Voronezh State University

Master Programme

“*IT in Systems Engineering*”

Computer Science Faculty

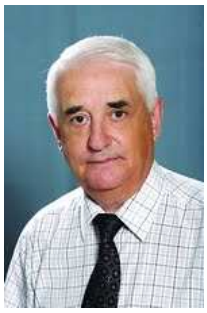
Voronezh

2013-2014

Contents

Welcome

Dear students !



Computer Science Faculty of the Voronezh State University invites you to continue your higher education enrolling in a master's program in one of the master's programs realized at the Faculty.

Computer Science Faculty is one of the prestigious and innovative among faculties of the Voronezh State University. The faculty closely cooperates (both in the academic and scientific fields) with leading brand-name IT companies (Microsoft, Oracle, SAP) and with leading IT companies of the Voronezh. As well, the faculty cooperates with more than 30 universities in Russia , Europe , USA, Japan and China.

Participation in the European project "Internationalized Curricula Advancement at Russian Universities in the Southern Region", supported by the TEMPUS programme, provides an opportunity both for the integration of russian and european universities in the development of master's programs and for inclusive study of our masters, implementing an individual study plan aimed for obtaining double diploma.

We are glad to see you among our masters and members of our international programs.

Eduard K. Algazinov
Dean of computer science faculty

Address: Dean office (386), Universitetskaya pl.1,
E-mail: algazinov@sc.vsu.ru

General Information

About faculty

The computer science faculty delivers academic programs in three majors:

- Information systems and technology (Bachelor and Master programs),
- Mathematics and computer science (Bachelor and Master programs),
- Software engineering (Bachelor program)

Bachelor program lasts 4 years (240 credits) and master program – 2 years (120 credits).

Faculty also delivers post-graduate programs leading to candidates and doctoral degrees.

There are 5 departments at the faculty where 10 full professor (doctors of science) and 20 associate professor (candidates of science) deliver lectures.

The faculty is active in research sphere. There are several research schools and laboratories which provides opportunities in different research fields to students and lecturers.

Research schools:

- advanced methods and technologies of information processing (pattern recognition, image processing and analysis, information processing technology in the diagnosis and information security systems) ;
- neurocomputers, applying of neural network technology to data and processes analysis;
- information security, data security and integrity in corporate information systems and database management systems, information technology, intellectual property protection.
- control theory and decision-making under incomplete certainty
- analysis and structural modeling and simulation of business processes, theoretical aspects of project management.

Student accommodation

Accommodation facilities for students are available at the university campuses. The Voronezh State University has wide network of campuses. For international students it is a dormitory 7 (40a Kholzunova st) which is 9-store buildings with all accommodation facilities needed, that include three-bedded rooms, as well as kitchenettes, bathrooms and lavatories. On arrival at the campus all residents are provided with bedding. As the dormitory is connected with the university building, the students can use a concert hall where all the events normally take place, a gym and a cafe. Currently most campuses are provided with the 24/7 Wi-Fi Internet access.

Admission criteria

Applicants who choose the major in IT in System Engineering are expected to have a B.Sc. in applied mathematics, computer science, information technology, physics or relevant fields of science. The applicants' degree must contain mathematics, physics and information technology. The students should have basic knowledge in computing including data structures and programming skills. Furthermore, the students must have familiarity with PC work stations and basic data manipulation tools.

Regarding mathematics the student should master calculus, also in functions of several variables. He/she is assumed to know basics of matrices, linear algebra, differential equations and optimization, numerical algorithms, statistics and probability. Knowledge of one of the traditional engineering disciplines (e.g. mechanical engineering, industrial engineering, computer engineering, electrical engineering) is of great advantage. Independence, team work and communication skills are important.

As tuition is given in Russian and English, the students must have good oral and writing skills in the English language. For participation in double degree program applicants should require for English corresponding to TOEFL 500 and ISLTS 173.

Academic year

First Semester	**01.09 – 30.01**	**Second Semester**	**10.02 – 01.07**
Classes	01.09 – 30.12	Classes	10.02 – 10.06
New Year vacation	01.01 – 8.01	Examinations	10.06 – 01.07
Examinations	09.01 – 25.01	Vacation	February 23rd, March 8th, May 1st, May 9th
Inter-semester break	31.01 – 10.02	Summer holidays	02.07 – 31.08

Academic support

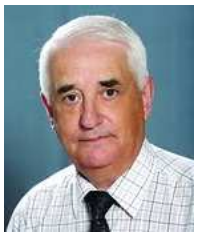
While studying at any university all students need reliable sources of information. At all times – books, newspapers and magazines have always been the most solid and reliable source of information.

At our university we have a complex library system. Our libraries offer 3 million books, periodicals and manuscripts, also the most ancient book is dated XVI century. According to the latest technologies, our library has its web-site and e-catalogues, where you can check any book and prolong it.

The University library provides widest access to the sources of the biggest e-libraries.

Address: pr. Revolutsii, 24 (http://www.lib.vsu.ru)

Our teaching staff



Eduard K. Algazinov
Dean,
Head of the Programme,
Doctor of Science, Professor

Alexander V. Sychev
Programme Coordinator,
Candidate of Science,
Associate Professor

Alexander A. Sirota
Doctor of Science,
Professor

Mikhail G. Matveev
Doctor of Science,
Professor

Igor V. Illarionov
Candidate of Science,
Associate Professor

Andrey S. Koval
Senior Teacher

Alexander A. Krylovetsky
Candidate of Science,
Associate Professor

Veronika V. Garshina
Candidate of Science,
Associate Professor

Alexander P. Tolstobrov
Candidate of Science,
Associate Professor

Vadim V. Fertikov
Candidate of Science,
Associate Professor

Mikhail A. Dryuchenko
Candidate of Science,
Assistant Professor

Sergey Borzunov
Candidate of Science,
Assistant Professor

Master Programme description

The “IT in Systems Engineering” Master Programme corresponds to 120 ECTS credits and leads to the degree of Master of Science in Information Systems and Technology. This two-year M.Sc. programme is meant for both Russian and international students. Lectures and tutoring are given in Russian and English.

Aims of the programme

The purpose of this programme is to develop the student’s theoretical and computational skills for participation in advanced product development in information systems engineering for the wide range of application areas. System engineering is a robust approach to the design, creation, and operation of systems. The goal is that the graduates will master in meeting together advanced information technologies and mathematics in application to analysis support for research and to product development, including system analysis, mathematical modeling, computer simulation and optimization.

They should be able to:

- identify and quantify system goals;
- create alternative system design concepts, performance of design trades;
- select and implement the best design;
- verify that the design is properly built and integrated;
- perform the post-implementation assessment of how well the system meets the goals.

Also graduates should be able to keep up with and contribute to new research findings and communicate scientific data and relationships – orally and in writing – using advanced computing and telecommunications tools.

This master programme reflects the industry attitude that engineering professionals need a foundational background in one of the traditional engineering disciplines (e.g. software engineering, enterprise systems engineering, etc.) plus professional, real-world experience to be effective as systems engineers.

The professional scope is wide-ranging and growing rapidly. IT in Systems Engineering is the Art and Science of creating optimal solution systems to complex issues and problems , and it's tools are strategies, procedures, and techniques that aid in performing systems engineering on a project or a product. The purpose of these tools vary from database management, graphical browsing, simulation, and reasoning, to document production and more. To better comprehend and manage complexity in systems it applies computational models and methods such as:

- systems modeling and simulation,
- system architecture,
- optimization,
- system dynamics,
- systems analysis,
- statistical and reliability analysis
- decision making

We also provide the student with a capability for doctoral studies and independent research.

Graduate should be prepared to address the following professional tasks: planning and design activities, organizational and management activities, research activities, scientific and educational activities, innovative activities.

We train our graduates to combine modeling, computational skills, advanced theory and data analysis in innovative ways. We provide solutions to questions of industrial R&D and project management.

