

EXCHANGE COURSES SYLLABI
ECONOMICS AND INNOVATIONS

ECONOMICS AND INNOVATIONS	
Innovative Economy and Knowledge Economy	<p>The main goal of this short-term program is the formation of competencies necessary for the training of personnel who have economic thinking, capable of analyzing economic problems at the micro, meso and macro level, as well as acquiring practical skills for their use in professional activities.</p> <p>The objectives of the course are to provide students with the following professional skills and competences:</p> <ul style="list-style-type: none"> ▪ knowledge of economic terminology, ability to apply it in professional activities; ▪ the understanding of principles of the knowledge economy and the interrelationship of basic economic processes and phenomena; ▪ the comprehensive understanding of the core idea of knowledge & innovation management to ensure the competitiveness of the organization; ▪ ability to manage the development of the organization, analyze and develop the organization's strategy on the basis of modern methods and advanced scientific achievements; ▪ ability to conduct research, process data received and analyze the results; ▪ ability to manage knowledge and innovations, create databases and knowledge bases, knowledge management systems and innovative organization processes; ▪ ability to identify promising areas of scientific research, to substantiate the relevance, theoretical and practical significance of the problem being studied; ▪ skills in analysis for making managerial decisions. ▪ possession of methods of strategic management of knowledge and innovations; ▪ the ability to form systems of knowledge management and innovation processes.
Human Capital in Innovative Economy	<p>The main goal of this short-term program is formation of students' theoretical knowledge and practical skills in the field of investing in human capital</p> <p>The objectives of the course are to provide students with the following professional skills and competences:</p> <ul style="list-style-type: none"> ▪ understanding the essence of the theory of human capital; ▪ knowledge of the basic forms of human capital and their content; ▪ knowledge of the methods of investing in human capital; ▪ ability to determine the effective investment system human capital; ▪ the ability to assess the return on investment in human capital; ▪ the ability to use ways to improve the effectiveness of human capital; ▪ ability to conduct research, process received data and analyze the results; ▪ ability to manage the development of the organization, analyze and develop the organization's strategy based on modern methods and advanced scientific achievements.

Project Management

The goal of this course is to gain basic knowledge about effective and professional project management based upon PMBoK-Guide and to provide practical wisdom for applying that knowledge to projects.

The course introduces project management from the standpoint of a manager who must organize, plan, implement and control tasks to achieve an organization's schedule, budget, and performance objectives.

The following tools and concepts are studied:

- project charter,
- scope statement,
- work breakdown structure,
- project estimating,
- scheduling methodologies.

Students will be introduced to the roles of project and program managers in current business enterprises and to the triple constraints of scope, time and cost.

After completing this course, the students should be able to:

- apply project management methodologies, processes, and tools to execute complex projects in organizations;
- Examine the roles that project management play in accomplishing an organization's strategic objectives;
- Develop effective approaches for managing high-performance project teams, communication strategies, and best practice closeout strategy that maximizes the value of the project experience;
- Critique the impacts of schedule, cost, and scope elements in projects and analyze different techniques for managing risks;
- Create project Charters, Scope statements, Work Breakdown Structures (WBS), Project Network Diagrams, and Responsibility Assignment Matrix (RAM).

By the end of the module, the participants will improve their ability to manage projects effectively. In particular they will be better able to:

- operate more competently as a member of a project team, and ultimately as a project manager;
- understand the competencies a project manager needs and the organizational and leadership challenges they face;
- logically plan, schedule and control projects using project management tools and techniques;
- understand the basic principles of the main project management methodologies, such as PMBoK and PRINCE2.

Course structure:

Module 1: Project Fundamentals and Overview

Module 2: Organizational Influences and Project Lifecycle

Module 3: Project, Program, Portfolio Management

Module 4: Project Structure

Module 5: Resource Management

Module 6: Project Personnel

Module 7: Project Communications and Organizational Issues

Innovation Management	<p>The Innovation Management course is has following goals and study objectives:</p> <ul style="list-style-type: none"> ▪ develop a comprehensive understanding of the role and strategic relevance of innovation in the greater competitive context of the firm’s strategy ▪ understand the role of innovation as a strategic mechanism for differentiation leading to the creation and delivery of superior value offerings ▪ view innovation from multiple perspectives, including its strategic, process, organizational, learning and linkage dimensions ▪ understand innovation as a strategic and dynamic capability ▪ develop an understanding of the relevant analytical frameworks relating to the organization’s innovation performance <p>By the end of the course it is expected that students will have acquired following competences:</p> <ul style="list-style-type: none"> ▪ ability to demonstrate a deeper understanding of the strategic role and contribution of innovation within the greater context of the organization’s strategy ▪ ability to explain key innovation concepts, notions and frameworks and their relevance to the business strategy of the organization ▪ ability to apply frameworks to analyze and assess the organization’s current innovation performance ▪ ability to identify appropriate interventions for improving the organization’s innovation performance ▪ be competent in elaborating on how thinking on innovation is changing and evolving, and the implications of this emerging thinking for a firm’s competitive performance
Innovation Systems: Russian Federation Development	<p>The description of the course is next: "The main goal of this short-term program is to acquaint students with the theory of innovation systems and provide them with practical skills in evolvment into the Russian innovation system business based on innovations and new technologies.</p> <p>The objectives of the course are to provide students with the following professional skills and competences:</p> <ul style="list-style-type: none"> ▪ the ability to evaluate the macroeconomic environment influence on the business and local authorities; ▪ the ability to analyze innovative potential of a country and to implement instruments of the innovative development; ▪ skills of search and selection mechanism to support the innovation activities of the organization in the Russian Federation"
Technology Entrepreneurship	<p>The Technology entrepreneurship course provides students with knowledge in current economic situation: trends, innovations and technology entrepreneurship. Entrepreneurship –basic definitions and approach. Technology entrepreneurship as the environment for innovations. Current stage of development of the entrepreneurship in different countries. Future trends in the economic situation in Russia and the world: strategic sectors for development. Concept of open innovations and technologic development. Transfer of technologies and technology brokering.</p> <ul style="list-style-type: none"> ▪ Entrepreneurship in Russia: how to start? ▪ Forms of doing business in Russia, ways of support, taxation systems, role of small business, international businesses and investment support. Intellectual property, ways of protection. ▪ “Imagine and create it” Generating business ideas and creating innovations. ▪ ”Design thinking” method of creating innovations, techniques of “World café”, brainstorming. ▪ “Plan it” Business planning for technology entrepreneurs: basic principles and models in the current situation.

