writers. Threads control. Suspending, sleeping, blocking and scheduling implementation. Object lock and synchronization. Graphical User Interface (GUI) programming. Layout managers, visual components, containers, menus. Events processing. Events delegation model and explicit event enabling model. Painting and graphics context. Clipping. The GUI thread and spontaneous painting. Images. Animation. Applets and frames. Drawing in applet. Open system interconnection model. TCP/IP protocols architecture. Internet addresses, DNS. Network programming. TCP- based client-server application. Servicing a set of clients. UDP- based client-server application. Distributed applications and RMI. URL in applet. Distributed and client-server database architecture. Hierarchical, relational and object-oriented databases. ODBC and JDBC interfaces. JDBC -based routines. Selection, projection and updating statements. Statement, prepared statement and query results processing. Web servers and browsers. Servlets for HTTP request and response, Http –session, cookies, Java server pages scripts. Security policy and security manager for Java	**2,5**	**Autumn**	Advanced information technologies for enterprises

	applets and applications. Keys generation algorithms. Messages digest algorithms and its implementation, data digital signature and digital certificates.			
Programming technologies	Objectives: This course is aimed at developing skills to create flexible data structures and methods of processing based on fundamental OOP concepts: abstract data types, encapsulation, inheritance and polymorphism. The course is based on the Microsoft .NET framework platform. It gives students the intermediate-level skills needed to write applications for the NET available in the Windows operating system. The NET framework is a set of technologies that are designed to transform the Internet into a full-scale distributed computing platform. The basic goal of the course is to reduce the time needed to build professional applications increasing the overall quality and functioning. Content: The content provides new ways to build both the Windows-based and the Web-based applications. New approaches reside on the fundamentals that are covered in the principles of the Windows operating system. Message handling mechanisms. Standard Windows application structure based on API elements, such as functions, macro extensions, messages, interfaces. The run-time environment (CLR). The code execution management. Portable executables. C# console applications. Namespaces and classes of the.NET framework. Assemblies and CLR metadata. Tools for exploring namespaces. Managed and unmanaged code. Garbage collector and memory allocations. Value and reference types. Built-in data types. Class object as the super-class in the NET framework. Creating class hierarchy. Virtual functions and their overridden versions. Exception handling. Class array, its properties and methods. Overriding operators and functions. Interfaces implementation. Sorting the objects and IComparable. Enumerations and their usage. Properties as named members of a class. Indexer declaration and usage. Delegate declaration and usage. Delegates and system events. Handling and raising events. Dynamic data structures in the .NET framework class library. Windows forms-based Win32 desktop applications. GDI+ graphics classes. Device contexts and graphical primitives drawing. Main GDI+ instruments, their usage and management. Bitmap-image structures, management and animation using timers. Debugging technology, methods and tricks. Investigating the coordinate transformations. Model and modeless dialogs. Basic control elements. Data grid and its management. Creating file system and timer components. Overview of the Web forms applications. Platform-independence. Browser-neutral user interface. ASP.NET applications. Creating a simple ASP.NET distributed application using ASP.NET classes. Basics of Network programming.	**2,5**	**Autumn**	Advanced information technologies for enterprises
Neuroinformatics: theory and applications	Objectives: With the phenomenal growth in the area of intelligent systems in the past years the subject of artificial neural networks and their introduction into information management has become very popular. The other prosperous direction of the intelligent theory concerns intelligent data analysis and decision making support systems. This course aims to combine two novel instrumentation concepts of neural net simulation algorithms for intelligent data analysis with virtual instruments engineering technology based on the LabVIEWR Graphical Programming Systems (National InstrumentsTM, USA). The course is oriented to provision of basic	**3,5**	**Autumn**	Advanced information technologies for enterprises

	knowledge in neuroinformatics and artificial neural network, their application in industry and scientific experimentation. The course proceeds from a clear but concise exposition of neuroscience fundamentals in mathematical theory and such algorithms as medicine, intelligent security system, technical diagnostics, etc. Content: Introduction. Preface to the problem. Artificial intelligence and intelligent data analysis. Brain computer and "brainware". Foundations of neural networks. Biological prototypes, artificial neurons and neuron models. Artificial neural networks: architectures and algorithms. Learning of neural networks: supervised and unsupervised training. Mathematical backgrounds of NN-theory. Algebraic formulation of neural networks learning via optimization problem. Unconstrained optimization and gradient descent algorithms. Stochastic gradient optimization. Genetic algorithms. The algorithm of dual functioning and back-propagation. Models, architectures and algorithms. Perceptions and threshold logic classification. Multilayer feedforward networks. Radial basis function (RBF) and RBF-networks. Supervised learning in multilayer feedforward networks. Backpropagation theory. Competitive learning rule and competitive dynamics. Kohonen self-organizing maps. Feedback recurrent networks and associative memories. Discrete Hopfield net and bidirectional associative memory. Information-theoretical approach to self-organizing neural networks. Overview of the emergent properties of non-linear self-organizing neural networks within the context of a blind signal separation problem and independent component analysis approach. Entropy-based criteria and independent component analysis. Application of neural networks. Knowledge -based system. Discussion working support system. Business processes of optimization.			
Knowledge engineering	Objectives: Knowledge engineering is defined as an information structuring methodology for different domains. It provides students with knowledge engineering characteristics including principles, practices, issues, methods, techniques and programs involved with knowledge elicitation, structuring and formalizing. Content: The course examines the following related topics: • defining and identifying cognitive aspects of knowledge modelling and representation; • relation, roles, data, information and the knowledge of different applications including intelligent and tutoring systems. Various approaches needed to ensure effective introduction and deployment; • the characteristics of theoretical and methodological topics of knowledge acquisition, including principles, methods, issues, and programs. Students are introduced to major issues in the field of knowledge engineering and to the role of knowledge analyst in strategic information systems development. Attention is given to relating knowledge engineering to other professional areas, e.g., education, information management, business administration. Students gain knowledge engineering comprehension and knowledge management role understanding in companies and organizations, in decision-making realized by the members of an organization.	**3,5**	**Autumn**	Advanced information technologies for enterprises