Learning outcomes and competences

On successful completion of the programme students will be able to:

- Lead and master a topic in the subject field literature and demonstrate mastery in a reasoned written and/or verbal report.
- Organize research in a specialized field in an understandable manner for international environment both orally and in writing, observing general rules for scientific reporting.
- Develop new methods and tools for designing information systems.
- Provide authorized support for design, implementation and maintenance of information systems and technologies.
- Organize the interaction between the developer and customer teams for design, implementation and maintenance of information systems and technologies.
- Make decisions in a wide range of professional topics in terms of different opinions.
- Develop and explore the theoretical and experimental models for the objects of professional activity in the areas such as: technology, education, medicine, administration, business management, banking systems, telecommunications, security, information systems, as well as enterprises in various fields, and all activities in the framework of information society economics.
- Carry out development and research methods of analysis, synthesis, optimization and forecasting processes, quality of information systems and technologies in professional activities.
- Process an object modeling with standard packages for computer aided design and research.

- Develop strategies for the design and define the design objectives, performance criteria, limitations, applicability for design of information systems and technologies.
- Find a compromise between different requirements (cost, quality, deadlines), the optimal solutions as in the long and the short-term planning.
- Collect and analyze scientific and technical information, domestic and foreign experience on the subject of study in academic, research and professional activities.
- Develop methods for solving non-standard problems and new methods for solving traditional problems.
- Provide staff training for professional staff.
- Develop projects of complex systems for various purposes and justify the choice of relevant hardware and software on the base of methods of systems analysis and optimal methods of decision-making.
- Prepare requirements on the design of components of information systems and technology on the base of systems engineering methodology.

Teaching and learning activities

Learning and teaching of IT in Systems Engineering typically involves a combination of the following:

- **Lectures.** These are seen as a very time-efficient way for students to learn part of the large material involved in the corpus of mathematics and information technologies. In some cases, students acquire prepared lecture notes or have a set textbook; in other cases the taking of notes is seen as part of the learning process.
- **Exercise sessions.** These are organized most often in tandem with lectures. They occur as groups with supervision, or individually as homework with subsequent supervision of the results. The aim of the exercises is two-fold: understanding of the theoretical material through examples and applications to problems. These sessions are essential in mathematics and information technologies, where understanding is acquired by practice, not memorization.
- **Homework.** While demanding on the time of the lecturer and/or teaching assistant, homework is clearly one of the most effective ways in which students can be encouraged to explore the limits of their capabilities. Homework, of course, allows feedback to the students, which gives them a clearer picture of their performance; however, while homework is often assigned, it is less often graded, except where classes are small.
- **Computer laboratory class.** These are perhaps the most significant in the teaching of information technologies, introducing an experimental aspect to

the subject. They feature not only in computer science related and computational courses, but also in statistics, systems modeling, dynamic systems etc.

- **Seminars.** These are organized in the form of presentations (with following discursions) the results of research work (which was done individually or in small group). The aim of the seminars is to help students to organize academic and research activities and practical skills how to disseminate acquired results in an understandable manner for the international community.
- **Research internship.** Typically it is done individually and provides the ability to apply classroom theory in practice.
- **Project work.** It is done individually or in small groups, and typically involve putting together material from different sub-fields to solve more complicated problems. Small group projects can help to develop the ability to do teamwork (identified as an important transferable skill). The projects may involve significant computational elements, as in the case of the computational competences referred to above. Projects, particularly significant final year projects where they exist, also afford the opportunity to develop students' verbal and written communications skills.
- **Dissertation (Thesis).** It is considered as the most important learning activity finalizing Master programme. Dissertation topics may arise from various application areas, research projects and contacts with industry. Typically, a dissertation contains theoretical research, as well as solving practical problems with the help of up-to-date mathematical and computational methods. Both the dissertation preparation and defence develop and demonstrate most important professional, analytical and communication skills of student.

The programme is continually evaluated and developed which may cause the courses offered and the position of the courses to change.

Assessment and evaluation

The aims and learning outcomes of the programme are reached through the different courses included in the degree. Assessment and examination take place at course level and details concerning assessment and grading for the courses can be found in each respective course descriptor.

All students are encouraged to take part in the evaluation of the programme. Each course in the programme is also evaluated separately and these evaluations form the basis of the continual development of the programme.

Programme structure

Degree Structure		
General Studies, obligatory modules	11	ECTS
General Studies, elective modules	6	ECTS
Major Subject, obligatory studies	64	ECTS
Major Subject, elective modules	10	ECTS
Minor Subject	15	ECTS
Elective Studies	14	ECTS
Total	***120***	***ECTS***

General Studies, obligatory modules, 11 ECTS

Code #	***Module title***	***Quarter***	***ECTS***
M.1 C.1	Logics and scientific methodology	1	2
M.1.C.2	Special chapters of Mathematics	3	4
M.1.V.1	History and methodology of computer science	2	3
M.1.V.3	Principles of Technical Computing, Scientific Presentations and Publishing	3	2

General Studies, elective modules, 6 ECTS

Code #	***Module title***	***Quarter***	***ECTS***
M.1.V.E.1.1 M.1.V.E.1.2	Philosophy of Informatics Philosophical problems of synergetics	2 2	2 2
M.1.V.E.2.1 M.1.V.E.2.2	English for IT engineers Business English	1-2 1-2	2 2
M.1.V.E.3.1 M.1.V.E.3.2	Applied statistics Fractals theory	3 3	2 2

Major Subjects, obligatory studies, 64 ECTS

Code #	*Module title*	*Quarter*	*ECTS*
M.2 C.1	Research and modeling methods for information process and IT	2	6
M.2 C.2	System Engineering	1	5
M.2 C.3	Seminar IT in Engineering	1,3	3
M.2 .V.1.	System Analysis and computer modelling	1	3
M.2 .V.3	Neural networks and genetic algorithms	2	3
M.3	Research and Master's Thesis	1-4	44

Major Subjects, elective modules, 10 ECTS

Choose one module or more from every slot. The extent of each module should be 3 or 4 ECTS

Code #	*Module title*	*Quarter*	*ECTS*
M.2.V.E.1.1 M.2.V.E.1.2	Intranet Security Systems Systems and networks of data communication	2 2	3 3
M.2.V.E.2.1 M.2.V.E.2.2	Compilation theory Computing with Java and JavaScript	2 2	3 3
M.2.V.E.3.1 M.2.V.E.3.2	Multimedia systems Internet Applications developing	2 2	4 4

Minor Subjects, 16 ECTS

Minor in “IT in Systems Engineering” can be studied by students of other Master’s degree programmes. Course units for minor studies can be freely chosen from the modules that Faculty of Computer Science offers in Russian or in English. However, suitable background knowledge is needed. Students can choose any minor taught at VSU or partner universities if the required prerequisites are met. The choice of minor should be discussed with the Programme Coordinator.

A minimum of 16 ECTS credit units should be selected from the modules below:

Minor Subjects (ECTS) *Quarter*

Code #	***Module title***	***Quarter***	***ECTS***
M.1.V2	Modern information technology for business management systems developing	1	4
M.2.V.2	Mathematical and computer methods for image processing	3	4
M.2.V.4	Data Mining	3	4
M.2.V.5	Parallel and Distributed Programming	3	4
M.2.V.6	Information security	2	3

Elective Studies 14 ECTS CUs

Elective studies can include any module offered by VSU if the required prerequisites are met. Studies in other universities may be included upon application. Elective studies may include a maximum of 10 ECTS credit units of internship improving expertise. The student should discuss the choice of elective modules with the Programme Coordinator.

