SUMMARIES OF THE COURSES

for the master's program

«Computer Science and Knowledge Discovery»

Educational direction

09.04.01 «Computer Systems Engineering and Informatics»

«Basics of Enterprise Activity»

The course "Foreign language" is aimed at familiarizing students with theoretical and practical aspects of enterprise activity in the Russian Federation. Students study basics of developing own business, acquire skills of adapting theoretical knowledge to Russian enterprise activity, study processes of enterprise activity and processes of implementing an enterprise project, business-planning, attracting resources, information on legal and economic aspects of starting an own enterprise; possible difficulties facing a businessman especially at early stages and development of enterprise activity in Russia. Students acquire practical skills of starting an own business and handling tasks related to current enterprise activity, searching for new ideas and resources for business development.

«Mathematical Foundations of Computer Science»

This discipline can be viewed as a continuation of the disciplines "Discrete mathematics" and "Mathematical logic and algorithm theory". The purpose of the discipline is to advance mathematical background of students, master the main models and techniques of computer mathematics. The discipline consists of the following parts: basics of universal algebra, discrete analysis, discrete functional schemes, applied logic, proof theory.

«Architecture of Parallel Computer Systems»

The course is devoted to studying techniques of organizing academic computations and tools for parallel and distributed computing. We use modern techniques and tools of modern software and hardware. Students acquire skills of

working with high-performance and computational systems, principles of scalar, flow and parallel and vector computational tools. Special attention is devoted to designing parallel, cluster, and distributed computational systems of homogeneous and heterogeneous architecture. Students learn how to handle various tasks in parallel and distributed environment and assimilate basic facts for designing distributed applications and databases, basics of applying modern software and hardware.

«Intelligent Systems»

The discipline provides a study of the basics of designing intelligent agents including movement, obstacle avoidance and pathfinding to tactical analysis and decision-making. The discipline also covers the use of algorithms based on decision trees, state machines, and elements of fuzzy logic. We consider applications of decision-tree training methods, the simplest neural networks and implementation of reinforcement training. The discipline also includes fundamentals of multiagent systems, specifics of designing intelligent agent environment, knowledge management, and natural language processing. This course discusses applications of the algorithms in a virtual environment (video game).

«Methodology of Learning Methods»

The course is included in the basic part of the general academic training. The purpose is to familiarize students with the structure of academic knowledge, research techniques, functions of academic theories and laws, extension of their outlook; developing ideas on criteria of scientific knowledge and requirements to academic research and its results. The training can become basis for continuing studies at other programs. The discipline has been developed based on the profile of university and features of students.

«Algorithm Design and Optimization»

The discipline can be viewed as a relative of the discipline "Mathematical foundations of computer science" and it is an integral part of education in the field of computer science and information technologies. The purpose of the discipline is to advance the mathematical background of students and master the main techniques of designing, analysis, and optimization of algorithms. The discipline consists of the following parts: methods and strategies of algorithm design, algorithm complexity, sort algorithms and search algorithms, numerical algorithms, graph algorithms, general complexity theory of algorithms.

«Software Development Technology»

The discipline provides knowledge and skill acquisition in the field of modern technologies of group development of software. We consider different models of the life cycle of software development, their advantages and drawbacks, capability maturity model-integrated (CMMI) and its key areas, team software process (TSP) and personal software process (PSP) developed in SEI University. We provide an overview of modern standards, methodologies, and documented processes and development environments: Rational Unified Process (RUP), Microsoft Solutions Framework (MSF), and TeamFoundation Server (TFS), agile development methodologies. We consider the issues of designing a project process, distribution of project roles, work planning and work tracking, quality monitoring and risk management.

«Design Management of Information Systems»

The course provides theoretical and practical training in the field of managing software projects and designing information systems. The course considers notions and models of the life cycle of information systems and software, unified and extreme processes of developing information systems, planning and managing the configuration of information systems, standards and quality of

information systems, aspects of tracing information systems. All lectures are accompanied by certain examples.

«Russian as a foreign language»

The discipline is intended for education of master's degree non-philological foreign students, who have the bachelor diploma of Russian institute of higher education and have the knowledge of Russian Language corresponding to the B 2 level. The program includes requirements for language knowledge level in different types of speech activity as well as grammar and speech material.