Enterprise resource planning systems	Objectives: This is an introductory course for university students. The course provides participants with an overview of enterprise resource planning concept, the introduction of the most powerful IT tool for enterprise management with the SAP ERP and offers a short period of practice on the system. The goal of the course is twofold: a) to provide an excellent opportunity for the students who are new to the ERP tools to learn the basics of the ERP; b) to provide hands-on experience with the SAP ERP from basic navigation to an overview of each of the major functional areas of the SAP software. The new introductory course uses a motorbike manufacturer as the case company to explain organizational structure and business processes within the SAP framework. Content: Introduction. What is the ERP? Company SAP. Overview of the products. Navigation in the SAP ERP. Basic conceptions, basic data and transactions in the SAP ERP. Virtual demo-corporation IDES. Introductory block of exercises. Block of exercises №1. Production planning and control. Overview of logistics processes, financial processes and processes of human capital management. Block of exercises №2. Controlling. Block of exercises №3. Logistics.	**2,5**	**Autumn**	Advanced information technologies for enterprises
Modern operating systems	Objectives: This course is a base for system administrators. Students are trained in base operations with file systems and their reserve copying. They execute standard Solaris installation from CD, learn to operate the software and its updates, develop skills on user's management, and get acquainted with the process of Solaris loading and stopping and also with the services control system. Moreover, they get necessary knowledge of system security, processes management and a system printing process. Content: The course examines a number of related topics. File system. Hierarchies of Solaris file system. The work with local disk stores. The work with external connected data carriers. Dynamic configuration stores. File system management in Solaris. Assembling file systems. Monitoring behind the use of file systems. Reserve copying. The work from CD and DVD. Reserve copying and restoration performance. The use of instant pictures UFS (UFS Snapshots). Solaris installation. Principles of Solaris installation from CD. Installation planning. The information demanded for successful installation. Solaris installation performance from CD. Software and updating management. Software management. Software updating. Users' management. Groups of users' management. Passwords management. System loading and services starting. Loading process. Adjustment in the boot PROM (For SPARC). Systems loading and stopping. Services management by means of SMF. System security. Access rights to files. Checking of system access. Processes. Processes management. The essence of processes and their life cycle. Information reception on processes. Signals. Processes priority management. Postponed and regular tasks performance. Printing processes. Printing processes service. Printing processes performance.	**2,5**	**Autumn**	Advanced information technologies for enterprises

Information security systems	Objectives: The objective is to introduce students to the basics of computer security. The reality reveals the importance of protected and reliable environment for every computer user. Starting with some introduction, students pass to the security standards and protocols overview, both de facto and de jure, as well as to the basics of the user program and data protection by means of the operating system with further assumption of business continuity ensuring. Then students pass to secure passwords usage and management, cryptographic methods and anti-virus tools. After theoretical background students get down to secure the work using the Internet and then they turn to the local and global network security. A focus is made on everyday real computer threats and adequate countermeasures. Content: The main subject areas include: • Introductory part: information security as an inseparable part of computer technologies; • Standards and laws overview: world and national standards (ISO 17999-BS7799, CCITSE etc.); • Operating systems overview and administrative methods of protection; safety procedures scheduling; • User program and data protection. Safe passwords, cryptography usage; • Anti-virus tools and countermeasures; • Business continuity ensuring: planning, responsibilities, roles, personnel trainings; • Network security: secure web browsing and e-mail, firewall technology. Conclusion.	**2,5**	**Autumn**	Advanced information technologies for enterprises
Interdisciplinary project	Individual research project	**5**	**Autumn**	Advanced information technologies for enterprises
Intelligent systems	Objectives: The purpose of the course is to prepare the student for practical activities in the field of creation, introduction and operation of intellectual systems. The goals of this course are to acquaint the student with brief history of becoming and development of artificial intellect (AI); to consider technical statements of the primary goals solved by systems of artificial intellect; to acquaint with modern areas of research on an artificial intellect; to acquaint with the basic models of representation of knowledge in intellectual systems; to consider theoretical and some practical questions of creation and operation of expert systems. Content: 1. Introduction: brief history and terminology 2. The theoretical problems solved by AI. Practice: «Correct statement of the purposes». 3. Practical application areas of AI methods. Testing: «Terminology and scopes of AI». Testing: «Directions of modern researches in AI» 4. Models of knowledge representation. The general review. 5. Logic. Practice: «Formal logic application for management of technical devices». Testing: «Bases of formal logic» 6. Production rules 7. Languages of the description production models Pro1og and Lisp. Practice: «Programming in language Pro1og». Practice: «	**3**	**Autumn**	Intelligent Systems

	Programming on Lisp». Testing: «Bases of language Pro1og». 8. Semantic networks. Practice: «Construction of a semantic network on the basis of a text fragment». Testing: «Bases of the theory of sets». 9. Frames. Practice: «Creation of the frame of a visual image». Practice: «Creation of not visual frame». Testing: «Bases of objective model»			
Methods of optimisation	Objectives: The main objective of the course is to display basic concepts of the optimization theory and numerical methods of solving extremal problems. The course provides profound knowledge of numerical optimization techniques and demonstrates examples of technical and economic applications. Content: 1. Mathematical programming: theory and applications; 2. Data analysis and decision making problems; 3. Decision making under uncertainty; 4. Optimal control theory and numerical methods; 5. Applications of ANN and GA in the problems of optimization	**2**	**Autumn**	Intelligent Systems
Software Development Technology	Objectives: The objectives of the course are to develop the abilities for data dynamic structures creation (files, lists, stacks, turns, associated files, hash-tables), which allow to store computer appendices data for reliable and effective operation. The course also develops skills of using the object-oriented approach in applications programming on the basis of classes library usage: NET Framework Classes on a platform.NET CLR; shared languages C #, C ++ and Visual Basic 7.0. Content: 1. New ways of building the Windows-based applications and the Web applications. 2. New approaches based on the principle of the Windows operating system fundamentals. 3. Message handling mechanisms. 4. The structure of a standard Windows application based on API elements: functions, macro extensions, messages, interfaces.	**4**	**Autumn**	Intelligent Systems
Modern Problems of Computers and Information Science	Objectives: The main objective of the course is to display fundamental concepts and new achievements of informational technologies and resources and their applications in different fields of human activity. The course provides the profound knowledge of modern optimization techniques playing an increasingly important role in controlling and planning, system analysis, designing, industrial automation, communications and management science. Content: 1. Structure, formalize and describe mathematical model of practical problem. 2. Choose and investigate corresponding optimization algorithm. 3. Construct optimization analysis program to select the best decision. 4. Construct technical report and provide data analysis of optimal project. 5. Use popular scientific software (Matlab, MathCAD, GeneHunter, etc.) for optimization analysis and modeling	**4**	**Autumn**	Intelligent Systems