Modules structure diagram

Code #	**Module title**	**ECTS**	**hours**						**Exam (quarter)**	**Pass (quarter)**	**hours per week**				**form of assessment**
			Total	contact hours				assignment work			I year		II year		
				total	lectures	semi-nars	labs				1 sem.	2 sem.	3 sem.	4 sem.	
											Weeks in semester				
											16	17	17	20	
1	2	3	4	5	6	7	8	9	10	11	13	14	15	16	17
M.1 C.1	Logics and scientific methodology	2	72	16	16			76		1	1				test
M.1.C.2	Special chapters of Mathematics	4	144	64	32		32	80		1	4				test

M.1.V.1	History and methodology of computer science	3	180	32	16	16		76		1	2				test
M.1.V.2	Modern information technology for business management systems developing	4	144	32	16		16	85	1		2				exam
M.1.V.3	Principles of Technical Computing, Scientific Presentations and Publishing	2	72	16			16			3			1		test
M.1.V.E.1	*Phylosophy of Informatics/ Philosophical problems of synergetics*	2	72	16	16			40		2		1			test
M.1.V.E.2	*English for IT engineers / Business English*	2	72	48		48		24		1,2	2	1			test
M.1.V.E.3	*Applied statistics/ Fractals theory*	2	72	32	16	16		40		3			2		test
M.2 C.1	Research and modelling methods for information process and IT	6	216	68	17		51	112	1			3			test

M.2 C.2	Systems Engineering	5	180	68	17		51	148		1	3				exam
M.2 C.3	Seminar on IT in Engineering	3	108	32		32		76		1,3	1		1		test
M.2.V.1	System Analysis and computer modelling for complex systems	3	108	48	32		16	96	1		3				exam
M.2.V.2	Mathematical and computer methods for image processing	4	144	48	16		32	96		1			3		test
M.2.V.3	Neural networks and genetic algorithms	3	108	51	34		17	57	2			3			exam
M.2.V.4	Data Mining	4	144	51	17		34	93	3				3		exam
M.2.V.5	Parallel and Distributed Programming	4	108	48	16		32	33	3				3		exam
M.2.V.6	Information security	3	81	48	16		32	33	2			3			exam
M.2.V.E.1	*Intranet Security Systems / Systems and networks of*	3	108	48	16		32	60		2		3			test

	data communication														
M.2.V.E.2	*Compilation Theory / Computing with Java and JavaScript*	3	108	32	16		16	76		2		2			test
M.2.V.E.3	*Multimedia systems / Internet Applications developing*	4	144	48	16		32	96		2		3			test
M.3	Research and Master's Thesis	54	1944							1,2,3,4					
	Total	**120**	4320	846							18	19	13	0	
	number of exams:										3	3	2		
	number of credit passes:										7	6	5	1	

Personal Study Plans

At the beginning of their studies, students prepare a personal study plan, in which students and contact people of the degree programme agree on what studies students will pursue and in what order. This plan includes detailed information on the major subject, minor subject, general studies, elective studies, credit transfer from previous degree/studies and possible complementary studies.

Credit Transfers

Any periods of studying at Russian or foreign partner universities are recognized by VSU accordance Russian regulations and Partnership Agreement. A credit transfer shall be implemented and ECTS credit units can be transferred from students' previous studies.

Annex

Course unit descriptions

M.1.C.1	Logics and scientific methodology, 2 ECTS
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 1st semester, quarters:1-2
Teachers	Lecturer (s): Assoc.prof. V.V. Ferroni, Ph.D.
Learning outcomes	As a result of this course the student should: demonstrate understanding the basic concepts and theoretical knowledge on the basics of logic and methodology of science, philosophy of science, philosophy of mathematics, philosophy of science when carrying out his own scientific research
Content	Introduction to Logic. Propositional calculus and predicate calculus. Automata Theory. Non-classical logics. Logical foundations of mathematics. Formal grammars and languages. The methodology of scientific knowledge. General philosophical methods. General scientific methods. Specific scientific and other methods. Modern "methodological innovations". Dialectical method. What is the philosophy of science? The development of the philosophy of science. The growth and development of scientific knowledge. Future of Science.
Mode of delivery	Lectures - 1 h. per week, project preparation 76 h., credit pass in 2nd quarter. Total amount 72 h.
Evaluation	Passed/failed, test in written 60%, project assignments 40%

Study materials	• *V. Kochanowski*. Philosophy of science: a manual - Rostov, M.: March, 2005. • *V.Moses* Philosophy and Methodology of Science: Textbook. - Voronezh: Central Black Earth book. Publishers, 2003. • *A.Ivin* Modern philosophy of science - Vysshaya shkola., 2005. • *S.Lebedev* Philosophy of science: a manual. - Moscow, Yurayt, 2011.
Language	Russian
Prerequisits	Basics of phylosophy

M.1.C.2	**Special chapters of mathematics, 4 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 1st semester, quarters:1-2
Teachers	Lecturer (s): Prof. Loboda A.V., D.Sc.
Learning outcomes	As a result of this course the student should: • Understand the necessity of mathematical formalisation for the questions and problems arising in connection with the different applied tasks in modern technologies of systems analysis and synthesis. • Can apply in practice the simplest known mathematical models, using the linear and polynomial functions. • Demonstrate the meaning of the possibilities for the complication of simplest models of problems under consideration for their more correct solving. • Use the tools of modern symbol mathematics packages for the investigation of developed polynomial models. • Demonstrate the meaning of the possibilities of developed theoretical models and the ways of its technical realization. • Can attract developed mathematical technique for the solving of model problems, connected with the description of complicated continuous and discrete systems

Content	Polynomials of one real (or complex) variable and it's properties. Analytic functions as a generalization of polynomials. Fractional-linear transformations and it's properties. Computer simulation in hydrodynamics. Polynomial and rational approximation. Quadric in different spaces and it's properties. Algebraic surfaces and manifolds in some geometric problems (homogeneity of embedded manifolds). Polynomials of matrices and it's properties. Analytic functions of the operator arguments. Computer packages and learning algorithms of polynomial problems. Spaces with a quadratic form. Orthogonal system of functions. Matrix algebra as a space with a quadratic structure. Polynomial maps and it's inversion. A system of nonlinear algebraic equations. Polynomials of discrete variables. Simple a functions of k-valued logic. Polynomials modulo k in k-valued logic. Quadratic functionals in the differential equations.
Mode of delivery	Lectures and laboratory work - 2 h. per week, pre-laboratory work and project preparation 80 h., test. Total amount 144 h.
Evaluation	Passed/failed, test in written 30%, laboratory work assignments 30%, project assignments 40%
Study materials	• *S. Yablonsky* Introduction to Discrete Mathematics: a manual for stud. university trained. specialty "Applied Mathematics". - Ed. 5th, sr. - M.: Higher school., 2008. • *V. Dyakonov* Maple 9.5/10 in mathematics, physics, and education. - M.: Solon - Press, 2006.
Language	Russian
Prerequisits	Basics of mathematical analysis, algebra and discrete mathematics

M.1.V.1	**History and methodology of computer science, 3 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 1st semester, quarters:1-2
Teachers	Lecturer (s): Assoc. prof. A.P. Tolstobrov, Ph.D.
Learning outcomes	As a result of this course the student should: demonstrate an understanding of general of the main stages of the development of computer science and the underlying paradigms of computer science when considering it's appearance and change and estimating the prospects of it's development.

Content	Background to Computer Science. The basic concept of information. Shannon formula. Boolean algebra and synthesis of digital devices. Algorithms. Paradigms of Programming Languages. Object-oriented programming paradigm. Information systems with databases. Systems based on knowledge. Data and knowledge. artificial intelligence. Security and Information Protection. The legal framework for the protection of information. Improving the performance of computers. The phenomenon of the Internet. The Information Society.
Mode of delivery	Lectures and seminars - 2 h. per week, self-study and writing a report - 76 h., test. Total amount 108 h.
Evaluation	Passed/failed, test in written - 30%, seminars assignments - 30%, individual project assignements - 40%
Study materials	• *J.G. Brookshear* Computer Science: An Overview. 11th Edition, Addison-Wesley, 2012
Language	Russian
Prerequisits	No special prerequisits

M.1.V.2	**Modern information technology for bustranslateiness management systems developing, 4 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 1st semester, quarters:1-2
Teachers	Lecturer (s): Professor M.G. Matveev, D.Sc.
Learning outcomes	As a result of this course the student should: • demonstrate competence in the field of advanced IT methodological bases, relating to the given problem; • describe IT trends and analyze IT development, providing • well-grounded arguments on future of given technology; • identify problems typical model of subject area and be able to use them in the solving these problems; • list advanced IT-solutions and tools, be able to select them for • solving problems in a specific subject area; • build project of collaborate work on a given problem.