	<ul style="list-style-type: none"> ▪ Stages of business development. Basic principles of lean startup. Business model. Kanvas model. Project planning: teamwork, deadlines, directions, responsibilities ▪ “Plan it” Business planning for technology entrepreneurs marketing aspects. ▪ Market analysis: trends, saturation’s evaluation, segmentation. Competitive analysis, pricing, promotion and distribution. ▪ “Plan it” Business planning for technology entrepreneurs: financial and investment aspects. ▪ Planning resources: tangible and intangible. Creating budgets and reports: BS, PL, CF. Sources of capital. Investment Plan and Proposal: P&P but different. Economic efficiency, metrics for technology startups. ▪ “Plan it” Business planning for technology entrepreneurs: avoiding risks. ▪ Risks classifications, instruments of risk management. ▪ “Plan it” Ways of commercialization. ▪ Patents, licenses and startups as ways to commercialize your technology. ▪ “Present it” Presentation as the successful instrument of the promotion of your project. ▪ NABC method from Stanford Research Institute. Elevator pitch: guide book for presenters.
Digital Marketing	<p>The aim and objectives of the short-term international educational module is to form the listener's understanding of modern methods of goods and brands promoting in digital media and communication (digital media).</p> <p>The goal of the course is to acquire the following professional competencies for students:</p> <ul style="list-style-type: none"> ▪ understanding the current trends in the development of digital marketing and the prerequisites for their formation; ▪ skill of identifying the available brand promotion method; ▪ ability to evaluate the effectiveness of the use of a particular promotion channel; ▪ ability to interpret current business objectives in specific tasks for the marketing department.
Russian and International Financial Systems	<p>The purpose of this course is to teach students the theory of Russians and international financial systems and acquire practical skills in analyzing the patterns of international monetary and financial relations development, the mechanism for their implementation in various forms.</p> <p>Students will acquire</p> <ul style="list-style-type: none"> ▪ the ability to identify the type of Russian and international financial systems and determine their main development trends; ▪ skills in reading and analyzing companies' reports according to IFRS; ▪ skills of analyzing the world economic situation with the formation of a forecast of its development on the basis of existing patterns.
Urban Development and Planning	<p>The course is offered in the form of practical classes that include interactive forms of training: interactive mini-lectures, case studies, brainstorm, watching video-materials, discussion, simulations and business games. Mandatory attendance, activity, involvement in the debate, analysis of case studies, business games determine the success of a training course. Independent work includes reading literature, analysis of the international instruments and standards, data gathering as a special task for the field work, statistical information gathering, and field studies.</p> <p>The competences gained within the studies include:</p> <p>The main provisions of the concept of sustainable development, aims and objectives of applied research in this field, methods of</p>