Mathematical modeling and simulation	Objectives: The lectures provide an introduction to modern visual technology of modelling and simulation of complex dynamic systems. Content: 1. Mathematical modelling is the basis of investigation and designing of complex and dynamic real-world systems. 2. Computer-based present state of mathematical modelling. 3. Changes in traditional designing technologies due to computers application for modelling and simulation of complex systems. 4. Fundamental importance of changes. 5. Mathematical modelling as a component of computer modelling. 6. Computer modeling as the basis for computer designing technologies.	**5**	**Autumn**	Intelligent Systems
Neuroinformatics and Neuro-technologies	Objectives: The objectives of the course are to provide an evaluation of new computation paradigms of artificial intelligence and brain-like computing intelligence for a large class of intellectual ill-formalising tasks solution; to develop an understanding of a new mathematical theory of self-organizing and adaptive machine learning algorithms via artificial neural networks paradigms; to gain experience of the main requirement to solve a large class of computational intelligence tasks of classification, clustering, pattern recognition and machine learning techniques ; to provide an understanding of advanced algorithms of recurrent self-organizing and learning neural networks oriented to different actual tasks solution. Content: 1. Neuroinformatics basics are architectures and algorithms. 2. Mathematical backgrounds of NN: learning via optimization problem. 3. Perceptron and threshold logic classification. 4. Multilayer feedforward networks. 5. Laboratory training with the fulfillment of a set of exercises. The use of LabView graphical programming system for real experiments and modelling problems solution.	**6,5**	**Autumn**	Intelligent Systems
Computing systems	Objectives: Computer technologies application for scientific research. Content: 1. History and stages of evolution of computer engineering; classification of computer complexes and systems. 2. Designing of hardware and software for computing systems. 3. Planning of processes; levels, the purposes, criteria, parameters and algorithms of planning; cooperation of processes and the basic aspects of its logic organization. 4. Hypermedia and system multimedia; the distributed databases and integration of resources with the distributed databases. 5. Software life cycle; technologies of working out of program complexes; technologies of an estimation of quality ON. 6. Methods and algorithms of object-oriented programming. 7. Standards of information support for products on stages of life cycle. 8. Technologies and means of e-learning; videoconferences; basic telecommunication systems; standards and communication protocols. 9. Searching of the scientific and technical information; modern principles of storage of the information; management of access to	**5**	**Spring**	Intelligent Systems

	resources; concept of electronic publications.			
History and Methodology of Informatics and Computer Science	Objectives: The course deals with modern directions of computer science history and development, such as history and evaluation of operating systems; events processing and threads control ability; history and the present state of relational and object-oriented databases; computer networking and client-server interaction. Content: 1. Mathematical logic and the theory of algorithms; 2. Cybernetics and computer science; 3. Computer mathematics; numerical methods and analytical calculations; 4. Programming languages and technology development; 5. Computer graphics and multimedia systems.	**2,5**	**Spring**	Intelligent Systems
Intelligent Computing	Objectives: The objective of this course is to study the base aspects in the fields of modern computer science, computational intelligence, software and hardware of intellectual systems. During this course students will: - learn main technologies, approaches and methods of computational intelligence; - learn modern aspects in software and hardware of intellectual systems; - implement modern aspects of intellectual computing, and implement neuro-computers and fuzzy processors for solving variable applied tasks. Content: 1. Introduction to computation intelligence. 2. Robotics systems 3. Neural Networks 4. Fuzzy Logic 5. Preprocessing 6. Adaptive Resonance Theory 7. Expert Systems 8. Artificial Immune Systems 9. DNA-computing 10. Swarm Intelligence 11. Hybrid Systems 12. Evolutionary Computation 13. Intellectual Hardware 14. Intellectual Software	**7/5**	**Autumn/ Spring**	Intelligent Systems
Cognitive Multiagent Systems	Objectives: • To develop an understanding of cognition principles and their use to build cognitive agents of different architectures; • To study to design multiagency systems with the cognitive agents for various distributed applications; • To provide an appreciation of the basic cognitive techniques and methods for decision making and learning based on knowledge; • To give experience of solving some variants of tasks in multiagency manner with cognitive agents; • To provide understanding of basic models and algorithms cognitive processing of information and learning; • To appreciate the capabilities and limitations of the cognitive multiagency systems for different application areas.	**8,5**	**Spring**	Intelligent Systems