Aims	The course provides the student the opportunity to learn the theory and practice of structural modeling of business processes, current models and methods for production planning, inventory management, quality management, budget management, project management
Content	• The tasks of the targeted organization operating and project activities of the enterprises within the framework of ERP and BPM systems. Methodological basis of the structural system analysis, methodology of the SADT, ARIS. Classification and characteristics of the notations of structural modeling. Practices and tools of modeling and functional-cost analysis of business-processes of the enterprise. • The basic model of decision-making (optimal and expert selection). Models and methods of the decision of typical business-management tasks: production planning, logistics and inventory management, quality management in the conditions of a random and fuzzy uncertainty. The use of MATLAB for the solution of business tasks. • Application of methods of artificial intelligence (fuzzy systems, artificial neural networks, genetic algorithms) in models of planning and management. MATLAB as a tool of realization of methods of artificial intelligence. • Project management tasks and their peculiarities. The main stages of project management, network diagrams, critical path method, CPM, PERT method, fuzzy modification of the method PERT. Peculiarities of project management in development of information systems and software products. Introduction of the system of MS Project . • Term of reference for the design of control systems division of the enterprise.
Mode of delivery	Lectures and laboratory work - 2 h. per week, self-study and writing a report - 85 h., exam. Total amount 144 h.
Evaluation	Grade, written exam - 40%, laboratory work assignments - 30%, individual project assignments - 30%
Study materials	• *E.K.Chew, P.Gottschalk* Information Technology Strategy and Management: Best Practices. - IGI Global Snippet,2009. • *F. Liu* Implement Artificial Intelligent Optimization Techniques with MATLAB: From A Novice To An Expert. Lambert Academic Publishing, 2011.
Language	Russian
Prerequisits	Fundamentals of theory of systems and systems analysis, modeling and computer simulation techniques

M.1.V.3	**Principles of Technical Computing, Scientific Presentations and Publishing, 2 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	2nd year, 1st semester, quarters:1-2
Teachers	Lecturer (s): Prof. E.N. Desyatirikova, D.Sc.
Learning outcomes	As a result of this course the student should: • find the best ways to solve typical math problems in research area using specialized software (MathCAD, TeX, LaTeX ,Adobe, etc.); • apply of High Performance Technical Computing to scientific problem solving; • represent the results in the form of scientific and technical reports, articles and papers in scientific conferences.
Content	The study of application of systems MatLab, MathCAD, Mathematica in various scientific area; Technology of technical computing and its control; Open source computer algebra systems; Scientific principles of presentation and current versions of software for scientific presentations and publishing of the results (TeX, LaTeX etc.).
Mode of delivery	Laboratory works - 1 h. per week, pre-lab work and project preparation - 56 h., test. Total amount 72 h.
Evaluation	Passed/failed, test in written - 30%, lab work assignments - 30%, individual project assignements - 40%
Study materials	• *F.A.Kuzin* Ph.D. thesis. Writing technique, rules and procedures of protection: a practical guide for graduate students and candidates for a degree / F.A. Cousins. - 11th ed., Ext. - Moscow: Os-89, 2011. • *R.Brian* Hunt and others. MATLAB R2007 from scratch Book and Video Course. M.: The Best Books, 2008. • *M.Goossens* Guide to LATEX package and its Web-based applications. - Verlag, 2001.
Language	Russian
Prerequisits	No special prerequisits

M.1.V.E.1.1	**Philosophy of informatics, 2 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 2nd semester, quarters: 3-4
Teachers	Lecturer (s): Assoc. prof V.V. Ferroni, Ph.D.
Learning outcomes	As a result of this course the student should: • demostrate understanding the problems and concepts of the philosophy of informatics when considering real IT systems.
Content	History of the formation of computer science as an interdisciplinary direction of science and technology in the second half of the twentieth century. Computer science as an interdisciplinary science of the functioning and development of information and communication technology,its technological realization by means of computers. The Internet as a metaphor for the global brain. Epistemological content of the computer revolution. Social Informatics.
Mode of delivery	Lectures - 1 h. per week, self-study work and individual project preparation - 40 h., test. Total amount 72 h.
Evaluation	Passed/failed, test in written - 60%, individual project assignments - 40%
Study materials	• *N.Tarasov* Philosophical problems of computer science. - "MODEK", 2007. • *D.S.Chernavskiy* "Synergetics and information (dynamic information theory)" - Moscow: Editorial URSS, 2004.
Language	Russian
Prerequisits	Basics of philosophy

M.1.V.E.1.2	**Philosophical problems of synergy, 2 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 2nd semester, quarters: 3-4
Teachers	Lecturer (s): Assoc. prof V.V. Ferroni, Ph.D.

Learning outcomes	As a result of this course the student should: • master the basic concepts and knowledge on the basics of the theory of self-organization and self-organizing systems (synergetics) in application to real life complex systems. • demonstrate understanding the problems of the philosophy of synergy when considering complex social, technical and biological systems.
Content	Subject and method of synergetics. Precursors and sources of synergy. Modern scientific direction, develops and extends the ideas of synergetics. Classification of self-organizing systems. The principles of self-organization. Self-organizing systems ontology. Epistemology of self-organizing systems. Axiology of self-organizing systems. Synergetics and philosophy. Synergetics in the history of philosophy.
Mode of delivery	Lectures - 1 h. per week, self-study work and individual project preparation - 40 h., test. Total amount 72 h.
Evaluation	Passed/failed, test in written - 60%, individual project assignments - 40%
Study materials	• *E.Knyazev, S.Kurdyumov* Synergetics fundamentals. Blow-up regimes, self-organization, tempoworlds. Snt-Petersbourg. "Aleteya". 2002. 414 p. • *E.Knyazev, S.Kurdyumov* Synergetics. Nonlinearity of time and landscapes coevolution. Moscow: KomKniga, 2007. • *I.Prigogine, I.Stengers* Order out of chaos. Moscow: Progress Publishers. 1986. • *G.Haken* Synergetics. M.: Mir. 1980.
Language	Russian
Prerequisits	Basics of philosophy

M.1.V.E.2.1.	**English for IT engineers, 3 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 1-2nd semester, quarters: 1-4

Teachers	Lecturer (s): Assoc. prof. Strelnikova A.P., Ph.D.
Learning outcomes	As a result of this course the student should: • demonstrate the level of knowledge of a foreign language not lower than the basic one (B1) and to develop cognitive and research skills in using foreign language resources • acquire the necessary level of competence to deal with the social and communicative problems in various areas of professional and scientific fields of activity • demonstrate in practice dealing with foreign colleagues and partners for scientific and professional purposes
Content	Proposal writing for the conference, making the abstract, writing a scientific article, annotating and reviewing scientific documents Business correspondence, telephone calls, writing CV and resume, interview for a job
Mode of delivery	Seminars – 2 h. (1st semester), 1 h. (2 semester) per week, self-study work and pre-seminar work - 24 h., test. Total amount 72 h.
Evaluation	Passed/failed, test in oral and written - 50%, seminars assignments - 50%
Study materials	• *S.R. Esteras, E.M. Fabre* Professional English in Use : For Computers and the Internet. – CUP, 2007 • *C. Downes* – Cambridge English for Job-hunting – CUP, 2008 • *M. Grussendorf* – English for Presentations, Express series / Marion Grussendorf – OUP, 2007 • *O.Safronenko* - English for Graduate Science Students. English textbook for graduate and postgraduate students of natural faculties. - Publishing House: High School, 2005
Language	English
Prerequisits	Basic level of English

M.1.V.E.2.2.	**Business English, 3 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 1-2nd semester, quarters: 1-4
Teachers	Lecturer (s): Assoc. prof. Strelnikova A.P., Ph.D.
Learning outcomes	As a result of this course the student should:

	As a result of this course the student should: • demonstrate the level of knowledge of a foreign language not lower than the basic one (B1) and to develop cognitive and research skills in using foreign language resources • acquire the necessary level of competence to deal with the social and communicative problems in various areas of professional and scientific fields of activity • demonstrate in practice dealing with foreign colleagues and partners for scientific and professional purposes
Content	Proposal writing for the conference, making the abstract, writing a scientific article, annotating and reviewing scientific documents Business correspondence, telephone calls, writing CV and resume, interview for a job
Mode of delivery	Seminars – 2 h. (1st semester), 1 h. (2 semester) per week, self-study work and pre-seminar work - 24 h., test. Total amount 72 h.
Evaluation	Passed/failed, test in oral and written - 50%, seminars assignments - 50%
Study materials	• *S.R. Esteras, E.M. Fabre* Professional English in Use : For Computers and the Internet. – CUP, 2007 • *C. Downes* – Cambridge English for Job-hunting – CUP, 2008 • *M. Grussendorf* – English for Presentations, Express series / Marion Grussendorf – OUP, 2007 • *O.Safronenko* - English for Graduate Science Students. English textbook for graduate and postgraduate students of natural faculties. - Publishing House: High School, 2005
Language	English
Prerequisits	Basic level of English

M.1.V.E.3.1	**Applied Statistics, 2 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	2st year, 3rd semester, quarters: 1-2
Teachers	Lecturer (s): Assoc. professor E.Sirota, Ph.D.
Learning outcomes	As a result of this course the student should:

	• Demonstrate an understanding of the basic concepts and definitions of the statistical analysis applied to stochastic processes and random fields • Demonstrate an understanding of the main design principles of computer simulation methods and algorithms applied to stochastic processes • Demonstrate an understanding of the main design principles of computer simulation methods and algorithms applied to random fields • To be able to practically use basic methods and algorithms for simulation applied to random processes and fields • Demonstrate the knowledge of the main concepts of the statistical theory of optimal estimation of the constant parameters in digital data processing systems
Content	Multivariate statistical analysis. Random vectors and their statistical characteristics. Random processes, random sequences and their statistical characteristics. Markov processes and vector random sequence. Methods and algorithms for simulation of random processes in discrete time. A common approach. Scalar and vector random fields. Main characteristics. Methods and algorithms for simulation of random fields. Bayesian estimation. Examples of algorithmic implementation. Algorithms for joint estimation of discrimination and constant parameters. Estimation algorithm (recovery) of random fields.
Mode of delivery	Lectures and seminars - 2 h. per week, pre-seminar work and individual project preparation - 40 h., test. Total amount 72 h.
Evaluation	Passed/failed, test in written - 30%, seminar work assignments - 40%, individual project assignments - 30%
Study materials	• *E.Wentzel* "Probability theory and its engineering applications". - M.: Vysshaya Schkola, 2007. • *V.Chistyakov* "Course in the theory of probability". - M. Bustard, 2007. • *S.Prigarin* "Methods for the numerical simulation of random processes and fields" - Novosibirsk ICMMG, 2005.
Language	Russian
Prerequisits	Knowledge of probability theory and mathematical statistics, calculus, algebra, computer science

M.1.V.E.3.2	**Fractals theory, 2 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	2st year, 3rd semester, quarters: 1-2
Teachers	Lecturer (s): Assoc. professor A. Flegel, Ph.D.
Learning outcomes	As a result of this course the student should: • Demonstrate the knowledge of main characteristics of fractals • Be aware of self-similar fractal objects and their implementation in the mathematical modeling • Demonstrate the ability to calculate fractal dimensions and other characteristics of fractals • Be able to apply numerical methods required for the study and analysis of dynamic systems and fractals • Be able to analyze complex nonlinear mapping used to describe fractal objects
Content	Fractals and the number system. Sierpinski sieve. Fractal Cantor. Fractal dimension. Overall design of structural fractals. Koch curve. Spiral trees, stars. Structural analysis of fractals. Randomness in fractals. Dimensional complex display. Mandelbrot and Julia fractals. Fractals Newton.
Mode of delivery	Lectures and seminars - 2 h. per week, pre-seminar work and individual project preparation - 40 h., test. Total amount 72 h.
Evaluation	Passed/failed, test in written - 30%, seminar work assignments - 40%, individual project assignments - 30%
Study materials	• *V.T. Grinchenko, V.T. Matsypura, A.A. Snarskiy* Introduction to nonlinear dynamics: Chaos and fractals - 3ed. Moscow: LPI Publishing, 2010. • *A.D. Morozov* Introduction to the theory of fractals. Moscow - Izhevsk: Institute of Computer Science, 2002. • *B.Mandelbrot* Fractal Geometry of Nature - M.: Institute of Computer Science, 2002.
Language	Russian
Prerequisits	Knowledge of probability theory and mathematical statistics, calculus, algebra, computer science

M.2.C.1	**Research and modeling methods for information process and IT (Mathematical Modeling of Information Systems and Processes), 6 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 1st semester, quarters: 1-2
Teachers	Lecturer (s): Assoc. prof. V. Garshina, PhD.
Learning outcomes	As a result of this course the student should: • Describe the main principles of the system approach to information system analysis giving theoretical description of system analysis methods and practical examples • Name the stages of developing, implementation and studying of information systems and processes computer models; state the objectives of the each stage and implementation requirements of various modeling methods and techniques. • Describe the functions and options of different information systems and processes modeling methods, provide their theoretical justification and describe the requirements, ways and peculiarities of their implementation regarding the given objectives. • Explain the choice of the right modeling method in a certain information system or process, regarding the given objectives. • Compare modern computer modeling tools as to their intent, options, features and application requirements for the development and studying of various information systems and processes. • Use the computer modeling tools to produce information systems and processes models, plan and perform experiments and carry out statistic analysis of the accuracy of the results.
Content	Decision process models in information systems. Decision process models. Searching strategies. Heuristic search. Planning. Purposeful systems. Fuzzy modeling and control principles. Fuzzy models development with the help of Fuzzy Logic (MATLAB). Using modeling methods for information systems and technologies development. Subject field ontological modeling. Ontology design languages, standards and tools. Semantics modeling in information systems. Agent-oriented approach to modeling. Agent-based intelligent distributed information systems. Evolution modeling. Genetic algorithms. Artificial life.
Mode of delivery	Lectures and labs - 4 h. per week, pre-laboratory work and individual project preparation - 112 h., exam. Total amount 216 h.

Evaluation	Grade, written exam - 40%, laboratory work assignments - 30%, individual project assignments - 30%
Study materials	• *E.K. Algazinov* Analysis and computer modeling of information processes and systems / E.K. Algazinov, AA Sirota. M. : Dialog MiFi 2009. • *S. Russell* Artificial intelligence. The modern approach: Lane. from English. / Stuart Russell and Peter Norvig. - 2nd ed. - M. Williams, 2006. • *G.F.Luger* Artificial Intelligence: Structures and strategies for complex problem solving - 4th ed. - M. Williams, 2003. • *L.A. Gladkov, V.V. Kureichik, V.M. Kureichik* Genetic Algorithms. - 2nd ed., Rev. and add. - Moscow: Fizmatlit, 2006. • *A.V. Leonenko* Fuzzy modeling with MATLAB and fuzzyTECH.-SPb.: BHV-Petersburg, 2003
Language	Russian, English
Prerequisits	Information processes and systems theory, the probability theory, algorithms and data structures, discrete mathematics, object-oriented programming

M.2.C.2	**Systems Engineering, 5 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 1st semester, quarters: 1-2
Teachers	Lecturer (s): Assoc. prof. S. Vlasov
Learning outcomes	As a result of this course the student should: • demonstrate understanding of systems thinking and systems approach in creating new or complex analysis of the existing system which is a product, a service, or a corporate organization. • develop projects of complex systems for various purposes and justify the choice of relevant hardware and software on the base of methods of systems analysis; • prepare requirements on the design of components of information systems and technology on the base of systems engineering methodology; • choose and put into practice computer-aided design tools; • unify and perform typing the design solutions;

Content	Introduction. system definition and systematic approach System dynamics as a method of systematic approach Modeling in systems engineering (MBSE) System lifecycle models Conceptual modeling and system requirements The standard description of the system architecture Systems modeling languages UML basics Fundamentals of SysML Design management systems Systems engineering products Systems engineering Services Systems engineering enterprise System of systems Systems engineering for software development Systems engineering project management Examples of application of systems engineering
Mode of delivery	Lectures and labs - 4 h. per week, pre-laboratory work and individual project preparation - 148 h., test. Total amount 180 h.
Evaluation	Passed/failed, written test - 30%, laboratory work assignments - 30%, individual project assignments - 40%
Study materials	• SEBOK Guide to the Systems Engineering Body of Knowledge (SEBoK), version 0.75, copyright 2012 by Stevens Institute of Technology. • *S.Friedenthal, A. Moore, and R. Steiner* A Practical Guide to SysML: The Systems Modeling Language. Morgan Kaufmann OMG Press. 2012. • *T.Weilkiens* Systems Engineering with SysML/UML: Modeling, Analysis, Design. Morgan Kaufmann Publishers, 2007.
Language	Russian, English
Prerequisits	Concepts of information systems design, programming

M.2.C.3.	**Seminar on IT in Engineering, 3 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 1st semester, quarters: 1-2 2st year, 1st semester, quarters: 1-2
Teachers	Lecturer (s): Assoc. prof. A.Sychev, Ph.D.