	<p>data collection and analysis for the purposes of SD study the nature of global environmental problems, the causes and effects of global urbanization, methods of systematizing and analyzing of scientific, technical, technological, socio-economic information, principles of design of the scientific, technical and analytical reports, publications and presentations.</p> <p>The students will learn:</p> <ul style="list-style-type: none"> ▪ to select the methodology and methods for data collecting and analysis of the obtained results ▪ to interpret the data and provide the significant results ▪ to determine the causes and effects of global problems in the context of urbanization ▪ to use the modern information and communication technologies for the analysis of documented results of applied research
Intellectual Management of Creative Projects	<p>Main topics:</p> <ul style="list-style-type: none"> ▪ creative industries and project management in interfaced hi-tech innovation processes. Knowledge management and strategic thinking; ▪ the lifecycle of project work in the field of art and technology. Creative groups and specifics of intragroup communication among interdisciplinary specialists. Updating, evaluation and management of intellectual resources in projects with creative and innovative aspects - principles and methods; ▪ native interaction technologies and customizable processes. Management models, analytics and resource logistics, optimality criteria in creative projects.
Contemporary Art	<p>Main topics:</p> <ul style="list-style-type: none"> ▪ art of the 20th-21st centuries. Avant-garde, modernism, postmodernism practices; ▪ development of a conceptual framework of abstract art, minimalism, conceptualism. Social history of the 20th century art. Formalism and structuralism; ▪ poststructuralism and deconstruction. Art as modern language. Philosophy and aesthetics of contemporary art: categories and discourse. Contexts of contemporary art. Performative practices — actionism, performance and happening. Art object and installation — articulation and expression of the author’s position, meanings, subjective perception.
Art and Natural Sciences: Theory, Aesthetics, Discourses	<p>Main topics:</p> <ul style="list-style-type: none"> ▪ critical and theoretical reflection on the issues of new technologies development in modern techno-biological art. Theory, philosophy and practice of bio art; ▪ experiments with biological materials — discursive, semantic and aesthetic aspects of Art & Science projects. Contemporary art and optics; ▪ aesthetic aspects and visual perception of optical effects. Wave and sonar studies in art projects. Network projects (neuro-art using biological material).
ICT & PROGRAMMING/TECHNOLOGY	
HIGH-PERFORMANCE COMPUTING DEPARTMENT	
Evolutionary Computing	<p>Objectives:</p> <ul style="list-style-type: none"> ▪ Students will study the basic principles and schemes of evolutionary algorithms (EA), learn how to design and implement EA

	<p>for various optimization problems, get skills to tune and test EA, examine parallel schemes of EA.</p> <p>Contents</p> <p>Evolutionary computing is a widely used optimization techniques. The main goal of the course is to familiarize students with basic concepts and principles of design of evolutionary algorithms (EA). The course includes theoretical basis, examination of the main components of EA and how to implement them. Further, the course considers methods of increasing the performance of algorithms and schemes for implementation of high-performance EA based on multiprocessor and distributed systems, as well as with the usage of GPU. During the course, students are involved not only in theoretical aspects, but also in demonstrations and analysis of real solved problems with the usage of evolutionary computing methods.</p> <p>Classes carried out in the form of lectures with elements of the discussion, where such questions as: "In what case and which EA algorithm is better?"; "For which problems EA can be applied?"; "Which set of parameters is it worth to choose during implementation of EA?" can be discussed. The main practical assignment represents a development and implementation of EA for the typical optimization problem, where students' algorithms are compared with each other in a competitive way.</p>
<p>Parallel Algorithms for the Analysis and Synthesis of Data</p>	<p>Objectives:</p> <ul style="list-style-type: none"> ▪ Students will learn basic approaches and effective algorithms for data analyzing. <p>The course consists of lectures about algorithms and approaches for data analyzing. At a practical part, students will implement described techniques and perform assigned tasks.</p>
<p>Discrete Modeling</p>	<p>Objectives</p> <ul style="list-style-type: none"> ▪ Students will get knowledge of modern methods of solving applied tasks, queuing systems, event models. <p>Contents</p> <ul style="list-style-type: none"> ▪ You'll learn the classification of methods and modern technologies for modeling, queueing systems, analytical models, Markov models, parallel and distributed simulation technology. ▪ You will be able to develop a models of complex systems and distinguish between simulation methods. ▪ You will learn the methods of development of discrete-event models using cellular automats, methods for statistical processing of simulation results, methods for verification and validation of models, methods of analysis of the results of the simulation. ▪ You will learn how to use modern software environments for mathematical modeling and simulation. You will be able to plan experiments with the developed models; learn how to develop discrete and continuous models in Mathcad
<p>Continuous Mathematical Models</p>	<p>Objectives</p> <ul style="list-style-type: none"> ▪ Students will get acquainted with the contemporary methods of mathematical modeling using deterministic continuous models (ordinary and partial differential equations), which includes model formulation, model analysis (analytic solution, numerical solution, analysis of the equilibrium points) and model calibration to data. <p>Contents</p> <p>Main topics of the discipline: Basics of mathematical modeling, ODE formulation and solution (analytic, numerical), the foundations of stability theory, model analysis and calibration.</p>

Advanced Technologies for Big Data	<p>Objectives</p> <ul style="list-style-type: none"> ■ Study of the main reasons of Big Data formation. It's detection and identification. ■ Introduction to Grid technologies, WMS, MapReduce, stream data processing ■ Understanding of MapReduce principles and Apache Hadoop technology ■ Understanding of HDFS principles and building of Apache Hadoop infrastructure ■ Introducing to Apache Storm Technology ■ Main topics of the discipline: ■ Definition of the term large data and the basic model. Use of large data. The role of large data in the national economy. ■ Requirements for the profession of analytics of large data. ■ The main stages of the life cycle. Collection, consolidation and cleaning of data. ■ Correlation coefficient. Graphical representation. Statement of the problem of regression analysis. Linear regression. Least square method. Their role in the analysis of large data. ■ Data collection and consolidation, data visualization, R language for analytics, work with DBMS. ■ Hadoop, HDFS, Map / Reduce, YARN, Storm, Apache Spark. ■ Importance of the phenomenon of large data for the development of society and science. Causes of the trend of large data. ■ Problems and opportunities associated with the appearance of large data.
Analysis and Development of Algorithms	<p>Objectives</p> <ul style="list-style-type: none"> ■ Students will learn the main efficiency classes of algorithms; examples of tasks of different complexity classes; basic data structures and ways of their software implementation; basic methods of developing algorithms; types, fields of application and methods of constructing search trees; typical tasks and algorithms for their solution on graphs and lines; basic problems of combinatorial optimization and computational geometry. ■ Students will learn how to develop algorithms for solving problems on graphs, on rows, combinatorial optimization problems, computational geometry problems; to evaluate algorithms asymptotically; to develop algorithms for generating combinatorial objects; to analyze the effectiveness of recursive and non-recursive algorithms; to choose data structures and algorithmic methods that are suitable for solving the task. ■ Students will master the skills of analyzing the effectiveness of algorithms; skills in solving problems using methods of "brute force", decomposition, reducing the size of the problem; skills in solving NP-complex problems by precise and approximate methods; skills in development and implementation of algorithms for solving problems on graphs, on lines, developing combinatorial optimization problems and computational geometry; skills in software implementation of basic data structures. <p>Contents</p> <p>Main topics of the discipline: the basis of system analysis, the economic and legal basis for development and use of software, design and life cycle of software, models and stages of software life cycle, software development methodology, the problems of designing and using high-performance applications, levels of parallelism, classifications of parallel architectures, parallel programming technologies for graphics processors, distributed architectures for high-performance computing, parallel software modeling, parallel</p>