	Content: Cognitive principles of the human nervous system: cognitive and effective systems; intelligence and knowledge structure, perception, decision-making, and execution; learning, self-learning, and self-organization; cognitive approach in intelligent systems. Cognitive components: logical, neural, and neurological modules; cognitive information processing; learning and self-learning; building of various modules; pruning and growing structures; models and algorithms of processing and learning. Cognitive systems and agents: structure and levels of cognitive systems; functional components; behavioral aspects; cognitive structures; design of cognitive structures and systems. Cognitive agents and multi-agency systems: architectures of cognitive agents - reactive, deliberative, and combining; multi-agency systems and cognitive agents; interaction of cognitive agents, interaction protocols; tools for multi-agency design. Applications of cognitive multi-agency systems: virtual teamwork games – soccer, basketball and so on; distributed industrial control systems; military strategic and tactic planning systems; humanoid robot and group robots control systems.			
Knowledge Management and Knowledge Engineering	Objectives: The course will introduce the underlying theme of the new degree, methodological data and knowledge processing. Knowledge engineering will be defined as an information structuring methodology for different domains. Characteristics of knowledge engineering includee the principles, practices, issues, methods, techniques and programs involved with the knowledge elicitation, structuring and formalizing. Content: students will have the following skills 1. Elicit, structure and formalize knowledge acquired from different sources; 2. Think creatively about and understand the strategic role of knowledge acquisition techniques in information processing and the role of information analysts in this area; 3. Contribute to increasing the creativity and productivity of information processing and working with different information; 4. Elaborate and assess his/her knowledge engineering skills resources and apply these skills; 5. Use popular scientific and business software (Mind Manager, Cmap Tool, K-vision, etc.) for knowledge structuring and knowledge base development.	**6,5**	**Spring**	Intelligent Systems
Speech Technologies	Objectives: The course is designed to develop the knowledge of speech analysis and synthesis advanced methods Content: Examination of a series of speech wave coding methods (PCM): • pulse-code modulation (PCM) • difference- (DPCM) • adaptive difference-code modulation (ADPCM) • delta-modulation • adaptive delta-modulation. The theoretical part of the course is devoted to studying methods of speech analysis and synthesis, linear prediction, vector signal and dash slicing (or vector quantization), entropy coding, analysis-synthesis methods, basic standards CELP, SELP and their application in communication systems. Some lectures are devoted to short time spectral analysis, filters of decimation and interpolation filters;	**4,5**	**Autumn**	Intelligent Systems

	banks of filters and signal compression standards of MPEG group; speech communication security: frequency inversion; tonal mask in; scrambling of speech elements and ciphering.			
Image Processing	Objectives: The objectives of the course are to develop understanding of image formation and representation as well as practical issues of encoding and processing image data; to provide an appreciation of the basic image manipulation techniques and methods for measuring and recognizing image-type features; to provide understanding of advanced algorithms, which underpin a lot of current computer vision systems. Content: 1. Image types and images coding 2. Spatial technique for image improvement 3. Finite impulse. Response filters 4. Image transformation 5. Image improvement 6. Color processing 7. Multi-scale image analysis 8. Morphological operations 9. Feature extraction for object recognition task 10. Image segmentation	**4,5**	**Autumn**	Intelligent Systems

Course title	Course description	ECTS	Spring/ Autumn	Program Title
History of Graphic Design ***(COMPULSORY COURSES)***	The aim of this course is to give the students an insight into cross-cultural global context of the contemporary graphic design. The course also deals with post-modern visual discourse, which empowers the students with experience on how to comprehend the inner messages of modern graphic design. In the present course graphic design is treated as the field of representation of the social, cultural and ideological challenges of the present.	**20**	**Spring 2017**	Design Semester
Typography Fundamentals ***(COMPULSORY COURSES)***	The course provides with basic knowledge of typography such as type anatomy and dimensions; Introduces history of Cyrillic alphabet. Shows typefaces classification.			
Concept design ***(COMPULSORY COURSES)***	The main goal of the course is to teach how to design the creative concept (idea) for any objective of visual communication; to provide different methods of creating verbal and visual images; to show possible ways of organizing the project's images database.			
Brand Visual Identity ***(COMPULSORY COURSES)***	Introduction to theoretical basics of brand visual identity. The aim of the course - to show how to create sensible name and reasonable message of your brand; to represent feasible ways of correlation between name, message and image of the brand by means of fonts, graphic shapes and color; to set an example how to make workable brief for graphic designer; teach how to design visual identity of your brand-project by yourself.			
Type Layout, Composition and Settings ***(COMPULSORY COURSES)***	The course provides knowledge of working with multipage layouts. Introduce basics of grids designing; shows how to create vivid headings by means of lettering.			
Web Design (HCD, UX)	Introduction to theoretical basics of Human Centered Design. The main goal of the course if to show how to create persons and user cases; to teach how to design GUI prototype.; to set an example how to make usability tests.			
Web Design (GUI) ***(COMPULSORY COURSES)***	The main goal of the course is to draw distinction between print and web design; to Provide different approaches to design of web sites; to teach how to transform prototype into vivid and useable interface of web site.			
Infographics ***(COMPULSORY COURSES)***	The course shows how to organize raw data and transforms it into sensible information; introduces theoretical and practical aspects of design graphic information; teaches how to create vivid information design without losing its meaning.			
Creative Photography ***(COMPULSORY COURSES)***	Introduction to general knowledge of photographic process. The students obtain basics of modern digital photography; learn how color, light and composition work in photo; combine new and traditional approaches in photography; develop personal project from idea to layout.			

Graphic Design Fundamentals *(ELECTIVE COURSES)* *IMPORTANT: If you don't have any experience in graphic design you have to take part in this course to continue studying the whole program.*	The course introduces to students basics of graphic design as a tool of producing visual communication by means of graphic shapes, color and typefaces. In additional to fundamental theoretical aspects you will get all necessary skills in vector and raster graphics software (Adobe Illustrator and Photoshop). Practical part of the course starts with basics of creative thinking and every-lesson sketching. On final stage you will be able to design packaging and label by yourself and provide necessary pre-press operations.	**10**		
Dynamic Identity *(ELECTIVE COURSES)* *SPECIAL REQUIREMENTS: Basic knowledge of object-oriented programming languages.*	The course is devoted of the notion of dynamics identity – as set of principles or patterns which define the connection between object/service and people. The aim of the course is to explore methods and approaches to defining identities as pattern and visualizing ideas be means of code-based and experimental tools. The work is divided to analyzing examples of existing cases and creating a unique dynamics identity project. The students can adjust their level of difficulty be choosing between code-based or non-coded solutions.			
Visualization and Computer Design *(ELECTIVE COURSES)*	The course introduces to the basics of spatial drawing and sketching and also helps to acquire skills in CAD technologies (3D modeling, animation, work with particles systems, data visualization and also stereographic).			
Russian Language *(ELECTIVE COURSES)*	Reading and understanding some simple texts. Understanding Russian native speakers (in the bounds of the covered lexical and grammar material). Creating dialogues on particular topics using words and grammar studied.			
Business English *(ELECTIVE COURSES)*	The course is designed for upper-intermediate/advanced learners of English. Upon completion of the course the students will be expected to demonstrate a broad basic knowledge and understanding of business-related language and terminology.			
New Media Theory *(ELECTIVE COURSES)*	Introduction to theoretical aspects of media phenomena. The course provides with distinguishing between traditional and new media; shows representation of principles of New media; teaches how to transform theory into practice skills.			
Typography in Space and Motion *(ELECTIVE COURSES)*	Learning the practice of amplifying typography in tactile, exciting and novel ways.			
Anthropology of communication		**6**	**Autumn**	Communication Design
Sociology of Media		**6**	**Autumn**	Communication Design
General course of communication		**12**	**Autumn**	Communication Design
Selective disciplines: Generative design / Brand strategy		**3**	**Autumn**	Communication Design
Finalising Master Thesis		**6**	**Spring**	Communication Design