The mastering of this program will allow the foreign students to handle their communicative needs in educational, social and cultural sphere, will produce the base for successful learning of special subjects, and, as a result – for successful presentation of a thesis.

The Russian Language course for master's degree students must ensure the forming of a graduate's communicative competence on the level sufficient for professional activity in Russian Language. The education is realized on the source of general scientific, country-specific, literary, social and political texts.

«Foreign Language»

This program is pointed on providing training courses for foreign citizens who had not studied the Russian language before. It includes language and speech models based on the requirements for the Elementary certification level. Achieving this level in Russian will satisfy the foreign students' basic communicative demands in social and cultural as well as in educational spheres of communication.

The content of the program involves implementation of flexible training models, depending on the communicative purposes, native language and students' individual features.

«Computer Tools in Education»

The discipline is devoted to studying software packages for numerical and symbol computing. We consider three different packages: numerical computations are represented in GNU Octave and R, symbol computations are represented in SageMath. All packages are distributed free of charge and are available for downloading. Special attention is paid to data types in embedded programming languages and visualization techniques, i.e. plotting graphs and diagrams.

«Algorithmic Mathematics»

Algorithmic mathematics (computer algebra, symbolic or algebraic computations) deals with algorithms and software for handling mathematical expressions and other mathematical objects. This course familiarizes students with basic polynomial methods and algorithms over infinite and finite fields, Groebner bases, and algebraic varieties. The course allows students to get acquainted with theoretical fundamentals of basic methods and algorithms of polynomial factorization including Berlekamp's algorithm, algorithms for solving polynomial equations including those based on Groebner bases and Buchberger's algorithm.

«Digital Signal Processing»

The course includes basic methods and algorithms of digital signal processing using computer simulation in MATLAB. The discipline includes discrete signals and their transforms, linear discrete systems and their characteristics, discrete Fourier transform (DFT) and its applications, design and analysis of FIR and IIR filters, quantization effects in digital systems, spectral analysis of signals, multirate signal processing, adaptive filters, wavelet transform. The course familiarizes students with theoretical fundamentals of basic methods and algorithms of digital signal processing, the technology of computer simulation of these methods and algorithms in MATLAB. The discipline helps to study embedded software packages (FDATool, FVTool, SPTool, WAVETool).

«Parallel Computing»

Students acquire new knowledge for a possible career in the field of parallel programming. We provide principles for constructing parallel computational systems and consider mathematical models of parallel algorithms and programs for analyzing the efficiency of parallel computing. The course considers low-level possibilities of modern operating systems for providing parallelism.

«Information Technologies in Academic Research and Project Activity»

The discipline is oriented to acquiring skills of applying high-performance computer engineering and information technologies for academic research and practical tasks from different knowledge domains. Students should be able to master new software packages and technologies for computational systems with different architecture, perform analysis of information technologies and select those that are the most efficient for handling practical and academic tasks formulated within the scope of industrial and/or pre-graduation practice. These tasks can be used for research and graduation project.

«Advanced Mathematical Methods»

The course consists of selected topics from linear and multilinear algebra and numerical linear algebra that are important for applications in different branches of mathematics and physics, primarily in vector analysis, differential geometry, and numerical methods of ordinary and partial differential equations. Besides we discuss some natural applications of linear algebra such as recurrence relation and linear differential equations with constant coefficients.

«Machine Learning on Big Data»

The course provides deep training in the field of big data analysis and extracting knowledge from raw data. We handle various machine learning tasks: classification, cluster-analysis, mining association rules, data visualization.

Students will also acquire skills of using different data analysis tools including distributed data analysis: RapidMiner, Weka, R, Apache Spark.

«Languages for Hardware Design and Verification»

The discipline is aimed at studying tools for joint representation and debugging of software-hardware systems using SystemVerilog including special data types, object-oriented programming and quasi-stochastic representation of such systems.

«Biometric Technologies»

The course is aimed at studying biometric dynamic and static characteristics of humans. We consider all stages of image processing in biometric problems: data acquisition, face image preprocessing, feature extraction from images. We draw special attention to efficient algorithms of reducing feature space dimension using features oriented to image processing as two-dimensional data. The course also involves algorithm implementation using vector-matrix techniques in MATLAB. We discuss the main principles of constructing, simulating, and testing human recognition systems based on face images. Various simulation models are also widely discussed.