	<p>algorithm design concepts, performance characteristics of parallel computing, ways of examining the performance of parallel applications, parametric performance models, modeling communication costs for various data network topologies, load balancing schemes in homogeneous and heterogeneous massively parallel systems.</p>
<p>Concurrent and Multithreading Programming</p>	<p>Objectives</p> <p>Students will learn:</p> <ul style="list-style-type: none"> ▪ to find out the basic directions of development of high-performance computers and basic classification of multiprocessor computer systems ▪ to apply the basic techniques and formal model of parallel programming ▪ to use tools for parallel programming on systems with shared memory ▪ to design parallel algorithms for computational problems ▪ to implement parallel programs for computing systems with shared memory ▪ to analyze speedup and efficiency of parallel algorithms. <p>Contents</p> <p>Course is intended to introduce students with the basics of high-performance computing for systems with shared memory. On completion of the course students will be able to apply their knowledge to design and implement parallel algorithms. Students will get basic skills to optimize their programs.</p>
<p>Computational Intelligence</p>	<p>Objectives</p> <p>Students will learn:</p> <ul style="list-style-type: none"> ▪ the basic tasks of machine learning, the basic concepts and basic mathematical apparatus of fuzzy logic, the basic concepts and principles of the operation of artificial neural networks, the main varieties of evolutionary algorithms, examples of the application of computational intelligence methods for solving problems; ▪ to set a task and develop an algorithm for solving it using the methods of computational intelligence, analyze scientific literature sources, analyze the solutions obtained, analyze the problem for choosing the best method of computational intelligence or a hybrid method suitable for a specific task, analyze the work of methods of computational intelligence with the identification of their strengths and weaknesses, to carry out analysis of the tuning parameters of neural networks, evolutionary algorithms and fuzzy method. <p>Students will study the technology of applying the methods of computational intelligence to solve practical problems, methods of intellectual data analysis, the skills of creating and testing artificial neural networks, evolutionary algorithms and fuzzy methods in one of the high-level programming languages, to analyze the work of methods of computational intelligence with the identification of their strong and weak parties, to carry out analysis of the adjustment of parameters of neural networks, evolutionary algorithms and fuzzy methods, methods of obtaining data from different cing available sources.</p> <p>Contents</p> <p>Main topics of the discipline:</p> <ul style="list-style-type: none"> ▪ Biological and formal neuron. Architecture of neural networks. Classification of neural networks. Basic principles of training neural networks. Perceptron and multilayer neural network. Retraining of the network. Methods for calculating the output

	<p>of an INS.</p> <ul style="list-style-type: none"> ▪ Neural networks with feedbacks. Hopfield Networks. Maps of Kohonen. Radial-basis neural networks. General information on the application of neural networks to solve problems of classification, approximation, modeling and control. Features of practical application of neural networks. ▪ Evolutionary algorithm. Types of evolutionary algorithms. Function fitness. Integer and real coding of information. Basic operators of evolutionary search and their varieties. Application of evolutionary algorithms for solving optimization problems. ▪ Parameters and adaptation of parameters. The theorem on the lack of free meals. Evolutionary strategies. Algorithms for estimating distributions. Systems of classifiers. Genetic programming. Algorithm of differential evolution. Features of the practical application of evolutionary computations. ▪ Linguistic variable. Fuzzy sets. The membership function. Basic operations and relations of fuzzy logic. Algorithms of fuzzy inference Mamdani and Sugeno. A model of the singleton type. Fuzzy databases. Calculations with words. Comparison of fuzzy and probabilistic systems. Features of practical application of systems with fuzzy logic. ▪ Neuroevolutionary algorithms. Neural networks. Evolutionary fuzzy systems. Sharing the methods of computational intelligence and machine learning ▪ Solution of problems of classification, approximation, clustering, control. Open libraries and programs for methods of computing intelligence.
Scientific Visualization and Virtual Reality	<p>Objectives Students will learn: modern GPU architecture, modern GAPI and shading languages, modern rendering techniques, approaches for distributed rendering. Students will learn to develop a substantial virtual reality project.</p> <p>Contents In this course, you will learn architecture of modern GPUs, modern GAPI, and one of the shading languages. You will learn how to synthesize highly realistic images using different approaches like forward shading and deferred shading, how to render natural phenomena, and how to perform post-processing on such images.</p>
Mathematical Epidemiology	<p>Objectives Students will get the idea of the history of mathematical epidemiology and its actual aims, to observe and apply the mathematical apparatus intended for solving the problems of epidemiology.</p> <p>Main topics of the discipline:</p> <ul style="list-style-type: none"> ▪ Introduction to mathematical epidemiology. Simple epidemiological models and their application. ▪ Models with host heterogeneities. Multi-pathogen and multi-host models. ▪ Stochastic dynamics. Spatial models. Controlling infectious diseases.
Visualization in Biomedicine	<p>Objectives Students will learn ways to generate and organize work with large data or forms and methods of scientific visualization; the main provisions of the theory of genetic search; the structure of evolutionary algorithms; evolutionary strategies, evolutionary and genetic programming; methods and technologies of eScience and eEngineering; ways to generate and organize work with large data; forms</p>