Design research		**18**	**Spring**	Communication Design
Research and creative practice		**6**	**Spring**	Communication Design

Course Title	Course Description	ECTS	Spring/ Autumn	Program Title
Fracture Mechanics 1	Characteristic scales of deformation and fracture. Theoretical strength of materials. Review of elementary defects. Classical fracture criteria. Stress concentration at spherical hole and inclusion under all-round tension. Lame equations for homogeneous and heterogeneous elastic media. Inclusions and heterogeneities as sources of internal stresses. Strain incompatibility as a source of internal stresses. Eshelby problem. Conditions on the interface between two media. Green tensors and integral equations for strains and stresses in a medium with isolated inhomogeneity. Ellipsoidal inclusion and inhomogeneity in uniform and polynomial external stress fields. Stress and strain concentrator tensors. Stress concentrations at spherical, cylindrical, oblate and prolate inclusions. Interaction energy between an inclusion and external field. Polarization tensor. Configuration force acting on an inclusion and Eshelby energy momentum tensor. Eshelby stress tensor and homogeneity of an elastic material. Invariant Eshelby integral. Eshelby integral in a medium with isolated inhomogeneity. Energy release due to curvilinear crack growth in an elastic solid. Cherepanov-Rice integral. Invariant J-integral in the case of a straight crack. Stress state of an elastic body with a crack. Stress-intensity factors. Crack opening. Irvin fracture criterion. Griffith's energy fracture criterion. Theoretical strength and Griffith's fracture criterion. Cohesive zone and Dugdale-Barenblatt model. Subcritical crack growth. A damage parameter concept.	**3**	**Spring**	Continuum Mechanics: Fundamentals and Applications
Fracture Mechanics 2	Reliability of Technologies, Service Life Prediction in the Design Phase, Assessment of the Residual Life, Elements of Theory of Probability, Random Events and Random Variables, Statistics of Random Variables. Probability Distributions, Evaluation of Statistics of a Random Process, Basics of Statistical Dynamics. Spectral Method, Elements of Spectral Analysis of a Stationary Random Process, Wiener-Khinchin Theorem. Evaluation of the Output Process Statistics, Service Loads, Classification of Service Loads on Structures, Spectral Characterization of Loads, Evaluation of Statistics of Structural Response, Fatigue Behavior of Materials and Structural Components, Fatigue Characterization of Structural Materials, Principles of Modeling Fatigue of Structures, Current Approaches to Fatigue of Structures in Design and in Service Conditions, Providing the In-Service Reliability of Structures, Fatigue Cracks in Structural Components. Application of the Griffith-Sedov-Westergaard-Irvin theory. Paris' Generalization of the Experimental Findings, Crack Propagation Assessment under Service Loading, Experimental Characterization of the Fracture Resistance of Materials and Structures, Application of the Irvin's Criterion for Fracture, Techniques of Experimental Evaluation of the Reliability Parameters, Principles of Monitoring the In-Service Reliability of Structures	**2,5**	**Autumn**	Continuum Mechanics: Fundamentals and Applications

Micromechanics of Strength and Plasticity	The basic concepts of the theory of defects. Definitions and basic geometrical, physical and mechanical properties of the point (vacancies, interstitials, interstitial and substitutional impurities), linear (dislocations and disclinations), planar (crystal surface, grain and phase boundaries) and volume (pores, inclusions and inhomogeneities) defects. Basic mechanisms of plastic deformation in the single-, poly- and nanocrystalline materials. Multistage plastic deformation, the basic mechanisms of strengthening on different stages of plastic deformation. Multilevel nature of plastic deformation; main features of micro-, meso-, macro- and megaplastic deformation. Typical dislocation and dislocation-disclination structures, the concepts of fragmentation, dynamic recrystallization and solid-phase amorphization. The concept of superplastic deformation and its features in nanocrystalline metals and ceramics. Relaxation of residual stresses and plastic deformation in composite materials and structures. The main classes of composite nanostructures. The concept of micro-micro-, micro-nano- and nano-nano-composites. The main types, mechanisms and nucleation sites of microcracks in different materials. The role of microcracks in the relaxation of residual stresses in composite materials and solid-state structures.	**3**	**Spring**	Continuum Mechanics: Fundamentals and Applications
Mathematical Methods in Solid Mechanics	Theory of mathematical and numerical methods for nonlinear boundary-value problems in solid mechanics. Models leading to variational inequalities. Existence and uniqueness of solutions. Approximations, numerical algorithms and convergence. Minimax theory and saddle point methods. Application to mathematical problems in plasticity theory: perfect plasticity and models with hardening.	**1**	**Spring**	Continuum Mechanics: Fundamentals and Applications
Functional Analysis 1	Metric spaces. Open and closed sets. Separability. Completeness. Compactness; Normed spaces. Banach spaces. Hilbert spaces; Linear operators. Bounded and unbounded operators. Uniform boundedness principle. Inverse operators. Banach inverse theorem. Introduction to spectral theory; Linear functionals. Hahn-Banach theorem. Duality. Riesz representation theorem for linear functionals on Hilbert space. Weak convergence. Adjoint operators on Hilbert spaces	**3**	**Autumn**	Continuum Mechanics: Fundamentals and Applications
Functional Analysis 2	Lebesgue measure. Measurable sets. Measurable functions. Lebesgue integral. Space of summable functions; Generalized functions. Differentiation of generalized functions. Sobolev spaces and their properties; Boundary value problems for linear elliptic equations. Generalized formulation of boundary value problems. The existence and uniqueness of solutions; Boundary value problems in linear elasticity. Generalized formulation. The existence and uniqueness of solutions	**3**	**Spring**	Continuum Mechanics: Fundamentals and Applications
Numerical methods for PDE's 1	Classical scalar elliptic boundary-value problems: equations and boundary conditions. Variational formulation as a basis of Finite Element Methods (FEM). Ritz and Galerkin methods. Natural and essential boundary conditions. Mathematical justification of FEM. Basic procedures of FEM implementation: meshing, numerical integration of shape functions, matrix assembling, consideration of boundary conditions, preconditioning and solving system of linear algebraic equations. Lagrange elements and examples. Several Hermite finite elements. Mixed finite elements	**2,5**	**Autumn**	Continuum Mechanics: Fundamentals and Applications