«Distributed Systems and Technologies»

The discipline studies a wide range of issues connected with the main principles, concepts, and technologies of distributed systems: connection, processes, identity, synchronization, integrity, and replication, fault protection, and security. The knowledge provided by this discipline can be used for constructing and managing distributed systems. The discipline includes practical training classes. Unsupervised work of students suggests studying the recommended sources of literature and preparation for classes. The final certification is based on graded examination results.

«Mathematical Modeling of Linear and Non-Linear Systems»

The discipline familiarizes students with the basics of mathematical modeling and synthesis of linear and non-linear systems at the input/output mapping. We study different forms of models classified as multidimensional polynomials, regression models, and neural networks. The comparative analysis of mathematical models is performed. The discipline also covers methods and algorithms of model design by solving the problems of system operator approximation in the root mean square metric using the input and output signal sets. Various neural network synthesis in MATLAB is represented. Modeling and synthesis of nonlinear transformers, filters, and compensators are represented.

The discipline is also aimed at studying nonlinear behavior of dynamical systems. It discovers the main properties of nonlinear processes during the design and use of a complex technical system. The discipline considers nonlinear dynamics and modern tools of dynamical analysis given through graphical programming environments. Students study mathematical representation of nonlinear systems and processes and their computer simulation through numerical integration.

«Basics of System Theory»

The discipline is oriented to mastering a number of areas of mathematics and system analysis used in engineering applications and academic research. The course encompasses all stages of complex system design beginning with information transform to digital form and its statistical processing and ending with system model design and its parameter optimization.

«Data and Visual Analytics»

Visual analytics is an advanced form of data analysis where analytical reasoning is followed by adoption of the highly interactive visualization techniques. This course introduces students to the concepts and tasks of visual analytics and examines several important data analysis and visualization

techniques. It provides hands-on experience with both existing products and in the development of custom visual analytics software.

«Information Security»

The course includes all issues of determining, reaching, and supporting confidentiality as well as the following properties of information or its processing tools: integrity, availability, non-repudiation, accountability, authenticity, and reliability. The discipline helps students to master the main concepts and problems of information security and offers a number of important modern techniques of information security. The course is aimed at forming skills for working with existing products and developing information security software.

«Academic Internship (Manufacturing (Design and Manufacturing))»

During educational practice the student must meet with the planning processes, the preparation, organization and execution of the research work, as well as methods of processing the results. In the process of educational training students learn to formulate scientific problem, to review and to compare the methods of its solution. One of the results of the practice should be well-designed reports on the results of scientific research.

«Internship (Manufacturing (Design and Manufacturing))»

As a result of the field experience the student must meet with the planning processes, the preparation, organization and execution of the research work, as well as methods of processing the results. During the field experience students learn to formulate scientific problem, to review and to compare the methods of its solution. One of the results of the practice should be well-designed reports on the results of scientific research.

«(Internship (Research Project)»

As a result of the field experience the student must meet with the planning processes, the preparation, organization and execution of the research work, as well as methods of processing the results. During the field experience students learn to formulate scientific problem, to review and to compare the methods of its solution. One of the results of the practice should be well-designed reports on the results of scientific research.

«Internship (Pre-degree Internship)»

During the training students must bring the final result of the study on their final qualifying work. During the pre-diploma training students learn to formulate a practical problem, to review and to compare the methods of its solution. One of the results of the practice should be well-designed report on the results of the research and the solutions of the practical problems.

«State Final Examination»

The State final attestation includes defense of the graduation qualification work. The State final attestation is the last mastering stage of the basic educational program.

The training level of graduates for performance of their professional tasks and compliance of their training with the requirements of the State Standard are assessed in the course of the State final attestation.

«Design of On-chip Reconfigurable systems»

Course "Design of reconfigurable systems on a chip (SOPS)" deals with different aspects of SoC design. The main aspects of this problem exist: SoC components, CAD as on tool for design, design flow, for most significant SoC fragments. All these aspects are presented in the course. Main attention is paid to base problems in present-day approach for SoC design: project verification and

debugging. The most significant project state – system level design – that recently becomes widespread is studies.

«Languages for Hardware Design and Verification of Software-Hardware Systems»

Discipline Languages for hardware/software systems design and verification is devoted to study of methodology and means for software-hardware codesign and coverification, including special data types, Object oriented programming and random-constraned simulation of such systems.