	<p>and methods of scientific visualization; to organize a distributed computing infrastructure to support object-oriented research and the life cycle of engineering products, to build complex 3D visualization applications using stereo effects; to design a visual interface for human-computer interaction; to design and develop parallel programs for computers of different architectures; technologies of knowledge extraction from large data. Students will acquire software development skills and use of ready-made software solutions for solving complex problems, knowledge of parallel programming technologies, skills of creating graphic images based on mathematical package visualization subsystems; skills of the graphic applications development using specialized high-level computer graphics environments; construction of 3D scenes.</p> <p>Main topics of the discipline:</p> <ul style="list-style-type: none"> ▪ Basics and visualization applications ▪ Mathematical Foundations of Computer Graphics ▪ The architecture of modern graphics processors (GPU) for graphics and computations ▪ Methods and algorithms for modeling global illumination ▪ Optimization of global lighting for 3D scenes ▪ Stereo-visualization algorithms ▪ Scientific visualization ▪ 3D rendering algorithms
<p>Machine Learning Technologies</p>	<p>Objectives Students will get an idea about the basic tasks and methods of machine learning and data mining; examine the statistical foundations of machine learning theory.; learn how to solve the problem of classification, regression, clustering, using machine learning methods and algorithms and evaluate the quality of the solutions; learn to apply software for machine learning to solve the domain-oriented problems.</p> <p>Contents The course combines lectures on statistical theory of machine learning with a practical mastering of efficient algorithms to solve real-world problems. The course consists of three sections, covering methods of classification and regression, unsupervised learning, and neural networks. As a result of the successful completion of the course the student will acquire knowledge extraction skills useful for professional work in any field related to the accumulation and processing of large amounts of data.</p>
<p>Methods and Models for Multivariate Data Analysis</p>	<p>Objectives Students will improve backgrounds in probability theory; develop skills in probabilistic modelling and statistic assessment.</p> <p>Contents Main topics of the discipline:</p> <ul style="list-style-type: none"> - Probabilistic models for random variables. Univariate random variable. CDF and PDF. Probability distribution parameters estimation. Probabilistic interval. Confidence interval. Tolerant interval. - Probabilistic models for random variables. Multivariate random variable. Regression and correlation analysis. Linear and non-linear regression. Canonical correlations. Principal component analysis. Empirical orthogonal functions. Factor analysis. ANOVA method. Cluster analysis. Multidimensional interval estimates. Nonlinear methods for dimensionality reduction.

COMPUTER TECHNOLOGY DEPARTMENT	
Machine Learning and Data Analysis	<p>Objectives</p> <ul style="list-style-type: none"> ▪ Models selection and hyperparameters tuning; ▪ Basic machine learning algorithms for classification, regression analysis and clustering; ▪ Data preprocessing: features extraction and outliers detection <p>Contents</p> <p>Machine learning gives computers the ability to learn without being explicitly programmed. Nowadays machine learning is rapidly introduced into all domains. This course will provide an overview of many concepts, techniques, and algorithms in machine learning, from basic classification with decision trees and clustering to support vector machines. By completing this course, you will learn how to apply, test, and interpret machine learning algorithms as alternative methods for addressing your research questions.</p>
Programming Languages	<p>The course helps to improve the ability to develop and analyze conceptual and theoretical models of the solved tasks of design and production and technological activities, the ability to organize corporate learning processes based on information technology and the development of corporate knowledge bases and the ability to apply modern methods, algorithms and tools for data analysis.</p>
Advanced Algorithms and Data Structures	<p>This course helps to master the skills of designing algorithms, skills in implementing algorithms using the programming language, skills of experimental research on the effectiveness of the algorithm. Also, students will be able to prove the correctness of the compiled algorithm and evaluate the main characteristics of its complexity, solve typical problems of discrete mathematics arising in educational and professional activities.</p>
Deep Learning	<p>In this course, you'll develop a clear understanding of the motivation for deep learning, and design intelligent systems that learn from complex and/or large-scale datasets. You will learn how to train and optimize basic neural networks, convolutional neural networks, long short term memory networks, and modern state-of-the-art architectures.</p>
Big data	<p>The course of Big data will help you to learn the theoretical basis of data processing, theoretical types of processing large amounts of data, the ability to process large amounts of data in the calculation of software solutions, modern methods of processing large amounts of data and tools. Also, the course will give the opportunity to improve skills in working with the processing of large amounts of data, skills in processing large amounts of data from algorithmic and intelligent systems and skills in applying large data processing for use in research activities.</p>
Genetic Algorithms	<p>The aim of the course is to introduce genetic algorithms and to give students practical experience in implementing and experimenting with them. The course will equip them to be able to assess the suitability of genetic algorithms for specific problems.</p>
Bioinformatics	<p>Bioinformatics is dedicated to teach students to databases and basic methods of Bioinformatics, modeling of biopolymer structures, genomics and proteomics, Bioengineering of animals, plants and microorganism.</p>
Social Media Data Analysis	<p>After this course you will know main characteristics and areas of application of social data analysis algorithms, basic concepts of social data analysis and basic mathematical methods of data analysis. By completing this course, you will master the skills in working with mathematical methods of data analysis, ways to assess the effectiveness of projects in different categories and the skills of developing a system to protect information from distortion.</p>
Constraint Satisfaction	<p>By completing the course of Constraint Satisfaction Problems, you will get skills in working with files, memory, graphics, debugs</p>