Numerical methods for PDE's 2	Introduction to general numerical methods for PDE's. Advanced Finite Elements. Discontinuous Galerkin methods (DG). Finite Difference Method (FDM). Finite Volume Methods (FVM). Boundary Element Methods (BEM). Meshless methods.	**1**	**Spring**	Continuum Mechanics: Fundamentals and Applications
Waves in Continua	One-dimensional models. Wave equation, Klein–Gordon equation: the fundamental solutions. Stationary and non-stationary waves. Dispersion relations. Phase velocity. The stationary phase method and the group velocity. Limit-absorption principle. Moving sources. Three-dimensional models: acoustic medium, elastic medium. Compression waves and shear waves. Rayleigh surface wave.	**2,5**	**Spring**	Continuum Mechanics: Fundamentals and Applications
Multiphase Flows	The concept of multiphase media. Approaches to development of multiphase media models: Euler-Euler description (interpenetrating continua, spatial averaging); Lagrange-Euler description; Kinetic description. Typical applications of models of multiphase media: structure of flows around bodies in multiphase flows; erosion of surface of bodies immersed into multiphase flows. Problems of combustion of heterogeneous media: mechanisms of combustion; detonation. Cavitation. Problems of bubbly flows. Wave propagation in bubbly media.	**3**	**Spring**	Continuum Mechanics: Fundamentals and Applications
Computational Fluid Dynamics	Computational Fluid Dynamics (CFD) basic concepts. Up-to-date CFD packages. Setting CFD problem and boundary conditions. Grid generation. Discretization of governing equations (finite volume method). Accuracy of numerical scheme. Iterative methods for solving fluid flow problems. Solution of unsteady problems	**2,5**	**Spring**	Continuum Mechanics: Fundamentals and Applications
Mechanics and Thermodynamics of Continua	The types of deformation behavior of materials. Deformations: configurations of deformable solids, fundamental matrices, material and spatial descriptions, deformation gradient, polar decomposition, strain tensors, compatibility conditions, composition and decomposition of deformations. Kinematics: material derivative, velocity gradients, strain-rate tensor and spin, corotational time derivatives. Kinematic compatibility conditions at strain discontinuity surfaces. Master balance equation. Local balance equations for regular points and strain discontinuity surfaces. Balances of mass, momentum, angular momentum and energy for open and closed systems. Cauchy and Piola – Kirchhoff stress tensors. Entropy inequality. Clausius – Duhem inequality. Energy dissipation due to propagation of the strain discontinuity surface (interface). Eshelby energy momentum tensor. Configuration forces in the cases of moving interphase boundaries and chemical reactions fronts. Chemical potential and chemical affinity tensors. Objectivity and material symmetry. Rational Electrodynamics of Materials. Perturbation Methods for Nonlinear Continuous Dynamical Systems in Engineering	**5**	**Autumn**	Continuum Mechanics: Fundamentals and Applications

Elasticity	Kinematics of solid: The concept of the continuum media and the Lagrange and Euler approaches to the description of its movement; Material derivative of vector and tensor; Strain measures and tensors; Infinitesimal strain tensor and vector of small rotation. Dynamics of solid: Conservation of mass law; Classification of forces acting on the material body; Integral laws of the dynamics; Cauchy's formula for the stress vector; Stress tensor; Differential equations of the deformable body dynamics. Thermodynamics of solid: First law of thermodynamics in integral and differential forms; Second law of thermodynamics in form of Clausius-Duhem inequality; Universal dissipative inequality; Third law of thermodynamics. Constitutive equations theory elements: Influential parameters, thermomechanical processes and constitutive equations; Material objectivity principle; Isotropic materials; Constitutive equations of isotropic thermoelastic material; Constitutive equations of viscous material; Constitutive equations of ideal plastic material. Constitutive equations in linear mechanics of solid: Classical constitutive equations of form changing processes: elastic material, viscous material, plastic material; Rheological models principle; Kelvin-Voigth material; Maxwell material; Standard linear viscous-elastic material; Ideal elastic-plastic material; Elastic-plastic material with linear hardening; Viscous-elastic-plastic material of Bingham. Basic equations of linear elasticity theory: Closed system of equations and boundary conditions for coupled thermal-elastic problem; Various forms of Hook's law; Theory of elasticity equations in displacements; Theory of elasticity equations in terms of stresses; Beltrami-Mitchell equations; Theory of elasticity equations and boundary conditions in Pobedria form.	**3**	**Autumn**	Continuum Mechanics: Fundamentals and Applications
Plasticity	Experimental and physical fundamentals of inelastic deformation. Constitutive equations for ductile material. The simplest problems of the plasticity theory. Plane strain. Extreme principles. Constitutive equations for viscoplastic material. Solution of physically nonlinear problems based on finite element method.	**3**	**Autumn**	Continuum Mechanics: Fundamentals and Applications
Computational Solid Mechanics	Steady state heat conduction problems. Transient heat conduction problems. Plane and three-dimensional elasticity problems. Determination of stress intensity factor. Determination of effective modulae of composite materials	**2**	**Autumn**	Continuum Mechanics: Fundamentals and Applications
Fluid Mechanics	General properties of fluids. Fluid kinematics. Stress tensor. Differential and integral formulation of fluid flow governing equations. Inviscid and viscous fluid models. Dimensional analysis, similitude and modeling. Incompressible viscous fluid flows. Navier-Stokes equations. Internal flows. Flow over immersed bodies. Boundary layer. Unstable flows and laminar-turbulent transition. Reynolds averaging of Navier-Stokes equations. Closure problem, turbulent viscosity. Compressible flows. Sound speed. Shock waves	**3,5**	**Autumn**	Continuum Mechanics: Fundamentals and Applications
Micromechanics of heterogeneous media	One has to identify the proper microstructural parameters in terms of which the given effective property is to be expressed. Different approaches to the problem of effective property are studied: the non-interaction approximation, rigorous bounds, approximate schemes aimed at accounting for interactions	**2**	**Autumn**	Continuum Mechanics: Fundamentals and Applications
Research and Developments of Mechatronic Systems	Lagrangian dynamics of mechanical systems. Dynamics of electrical circuits. Electromechanical systems. Piezoelectric systems. Piezoelectric sensors and actuators. Active and passive vibration damping beam structures using piezoelectric systems	**2,5**	**Autumn**	Continuum Mechanics: Fundamentals and Applications