Learning outcomes	As a result of this course the student should: • prepare and give scientific presentations by using modern computer tools; • present the report on the obtained results orally in an understandable manner, observing general rules for scientific reporting; • demonstrate knowledge regarding the area of study and related professions from the discussion in the Seminars on IT in Engineering; • demonstrate capacity for research and abilities to search, process and analyze the information from a variety of sources; • show within class attending activity and through extended project work preparation and presentation the ability to work autonomously
Content	Orientation master students in the possible directions of research, pre-selection of the direction of research, selection and justification of the research topic, goal and objectives of the research, the rationale for the relevance of the topic chosen and the characteristic scale of the problem being studied, the choice of the object field. Formulating hypotheses of the study, the definition of a methodological approaches that will be used to run it. Discussion on state-of-art in the subject area of a thesis. Developed analytical review of literature on the topic of the dissertation research. Research tools, the interim results of scientific research or scientific and practical developments in the process of preparing a thesis.
Mode of delivery	Seminars - 1 h. per week, pre-seminar and presentations preparation - 76 h., test. Total amount 108 h.
Evaluation	Passed/failed, seminar work assignments – 30%, presentations - 70%
Study materials	Recommended by the professor of the major
Language	Russian, English
Prerequisits	Recommended M.Sc. course *M.1.V.3. Principles of Technical Computing, Scientific Presentations and Publishing*

M.2.V.1	**Systems analysis and computer simulation of complex systems, 3 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 1st semester, quarters: 1-2

Teachers	Lecturer (s): Prof. A.A. Sirota, D.Sc.
Learning outcomes	As a result of this course the student should: • Demonstrate their understanding of the basic principles of system approach and systems analysis methods providing sufficient theoretical description of the considered methods and examples of their application in the design of complex sictem; • Understand the role and place of the computer simulation methods and techniques for the design of complex systems, and formulate the basic theoretical backings of the methods, techniques and characteristics of their application; • Know the stages of the systems' computer models creation, the technologies applied for this and the standard simple mathematical and hybrid circuits used to construct system components models and their interaction in the form of block diagrams, diagrams and their standard descriptions; • Be aware of the capability and characteristics of modern tools of system computer modeling (Matlab + Simulink, Arena, GPSS, Powersim, etc.) in the form of practical solutions to the problems of analysis and synthesis of various application complex systems; • Demonstrate ability to create, design an experiment and test computer models of queuing systems, communication systems, and systems' conflict interaction through the construction of simulation models using the technologies of visual simulation in Matlab + Simulink + Stateflow.
Content	The systems methodology and systems analysis. Synthesis and analysis of information systems. Application of systems analysis and information technologies to the design of information systems. Computer simulation and systems schemes used in the modeling. The principles of simulation models construction and tools for it's software implementation. Queuing systems with variable structure modeling, communication systems modeling. Systems conflict research.
Mode of delivery	Lectures and laboratory works - 3 h. per week, pre-laboratory work preparation - 96 h., exam. Total amount 108 h.
Evaluation	Grade, exam in written - 40%, lab work assignments – 30%, individual project assignments - 30%
Study materials	• *E.K. Algazinov* Analysis and computer modeling of information processes and systems. M. : Dialog MiFi 2009. • *A.A. Sirota* Computer modeling and evaluation of complex systems. - M.: Technosphere, 2006.

	• *A.A.Barsegyan* Data and processes analysis - St.: BHV-PITER, 2009.
Language	Russian
Prerequisits	The theory of information processes and systems, probability theory, algorithms and data structures.

M.2.V.2	**Mathematical and computer-based image processing, 4 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 1st semester, quarters: 1-2
Teachers	Lecturer (s): Assoc. prof. V.V. Fertikov, Ph.D.
Learning outcomes	As a result of this course the student should: • demonstrate theoretical knowledge in the computer vision and mathematical apparatus for describing the continuous and digital image and transforming systems, using the discipline terminology; • demonstrate a detailed understanding of alternative ways to implement the algorithms in conducting their analysis in terms of computational complexity in the pre-treatment, quality improvement, restoration and segmentation of images; • be able to practically apply the knowledge in choosing the method of solving the problem in these specialized fields and the particular mode of its algorithmic implementation; • have the skills to work with one of the available tools in the areas of computer vision, sufficient for practical implementation of proven methods and algorithms.
Content	Approaches to the classification of methods, algorithms and systems for digital image processing. Stages of image processing computer vision system. Mathematical formalism for describing continuous images. The two-dimensional Fourier transform. Mathematical description of the systems for the conversion of continuous images. Linear and space-invariant systems. Fundamentals of colorimetry. Sampling and recovery. Quantization of images. Linear digital image processing. Generalized linear operator separability conversion. Composition operator. Convolution operator. Unitary transformations. Recursive filtering. Features of realization. Review of methods to reduce the noise level and noise in the image. Review of methods for improving the (subjective) quality images.

	Stages contour analysis in the problem of image segmentation. Review of the methods of image segmentation threshold. Review of the methods of region-oriented segmentation. Parallel recursive image processing techniques.
Mode of delivery	Lectures and labs - 3 h. per week, self-study, pre-laboratory work preparation - 96 h., test. Total amount 108 h.
Evaluation	Passed/failed, test in written - 30%, laboratory work assignments - 40%, individual project assignments - 30%
Study materials	• *M.Gashnikov* Methods of computer imaging. - Moscow: FIZMATLIT, 2003 • *R. Gonzalez* Digital Image Processing - M. Technosphere, 2005. • *V. Dyakonov* MATLAB 6.0/6.1/6.5/6.5 + SP1. SIMULINK 4/5. Signal and image processing - M.: SOLON-Press, 2005. • *B. Jan* Digital Image Processing - M. Technosphere, 2007.
Language	Russian
Prerequisits	Calculus, algebra, geometry

M.2.V.3	**Neural network technologies of information processing, 3 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 2nd semester, quarters: 3-4
Teachers	Lecturer (s): Prof. A.Sirota
Learning outcomes	As a result of this course the student should: • Demonstrate knowledge of the mathematical justifications of the possibility of using neural networks as a universal device for processing information on the basis of appropriate theorems, propositions; • Show the understanding of the basic principles of organization and use of neural networks of different classes in information-measuring and control systems by giving typical examples; • Know the reference architectures of neural networks of the most common classes (MLP, RBF, Hopfild, SOM, etc.) and the basic networks' learning algorithms (BP algorithm and its variants) in the form of structural diagrams, block diagrams and their standard descriptions; • Be able to solve practical problems arising while creating, training, and using neural networks of different classes with

	the help of standard techniques and algorithms of backing the network architecture, the choice of method and learning parameters, and formation of the training data; • To demonstrate the ability to create, train and test neural network of the given architecture in solving practical problems of information processing by constructing standard simulation models in the medium Neural Network Toolbox environment Matlab.
Content	The history of neural networks. Biological and artificial neuron. Classification of neural networks. Basic concepts and definitions. Unidirectional multilayer network. Practical challenges of building and training of multilayer perceptron type neural networks. Technology and examples of multilayer perceptron type networks. Neural networks with radial basis functions. Recurrent Neural Networks. Hopfield network. Self-organizing neural networks. Kohonen algorithm. Genetic algorithms processing.
Mode of delivery	Lectures and labs - 3 h. per week, self-study, pre-laboratory work preparation - 96 h., test. Total amount 144 h.
Evaluation	Passed/failed, test in written - 30%, laboratory work assignments - 40%, individual project assignments - 30%
Study materials	• *N.Yarushkina* Fundamentals of the theory of fuzzy and hybrid systems - Moscow: Finance and Statistics, 2004. • *S.Osovski* Neural networks for information processing. - Moscow: Finance and Statistics, 2002.
Language	Russian
Prerequisits	Calculus, algebra, probability theory, computer science basics

M.2.V.4	**Data Mining, 4 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	2st year, 1st semester, quarters: 1-2
Teachers	Lecturer (s): Ass. prof. A.V. Sychev, Ph.D.
Learning outcomes	As a result of this course the student should: • Demonstrate an understanding of purpose and architecture of data warehousing when implementing Data Mining techniques.