Problems	the developmental tasks of constraint satisfaction, skills of justifying the tasks of meeting the constraints in the design and technological activities. Also, you will learn methods for constructing and analyzing data satisfaction problems.
Mathematical statistics	This course provides students with decision theory, estimation, confidence intervals, and hypothesis testing. It introduces large sample theory, asymptotic efficiency of estimates, exponential families, and sequential analysis.
Optimization	This is an introductory course to the stochastic optimization problems and algorithms as the basics sub-fields in Artificial Intelligence. We will cover the most fundamental concepts in the field of optimization including metaheuristics and swarm intelligence. By the end of this course, you will be able to identify and implement the main components of an optimization problem. Optimization problems are different, yet there have mostly similar challenges and difficulties such as constraints, multiple objectives, discrete variables, and noises. This course will show you how to tackle each of these difficulties. Most of the lectures come with coding videos. In such videos, the step-by-step process of implementing the optimization algorithms or problems are presented. We have also a number of quizzes and exercises to practice the theoretical knowledge covered in the lectures.
MECHATRONICS DEPARTMENT	
Dynamics of Robotic Systems	The course "Dynamics of Robotic Systems" is devoted to the study of multi-body manipulative and locomotive robotic systems' dynamics. The problems of optimal trajectories planning and high-performance control of robot motions cause an increased interest in efficient tools for analytical and numeric representation of system dynamics. The relevance of the problems considered within the course is greatly influenced by the expansion of robotic systems towards various fields of engineering and industrial production, while the range of industries where robotic complexes are used is constantly growing, including space and aviation equipment, automotive industry, machine tool building, etc. Today's specialist in the field of robotics must fully master the main issues related to the analysis, programming of the movement of robotic mechanisms, to be able to understand the basic laws and features of controlled dynamics of robots. Within the course we will study basic concepts such as generalized forces and moments, Lagrangian and Hamiltonian of the system, holonomic and non-holonomic constraints, configurational and operational spaces of robots, basic principles such as the principles of D'Alamber and Hamilton, and the most efficient approaches for modeling the dynamics of robotic systems, such as the methods of Newton-Euler and Euler-Lagrange as well as its software implementation. Special attention is paid to the identification of robotic systems, as a way to obtain estimates of a priori unknown parameters necessary both for computer simulations, planning and analyzing motion as well as controllers design. Most of the examples studied within the discipline have practical motivation from the field of modern industrial robotics.
Cyber Physical Systems and Technologies	<p>Main topics:</p> <ul style="list-style-type: none"> ▪ principles, methods and stages of cyberphysical systems implementation; principles of checking of cyberphysical systems protection from the destructive information impact; ▪ modern approaches, methods and tools for the cyberphysical systems development and operation; ▪ methods of calculation and instrumental evaluation of the protected cyber-physical systems implementation results. ▪ principles and methods of cyberphysical systems analysis; ▪ instruments for information search and summarizing. ▪ structures of various cyber-physical systems; ▪ computational tools for cyberphysical systems design and implementation;