Dynamics of thin-walled structures	The course includes the nonlinear dynamic theory of spatially curved and naturally twisted thermoviscoelastic rods and the linear dynamic theory of thermoelastic shells. These theories take into account the rotational inertia and all the basic types of deformation: bending, twisting, stretching, transverse shear. The theory of rods includes all the known versions of rod theory, but it has a wider range of applicability. In particular, it describes the experimentally discovered Pointing's effect, which consists in shortening of a rod under twisting deformations. Theory of shells includes the most general shell theory of 12th order, which is useful when describing the nanosized scale level objects, the shell theory of 10th order, designed for engineering applications in the case of sufficiently thick shells, as well as the Kirchhoff-Love shell theory. The main peculiarity of the theories is that they can be used to model the dynamics of thin objects with complex internal structure. In particular, it can model multi-layer rods and rods with internal cavities, multi-layer shells, as well as rods and shells with complex microstructure. In the course of the dynamics of thin-walled structures, the use of the following methods is demonstrated: the general methods of the continuum mechanics with rotational degrees of freedom, the differential geometry, the direct tensor calculus, the generalized theory of symmetry, the dimension theory, methods for constructing exact solutions of differential equations, asymptotic methods for solving differential equations, and in particular, differential equations with a small parameter at the highest derivative.	**3**	**Autumn**	Continuum Mechanics: Fundamentals and Applications
Advanced Statistics, Probability and Stochastic Processes	Probability Theory: foundations, boundaries of applications, approximate computation of the characteristics of the functions of random variables, asymptotical distributions of order statistics and extreme values, limit theorems, normal distribution models, Monte Carlo method and the boundaries of its application. Stochastic Processes: classification, Markov models, elements of spectral theory and its application. Mathematical Statistics: data analysis problems, maximum likelihood and Bayesian approaches, methods of moments, quantiles and substitution, interval estimation and hypotheses testing, regression problems, elements of nonparametric and robust statistics, statistics of stochastic processes.	**2**	**Autumn**	Continuum Mechanics: Fundamentals and Applications
Reliable Modeling and Error Control	Sources and ingredients of computational error. A priori and a posteriori error estimates for problems in linear algebra. Error estimates for ODE's and Runge rule. A priori error estimates for linear PDE's. A posteriori error estimates: review of main approaches. Modeling error - verification and validation	**1**	**Autumn**	Continuum Mechanics: Fundamentals and Applications
Tensor Calculus	The concepts and techniques of tensor algebra, theory of tensor functions and tensor analysis are introduced. The symmetries of tensors and tensor functions are considered. The attention is drawn to application of tensor algebra and calculus in various fields of science.	**2**	**Autumn**	Continuum Mechanics: Fundamentals and Applications
Parallel Algorithms for Scientific Applications	Introduction to parallel computing. Overview of parallel programming technologies for shared-memory and distributed-memory systems. OpenMP and MPI technologies. Parallel algorithms for typical problems in computational mathematics. Parallel algorithms for dense and sparse linear algebra. Up-to-date open-source parallel linear algebra libraries. Introduction to high performance computing in continuum mechanics.	**2**	**Autumn**	Continuum Mechanics: Fundamentals and Applications

Turbulence Modeling	Turbulence: approaches and terms. Free shear turbulent flows. Wall bounded turbulent flows. Closure problem in the Reynolds-averaged Navier-Stokes (RANS) equations. Algebraic turbulence models. One-equation differential turbulence models. Two-equation differential turbulence models. Differential Reynolds stress models. Large-Eddy Simulation (LES) and hybrid RANS/LES approaches.	**2**	**Autumn**	Continuum Mechanics: Fundamentals and Applications
Research and Modeling Seminar I	This seminar is aimed to improve the fundamental and interdisciplinary components of students' education in the field of continuum mechanics and related fields as a result of using personnel and partnership resources of the Institute of Problems of Mechanical Engineering of the Russian Academy of Sciences, (IPME RAS), Institute of Applied Mathematics and Mechanics SPbTU and foreign partners-university. Students will be participate in research projects carried out with doctoral candidates and staff SPbPU, IPME RAS and partner universities.	**6**	**Autumn**	Continuum Mechanics: Fundamentals and Applications
Research and Modeling Seminar II	This seminar is aimed to improve the fundamental and interdisciplinary components of students' education in the field of continuum mechanics and related fields as a result of using personnel and partnership resources of the Institute of Problems of Mechanical Engineering of the Russian Academy of Sciences, (IPME RAS), Institute of Applied Mathematics and Mechanics SPbTU and foreign partners-university. Students will be participate in research projects carried out with doctoral candidates and staff SPbPU, IPME RAS and partner universities.	**6**	**Spring**	Continuum Mechanics: Fundamentals and Applications
Research and Modeling Seminar III	This seminar is aimed to improve the fundamental and interdisciplinary components of students' education in the field of continuum mechanics and related fields as a result of using personnel and partnership resources of the Institute of Problems of Mechanical Engineering of the Russian Academy of Sciences, (IPME RAS), Institute of Applied Mathematics and Mechanics SPbTU and foreign partners-university. Students will be participate in research projects carried out with doctoral candidates and staff SPbPU, IPME RAS and partner universities.	**7,5**	**Autumn**	Continuum Mechanics: Fundamentals and Applications
Mechanics and Applied Mathematics in Science and Technology I	Challenging engineering problems of solid mechanics. Interaction between elastic structures and continuum media. Mechanics of coupled fields. Generalized continua. Granular materials. Configuration forces. Topics on biomechanics. Topics on mechanochemnistry	**2**	**Spring**	Continuum Mechanics: Fundamentals and Applications
Mechanics and Applied Mathematics in Science and Technology II	Challenging engineering problems of solid mechanics. Interaction between elastic structures and continuum media. Mechanics of coupled fields. Generalized continua. Granular materials. Configuration forces. Topics on biomechanics. Topics on mechanochemnistry	**4**	**Autumn**	Continuum Mechanics: Fundamentals and Applications