	• Demonstrate an understanding the basic concepts of multivariate data analysis and online analytical processing (OLAP) when processing real multi-dimensional data with Data Mining systems • Demonstrate the knowledge of common data mining techniques and algorithms, their applicability and the specific features when selecting relevant method for solving specific problems of data mining. • Practically use Data Mining tools (RapidMiner, Matlab and MS Analysis Serivces) for solving specific data mining problems. • To be able to apply the knowledge of visual data analysis (visual mining) to choosing a relevant form of multidimensional data representation (for preliminary analysis) and results data mining. • Demonstrate an understanding of the basic stages of the data mining process and it's organizational factors, as well as relevant standards, when designing or implementing data mining systems
Content	Introduction to Data Mining. Decision support systems and data warehouses. OLAP-systems. Data Mining Tasks and Algorithms: classification, clustering, association rules, visual mining. Data Mining Process structure. Data Mining Standards.
Mode of delivery	Lectures and labs - 3 h. per week, self-study, pre-laboratory work preparation - 93 h., exam. Total amount 144 h.
Evaluation	Grade, test in written - 30%, laboratory work assignments - 40%, individual project assignments - 30%
Study materials	• *A.A. Barsegyan*, etc. “Analysis Techniques: Data Mining, Visual Mining, Text Mining, OLAP”. - 2nd ed. - St. Petersburg: BHV-Petersburg, 2007. • *J. Macklen* Microsoft SQL Server 2008: Data Mining. - St.: BHV-Petersburg, 2009. • *H.Jiawei, M.Kamber, J.Pei* Data Mining. Concepts and Techniques. - 3rd ed. Elsevier, 2012.
Language	Russian, English
Prerequisits	Calculus, algebra, probability theory, computer science basics

M.2.V.5	Parallel and Distributed Programming, 4 ECTS
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	2st year, 1st semester, quarters: 1-2
Teachers	Lecturer (s): Prof. S.D. Kurgalin, D.Sc. Assistant (s): S.V. Borzunov, Ph.D.
Learning outcomes	As a result of this course the student should: • compare basic architectures of high-performance computers and computer networks; • demonstrate basic methods and means of parallel processing: algorithms parallel processing, means of representation, software parallel computing and their implementation; • compose programs in systems with shared and distributed memory with the using of OpenMP and MPI; • use basic functions for process management and implementation of interprocessor communication; • use principles of distributed computing with a Grid infrastructure, their purpose, functions, architectural characteristics for parallel tasks; • formulate and run compute jobs on a Grid.
Content	The basic architecture of high-performance computers and information networks, the methods and tools for parallel processing: parallel processing algorithms, ways of its representation, parallel computing software and its implementation, basic functions for process management and implementation of the IPC, the definition and basic principles of distributed Grid computing systems with infrastructure, its purpose, function and architecture features. Programming systems with shared and distributed memory using OpenMP and MPI; description and launching of computing tasks in the Grid infrastructure, solving of problems in the system and the Torque batch processing software, ARC NorduGrid. The main directions of development of high performance computing, distributed computing technology and data processing, the current implementation of Grid technologies in projects EGEE and NorduGrid.
Mode of delivery	Lectures and labs - 3 h. per week, pre-laboratory work presentation - 33 h., exam. Total amount 144 h.
Evaluation	Grade, test in written - 30%, laboratory work assignments - 40%, individual project assignments - 30%

Study materials	• *A.S. Antonov* Parallel programming using OpenMP technology. MSU Press, 2009. (in Russian) • *G. Andrews* Foundations of Multithreaded, Parallel, and Distributed Programming. Addison-Wesley, 2000.
Language	Russian, English
Prerequisits	Algorithms and data structures, discrete mathematics, computer architecture

M.2.V.6	**Information Security, 3 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 2nd semester, quarters: 3-4
Teachers	Lecturer (s): Assistant professor M.A. Dryuchenko, Ph.D.
Learning outcomes	As a result of this course the student should: • As a result of this course the student should: • Analyze different approaches to the solution of the problem of protecting copyright, confidentiality, authenticity and integrity of data processed in informational telecommunication systems • Be able to apply theoretical knowledge for modeling and using (in cryptographic applications) random variables with a given distribution in the form of a program code • Estimate a complexity of analysis for a cipher in a given context • Legally correct apply the methods of information security in government and commercial enterprises • Implement typical steganographic algorithms in the form of a program code • Practically use open source packages of information security
Content	Theoretical and practical aspects of information security. Problems of copyright protecting, confidentiality, authenticity and integrity of data processed in informational telecommunication systems. General requirements for the construction of a secure information system. Cryptographic methods of information protection. The concept of the modern mathematical methods used in cryptography. Symmetric and asymmetric cryptosystems. Usage of cryptographic methods for identification and authentication. Cryptanalysis. Random variables generation with a given distribution law. Steganographic methods for information protection. Digital

	watermarks. Principles of steganalysis. Methods for source and binary code protection. Cloud computing security.
Mode of delivery	Lectures and labs - 3 h. per week, self-study, pre-laboratory work preparation - 33 h., exam. Total amount 108 h.
Evaluation	Grade, test in written - 30%, laboratory work assignments - 40%, individual project assignments - 30%
Study material	• *A.Y. Scherbakov* Modern computer security. Theoretical framework. Practical aspects – M: Knizhnij mir, 2009. – • *G.F. Konahovich, A.Y. Puzyrenko* Computer steganography theory and practice – Kiev: MK-Press, 2006. • *P. Alfyorov, A.Yu.Zubov, A.C.Kuzmin , A. V. Cheremushkin* Cryptography bases — M. Helios of ARV, 2002. • *A. Malyuk* Information security: conceptual and methodological bases of information security. Studies. grant for higher education institutions. - M: Goryatchaya linya - Telecom, 2004. • *V.M. Fomichev* Methods of discrete mathematics in cryptology. - M.: Dialog-MIFI, 2010.
Language	Russian
Prerequisits	The students should have skills of programming, basic knowledge of algorithmization and basic knowledge in algebra, mathematical statistics, probability theory and digital signal processing

M.2.V.E.1.1	**Intranet Security Systems, 3 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 2nd semester, quarters: 3-4
Teachers	Lecturer (s): Senior teacher, A.S. Koval.
Learning outcomes	As a result of this course the student should: • Demonstrate an understanding of purpose and architecture of network security when implementing intranet security. • Demonstrate an understanding risk theory basic concepts in the intranet security design • Demonstrate the knowledge of common methods and techniques, their applicability and the specific features when selecting countermeasures against threats is a given specific intranet network.