	<ul style="list-style-type: none"> ▪ methods of the life cycle description and supporting technologies for cyber-physical systems.
Modeling and Control of Robotic Systems	<p>Main topics:</p> <ul style="list-style-type: none"> ▪ construction of mathematical models of robotic systems motion; ▪ analysis of kinematics and dynamics of robotic systems using different approaches and modifications; ▪ control algorithms for robotic systems in various software environments. ▪ the main system solutions for design, construction and development of cyberphysical systems. ▪ the concepts of the automated control system of technological processes. ▪ the modern methods of motion control and trajectory planning for robotic systems. ▪ scenarios of automation of technological operations using robotic systems.
Adaptive and Robust Control	<p>Main topics:</p> <ul style="list-style-type: none"> ▪ algorithms of adaptive and robust control of linear and nonlinear systems; methods of practical implementation of algorithms. ▪ schemes in simulation environments (MatLab/Simulink, Scilab); engineering techniques to improve the robustness of control systems and their software support. ▪ debugging of hardware design schemes for solving problems of adaptive and robust control in mechatronic and robotic systems.
Control Systems Programming	<p>Main topics:</p> <ul style="list-style-type: none"> ▪ principles of system approach for control system software design. ▪ instruments for design and implementation of the control algorithm for different structures of control devices. ▪ software for programming of computing devices for control systems of electric drives, mechatronic and robotic systems.
Robotic Systems Hardware	<p>Main topics:</p> <ul style="list-style-type: none"> ▪ technical implementation of digital control devices and information processing, their typical mathematical models. ▪ parameters of mathematical models of digital control systems. ▪ typical structures of digital control and information processing systems. ▪ algorithms of digital control devices and information processing.
Biomechatronic Systems Development	<p>Main topics:</p> <ul style="list-style-type: none"> ▪ classification, state and prospects of modern mechatronics and robotics, main fields of application, their economic and social significance. ▪ typical design documentation; development of drawings of parts and assembly components by the computer-aided design; computer software packages in dynamic, static and strength calculations; basic understanding of the typical mechanisms, components and parts of machines and devices, their purpose, comparative characteristics, capabilities and feasibility of use; ▪ classification, state and prospects of modern robotics, the main fields of application, economic and social importance, the history of robotics, related new areas of science and technology (mechatronics); world experience and existing ideas and developments in the mechanics and management of modern manipulation robots; composition and structure of mechatronic manipulation systems for various applications, considering a complex of technical, economic, environmental,

	<p>social and other requirements and evaluation criteria;</p> <ul style="list-style-type: none"> development of spatial representation and imagination, constructive and geometric thinking, the ability to analyze and synthesize mechatronic systems; basics of design and construction of mechatronic systems; system of basic constant mechanical parameters, their role in dynamics and statics and methods of identification; basics of standardization; structural models of mechatronics objects and models of external operating conditions of objects.
Robot Sensing Systems	<p>Main topics:</p> <ul style="list-style-type: none"> principles of neural networks on the example of convolutional neural networks in solving classification problems. possible means of integrating neural networks into mechatronic modules.
CAD Systems	<p>Main topics:</p> <ul style="list-style-type: none"> fundamentals of standardization, the basic requirements set out in the regulatory and technical documentation, spatial transformation of three-dimensional objects displayed in projection planes
Construction of Mechatronic Modules	<p>Main topics:</p> <ul style="list-style-type: none"> methods of automatic control theory used in mechatronic modules and robots. automated control systems for robots and manipulators. the main elements of the mechanical part of robots and mechatronic modules and systems; electromechanical elements of mechatronic systems; information devices of robots and mechatronic systems; quality indicators of mechatronic systems; materials for mechatronic systems development. Knowledge: advantages and disadvantages of the mechatronic approach; stability of the walking machine. principles of energy recovery to create energy efficient robots simulation of motion and functioning of designed systems and robots in V-REP, Gazebo and SimMechanics programs.
Smart Materials in Mechatronics	<p>Main topics:</p> <ul style="list-style-type: none"> regularities underlying the interdependence between the composition, structure and properties of materials; the physical patterns underlying smart materials.
Modeling and Control of Mechatronic Systems	<p>Main topics:</p> <ul style="list-style-type: none"> the basic principles of reducing economic costs in the development of mechatronic and robotic devices. system structure and components, stable control algorithms and subsystems for emergency scenarios. experimental modeling systems and tools for comparative evaluation using simulation systems. principles of planning and calculation of necessary resources.
ECOLOGY/ENVIRONMENTAL MANAGEMENT DEPARTMENT	
Corporate Environmental Management	<p>The course examines corporate environmental management strategies and tools for effective management of resources and energy and decrease an environmental impact at the level of enterprise. The theoretical base includes obtaining the necessary knowledge and skills for the development, implementation and auditing of the environmental management system (ISO 14001), environmental performance assessment (ISO 14031), environmental product marketing (ISO 14020 group), environmental risks management (ISO 31000) and climate risks reduction (ISO 14064). Students obtain also required attitudes by participating in small</p>

	groups discussions, fulfillment of practical works, which is carried out in the format of analysis of case studies. The course includes visits to industrial companies and master classes from environmental managers of the leading industrial companies of St. Petersburg.
Environmental Audit	<p>The course examines the procedure for environmental auditing of the companies in accordance with the requirements of ISO19011. The students learn the existing environmental regulation of the Russian Federation, as well as the requirements to the environmental protection at the companies' level.</p> <p>For better understanding application of the guidelines of ISO 19011 standard the course offers a series of practical works in small groups. During the practical works students can understand the material better by considering the real-life situations in the format of role games.</p>
BIOCHEMISTRY DEPARTMENT	
Molecularly Organized Systems	<p>Main topics:</p> <ul style="list-style-type: none"> ▪ Interdisciplinary, synergetic approach ▪ System models and graphical methods for describing model dynamics ▪ Entropy and information ▪ Fractals and dendrites ▪ Self-organizing systems in non-living and living nature ▪ Systems of " smart " delivery of active substances based on nanocapsules ▪ Self-healing systems ▪ Inanimate systems with gradients that can " talk " to the cell and to the microbiome
Advanced Materials	<p>Main topics:</p> <ul style="list-style-type: none"> ▪ Functional nano-and macrostructured materials, their classification, structure and physical properties ▪ Physical and chemical basis of functional response of materials ▪ Physical and chemical aspects and technological methods of obtaining functional nanomaterials ▪ Zero-dimensional nanostructures ▪ One-dimensional nanostructures ▪ Two-dimensional nanostructures and functional films ▪ Chemical methods for obtaining nanostructured materials ▪ Nanolithography and ink-jet printing technology
Advanced Methods in Chemical Nanoengineering	<p>Main topics:</p> <ul style="list-style-type: none"> ▪ Nanostructured materials and their characterization ▪ Transmission and scanning electron microscopy techniques ▪ Methods based on x-ray, synchrotron and neutron diffraction and scattering ▪ Methods of optical spectroscopy ▪ Methods of vibrational spectroscopy ▪ Investigation of disperse systems by dynamic light scattering ▪ Methods for characterization of porous structure and surface properties of materials