Course title	Course description	ECTS	Spring/ Autumn	Program Title
Numerical Methods in Heat and Mass Transfer I	The course gives an introduction to numerical simulation of heat and fluid flow problems in industrial and natural processes. Modern methods of numerical simulation will be discussed. A lot of practical trainings of numerical simulation are scheduled. A high attention will be drawn to analyses and verification of calculation results. Verification of some calculation results by comparing with PIV experiments will be fulfilled.	**5**	**Autumn**	Power Plant Engineering
Numerical Methods in Heat and Mass Transfer II		**4**	**Spring**	Power Plant Engineering
Power Machines	Steam and gas turbines. Microturbines	**5**	**Autumn**	Power Plant Engineering
Steam Boilers	Characteristics of fuels, especially of biofuels. Combustion and gasification. Design of a steam boiler and its components. Energy balances. Solving steam boiler problems by mathematical modeling. Emissions. Biomass handling	**6**	**Autumn**	Power Plant Engineering
Thermal Power Plants	Modern power plants, co-generation, small scale CHP, gasifiers, co-firing, stirling, improving efficiency.	**6**	**Autumn**	Power Plant Engineering
Modes of Operation of Thermal Power Plants	TPP, mathematical modelling, "CAD United Cycle"**.** Thermal Power Plants, different type and flowsheets of TPP, the basic concept of mathematical modeling, basic knowledge with "CAD United Cycle", creation of the first math model. **Flowsheets of steam-power unit of TPP.** Steam-power unit, different flowsheets of steam-power unit, cogeneration**. Flowsheets of steam-power unit of TPP (practical training).** Creating of Flowsheet of steam-power unit in CAD United Cycle". **Operating modes of TPP.** Different operating modes of TPP, condensing mode, heat-extraction mode, mixed mode, winter and summer operating mode, mode of "technological minimum"**. Operating modes of TPP (practical training).** Calculation of different operating modes of TPP in CAD United Cycle".	**4**	**Spring**	Power Plant Engineering
Renewable Energy: Resources and Technologies	Renewable energy sources: The sun, solar radiation, day/ year solar path, solar irradiation over horizontal and inclined surface. Solar energy availability and limitations, shadowing. Solar energy conversion paths: thermal, photovoltaic, wind energy, biomass. Geothermal sources. Solar, wind, hydro, and geothermal resource estimation. Measuring equipment and measurements. TMY models, data detail levels. Resource atlases, online resources (Meteonorm) Access to fossil resources, their depletion. Environmental problems of fossil fuel use, global warming. Practical use of renewables vs fossil fuels. Energy policy instruments.	**4**	**Spring**	Power Plant Engineering

Modeling of Vaporization Processes	Main two-phase flow parameters for description of steam generation. Superficial and actual parameters. Void fraction. Phase velocities. **Empirical formulas and basic models for pool boiling.** Normative method. Chen's method. **Heat transfer by forced flow boiling.** Effect of convection and boiling processes on heat transfer. **Boiling crisis.** Transition of nucleate boiling in film boiling. Methods of heat transfer coefficient and wall temperature calculations. **Deterioration of heat transfer at dryout.** Evaporation of the liquid film on the wall. Methods of heat transfer coefficient and wall temperature calculations in dispersed steam-water flow. **Computer programs for the best estimation of thermohydraulics in the power equipment flow circuits.** Acquaintance with Russian program KORSAR which is an example of one the best modern estimation programs.	**4**	**Spring**	Power Plant Engineering
Energy Systems Engineering	History and fundamentals of thermodynamics and energy engineering. Modern problems of power plant engineering, combined heat and power production, especially from biomass. Fundamentals of steam and gas turbines in energy production. Systems engineering. Planning and implementation of energy systems. Economic optimization of energy system projects.	**5**	**Spring**	Power Plant Engineering
Bioenergy Technology Solutions	Introduction to Biomass: Overview of historic and current biomass consumption and organic waste production. **Bioenergy Status Today:** Trends. Perspectives. Limitations in bioenergy. **Biomass Feedstock:** Agricultural and forestry. Municipal solid waste. Grains, sugar crops. Algae. New biomass feedstocks (fast growing forests, etc.). **Biofuels from Biomass:** Ethanol. Biodiesel. BioOil. Biomass-to-liquid (BTL). Biomethane. **Heat and Power from Biomass:** Available Technologies: Direct combustion, gasification, co-firing of biomass with coal. **Energy from Waste. Environmental Impacts of Biofuel Production.**	**5**	**Spring**	Power Plant Engineering
Energy Efficiency and Energy Saving in Industry	Major terms and definition in the field of energy saving and energy efficiency. Energy Balances. Energy efficient production of heat and electricity.	**4**	**Autumn**	Power Plant Engineering
Combined Cycle Power Plants	History of combined cycle technology. Basics of thermodynamics: steam cycle, gas cycle and combined cycle. Gas turbine plant, steam plant, combined cycle power plant. Combined cycle power plant: main equipment, flow diagram, available parameters, implementation. Gas and steam turbines for combined cycle power plants, waste-heat recovery boilers. Basic equations for manual and computer calculations. Indicators of Overall and Thermal Efficiency of Combined Cycle Power Plant. Major benefits of Combined Cycle Power Plant, its perspectives for world energy sector.	**4**	**Autumn**	Power Plant Engineering