	• Practically use security tools and solutions of popular client and server operating systems (MS Windows, GNU/Linux) for solving specific security problems of intranet networks. • To be able to design and implement data protection system based on common for popular operating systems data protection techniques (such as IPsec) to protect data in an intranet network with a specified configuration and content. • Demonstrate an understanding of the organizational factors, as well as national and international security standards, when designing and implementing data intranet security systems.
Content	Intranet: identifying risks, risk analysis, a system of counteraction to develop responses to possible violations of information security. IPv4, IPv6 networks and Ipsec technology. Virtual private networks. RADIUS. Network quarantine. A public key infrastructure. Multi-factor authentication. Smart card. Secure data storage and processing on the host OS. Security of network devices 2 and 3 levels. TACACS, RADIUS - solutions. The hardware implementation of IPSec, VPN. Hardware implementation of firewalls, IDS, IPS.
Mode of delivery	Lectures and labs - 3 h. per week, self-study, pre-laboratory work preparation - 60 h., test. Total amount 108 h.
Evaluation	Passed/failed, test in written - 30%, laboratory work assignments - 40%, individual project assignments - 30%
Study materials	• *S. Convery* Network Security Architectures. – USA : Cisco Press, 2004. • Cisco SAFE Reference Guide, http://www.cisco.com/go/safe
Language	Russian, English
Prerequisits	Computer science basics, computer networks

M.2.V.E.1.2	**Systems and networks of data communication, 3 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 2nd semester, quarters: 3-4
Teachers	Lecturer (s): Assoc.professor N.N.Vinokurova, Ph.D
Learning outcomes	As a result of this course the student should: • demonstrate the knowledge of the current state of systems and data communication networks when designing data

	communication systems; • demonstrate understanding of basic principles of technical equipment, devices, systems, data communication, processing, storage and distribution when designing data communication systems in developing data communication systems; • demonstrate skills in analysis and design of systems and networks of different purposes; • be able to assess the effectiveness of communications systems with different ways to separate the signals.
Content	General information about the radio communication systems (RTS). Signals and Noise in the RTS transmission. Complex signals. Simulation of signal and noise. RTS Digital transmission. Transmission and reception of digital data. Multi-channel and multicast systems. Synchronization in discrete communication systems. Prospective data acquisition system.
Mode of delivery	Lectures and labs - 3 h. per week, self-study, pre-laboratory work preparation - 60 h., test. Total amount 108 h.
Evaluation	Passed/failed, test in written - 30%, laboratory work assignments - 40%, individual project assignments - 30%
Study materials	• *V.I. Ivanov* Digital and analogue data communication systems. - M.: Goryachaya liniya -Telecom, 2005.
Language	Russian
Prerequisits	Probalitity theory, information theory and electronics basics

M.2.V.E.2.1	**Compilation Theory, 3 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 2nd semester, quarters: 3-4
Teachers	Lecturer (s): Assoc. prof. V.G. Khlebostroev, Ph.D.
Learning outcomes	As a result of this course the student should: • As a result of this course the student should: • demonstrate understanding of mathematical basics of programs translation when analysing program compilers • demonstrate the knowledge of compilers constructing

	principles when designing a compiler for a concise programming language • practically implement parsers, interpreters and translators
Content	Informal introduction to grammars. The basic structure of a translator. Tools for building parsers. Introduction to Antlr. Elements of language theory. LL (k)-grammars. LR (k)-grammars Code generation. Code optimization.
Mode of delivery	Lectures and labs - 2 h. per week, self-study, pre-laboratory work preparation - 76 h., test. Total amount 108 h.
Evaluation	Passed/failed, test in written - 30%, laboratory work assignments - 40%, individual project assignments - 30%
Study materials	• *A.Aho* Compilers: Principles, Technologies and Tools. - M.: Williams, 2001.
Language	Russian
Prerequisits	Programming basics, calculus and algebra

M.2.V.E.2.2	**Computing with Java and JavaScript, 3 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 2nd semester, quarters: 3-4
Teachers	Lecturer (s): Assoc. prof. S.Khoroshavin, Ph.D.
Learning outcomes	As a result of this course the student should: • be able to apply methods of programming for solutions of common math problems • be able to express mathematical structures with JavaScript and Java data structures for solving math problems
Content	General mathematical calculations. JavaScript. General mathematical calculations. Java. Calculations related to linear algebra. Calculations associated with ordinary differential equations. The use of computer animation in mathematical research.

Mode of delivery	Lectures and labs - 2 h. per week, self-study, pre-laboratory work preparation - 76 h., test. Total amount 108 h.
Evaluation	Passed/failed, test in written - 30%, laboratory work assignments - 40%, individual project assignments - 30%
Study materials	• *P. Wilton* JavaScript: programmer's guide. - Peter, 2009. • *B. Demidovich* Foundations of Computational Mathematics. - St. Petersburg. [Etc.]: Lan, 2006 • *B. Demidovich* Numerical methods of analysis. Approximation of functions, differential and integral equations. - St. Petersburg. [Etc.]: Lan, 2008.
Language	Russian
Prerequisits	Probalitity theory, information theory and electronics basics

M.2.V.E.3.1	**Multimedia systems, 4 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 2nd semester, quarters: 3-4
Teachers	Lecturer (s): Ass. prof. I.V. Illarionov, Ph.D.
Learning outcomes	As a result of this course the student should: • As a result of this course the student should: • be able to use basic multimedia library for software development • demonstrate knowledge of the basic principles and concepts underlying the multi-channel audio technology, the implementation of hardware and software applications • demonstrate familiarity with modern technology presentation of multimedia content in the development of Internet applications • know the principles of the description of semantics multimedia and be able to use relevant parts of the standard MPEG -7, 21 in projects aimed at the content recognition of multimedia • demonstrate knowledge of the structure and principles of multimedia servers and operating systems in solving design problems for network broadcast multimedia content

Content	Introduction. Simple tools of MM programming (for example Delphi environment). MM programming with the use of Media Control Interface (MCI). Low-level Programming with Windows: WAV format. Low-level Programming with Windows: MIDI format. Low-level Programming with Windows: AVI format. Low-level programming in Windows: codecs, mixers, timers, mmio *. Modern technologies of multi-channel audio, and their implementation and application. Software technology DirectX. The components of DirectX. OpenAL technology and OpenML in MM programming. MM programming in JAVA: Java Sound API, Java Media Framework, tools of Java. MM representation of the content in Internet: VRML, X3D. Standards of MM content description MPEG-7, MPEG-21. MM database: design, implementation. SQL / MM. MM servers and operating systems. MM synchronization problem. SMIL language.
Mode of delivery	Lectures and labs - 3 h. per week, self-study, pre-laboratory work preparation - 96 h., test. Total amount 144 h.
Evaluation	Passed/failed, test in written - 30%, laboratory work assignments - 40%, individual project assignments - 30%
Study materials	• *N. Sekunov* Sound Processing on PC - SPb.: BHV-Petersburg, 2001. • *H. Deitel, J. Deitel, T. Nieto* How to Program Interner and WWW - M.: Binom, 2002.
Language	Russian, English
Prerequisits	Programming, computer graphics

M.2.V.E.3.2	**Internet Applications developing, 4 ECTS**
Programme	IT in Systems Engineering (MSc. in *Information Systems and Technology*)
Year and period	1st year, 2nd semester, quarters: 3-4
Teachers	Lecturer (s): Ass. prof. I.V. Illarionov, Ph.D.
Learning outcomes	As a result of this course the student should: • demonstrate familiarity with the .NET platform and C# in the form of relevant programming skills; • demonstrate understanding ASP.NET and principles of

	ASP.NET applications developing in developing ASP.NET projects; • practical create Web-database applications; • demonstrate the knowledge of Web-services technology applying it in real software projects.
Content	Review of existing Internet technology. Microsoft.NET platform. Familiarity with C #. Overview of FCL. ASP.NET technology. Accessing Data in ASP.NET, ADO.NET. Creating a Web-ASP.NET applications. Development controls, filters ASP.NET. Introduction to web-services. Web-applications security problems.
Mode of delivery	Lectures and labs - 3 h. per week, self-study, pre-laboratory work preparation - 96 h., test. Total amount 144 h.
Evaluation	Passed/failed, test in written - 30%, laboratory work assignments - 40%, individual project assignments - 30%
Study materials	• *S.Wildermuth* Practical ADO.NET: Data Access in Internet. - M.: Williams, 2003. • *J.Prosise* Programming for Microsoft. NET.- Moscow: Russian edition, 2003. • *B.Hamilton* Professional ADO.NET. - St.Petersburg.: Piter, 2005.
Language	Russian
Prerequisits	Programming, HTML basics