	<ul style="list-style-type: none"> Atomic force microscopy
Computational Methods and Modeling in Materials Chemistry	<p>Main topics:</p> <ul style="list-style-type: none"> Basic principles of molecular modeling: main methods and their application Examples of application of molecular modeling methods in chemistry and nanotechnology
Smart Materials	<p>Main topics:</p> <ul style="list-style-type: none"> Functional nano-and macrostructured materials, their classification, structure and physical properties Physical and chemical basis of functional response of materials Physical and chemical aspects and technological methods of obtaining functional nanomaterials Self-assembly and self-organization processes
Modern Technologies for Manufacturing Nanoscale Objects and Materials	<p>Main topics:</p> <ul style="list-style-type: none"> Modern dynamics of nanostructured materials markets: current needs assessment and forecast for the future Modern technology of nanopharmaceutics and nanobioengineering Robotic nanoengineering and nanofabrication Aspects of new technologies introduction process and requirements to its documentary support
SOFT SKILLS	
Intercultural Communication	<p>The main goal of this course is to expose international students of ITMO University, specializing in different fields of study with the problems intercultural communication in the field of business-like cooperation and interpersonal communication within the different cultures. The main goal of the special course and seminar is to achieve cross-cultural competence in all dealings with multicultural colleagues and clients.</p> <p>Course objectives. Course objectives include detailed cross-cultural understanding that comes to cross-cultural competence in:</p> <ul style="list-style-type: none"> knowledge, awareness and sensitivity in intercultural communication; ability to use and interpret case studies from particular cultures taking in the account the specific regional and country character; capacity to use cross-cultural interpretation of behavior and communication in everyday life and management; Intercultural communication skills in the new cultural context. <p>The study of intercultural communication assumes putting the problems in the context of the global cooperation and the role of Russian university in this process.</p>
Russian as a Foreign language	<p>The Russian Language Course is aimed at developing speaking, listening, reading and writing skills at the A1 level. Students will learn:</p> <ul style="list-style-type: none"> to understand and use familiar everyday expressions and basic phrases; to introduce themselves and others and ask and answer questions about personal details such as where they live, people they know and things they have; to interact in a simple way provided the other person talks slowly and clearly and is prepared to help; to make simple conversation about their families, studies, daily lives and Russian culture.

English for Specific Purposes	<p>English for Specific Purposes classes are designed specifically for students based on their educational programs in order to provide them with specific skills and vocabulary that will help them advance further in their studies and careers:</p> <ul style="list-style-type: none"> ▪ ESP for Information technologies ▪ ESP Robotics and Mechatronics ▪ ESP Management ▪ Other
Negotiation, Influence and Conflict Management	<p>We all negotiate every day. We communicate online and in person, with colleagues or in a store. The well-known negotiation techniques of hard and soft types, when there's a winner and a loser are now long forgotten. In a fast-paced world we all need extra negotiation skills that open new perspectives on reaching our goals and help us find creative solutions to daily challenges, taking into consideration interests of both sides. This course covers "Harvard" method, and "Kremlin School" approach. Among other things, the students will learn what the "bargaining arena" and the best alternative are. We will talk about getting out of standard negotiation traps and come to mutually beneficial agreements.</p>
Emotional Intelligence	<p>The vortex of information that spins all of us demands that we perceive, digest and produce information very quickly. We can only be productive if we are emotionally stable, understand those we work and live with and enjoy ourselves to a certain level. This course will teach you how to analyze your own emotional state and control it; and how to account for the emotional natures of those around you in order to build productive relationships. Emotional literacy-intelligence with a heart-can be learned through the practice of specific transactional exercises which target the awareness of emotion in ourselves and others, the capacities to love others and oneself while developing honesty, and the ability to take responsibility for our actions.</p>
Internationalization of research	<p>Internationalization of research course will provide you with the tools that help us organize ourselves in research environment, build a research team or become a part of one successfully, share your findings with the scientists in an oral or written form (presentation skills), present your research (participating in the conferences) or pitch your ideas to the investors. You will be able to write a good resume, know how to write a scientific article, locate funding to scaffold your research (apply for grants). In a nutshell, this course will teach you everything that an aspiring researcher needs to know to be successful.</p>