TOMSK STATE UNIVERSITY

Master’s Degree Programme in Engineering

VERIFICATION AND TESTING OF HARDWARE/SOFTWARE COMPONENTS OF TELECOMMUNICATION SYSTEMS

Course Handbook

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| Master’s Degree Programme in EngineeringVERIFICATION AND TESTING OF HARDWARE/SOFTWARE COMPONENTS OF TELECOMMUNICATION SYSTEMS | semesters |
| 1 | 2 | 3 | 4 |
|  | credits[[1]](#footnote-1) | credits | credits | credits | credits |
| M 1 Disciplines | 60 |  |  |  |  |
| Compulsory courses | 51 |  |  |  |  |
| M 1.1. | History and Methodology of Technical Sciences | 3 |  |  | 3 |  |
| M 1.2 | Computer-aided Technologies | 5 |  | 2 | 3 |  |
| M 1.3 | Intellectual Property Rights Protection  | 2 | 2 |  |  |  |
| M 1.4 | English for Business Communication | 3 | 3 |  |  |  |
| M 1.5 | Modern Concepts of Natural Sciences | 2 |  |  | 2 |  |
| M 1.6 | High Level Languages in Software Engineering  | 5 | 5 |  |  |  |
| M 1.7 | Elements of Coding Theory | 4 | 4 |  |  |  |
| M 1.8 | Computer Systems Security | 4 | 4 |  |  |  |
| M 1.9 | Software Verification and Testing  | 4 |  | 4 |  |  |
| M 1.10 | Hardware Verification and Testing  | 4 |  | 4 |  |  |
| M 1.11 | Model Based Testing of Protocol Implementations | 4 | 4 |  |  |  |
|  |  |  |  |  |  |  |
| Optional courses[[2]](#footnote-2) | 20 |  |  |  |  |
| M 1.12 A | English for Computer Science | 4 |  | 4 |  |  |
| M 1.12 B | English for IT Professionals | 4 |  | 4 |  |  |
| M 1.13 A | System Analysis | 4 |  |  | 4 |  |
| M 1.13 B | Logics | 4 |  |  | 4 |  |
| M 1.14.A | Logical Background for Knowledge Bases | 4 |  |  | 4 |  |
| M 1.14 B | Logic Synthesis for Digital Circuits | 4 |  |  | 4 |  |
| M 1.15 A | Implementing Combinatorial Algorithms | 4 |  |  | 4 |  |
| M 1.15 B | Complexity of Combinatorial Problems and Algorithms | 4 |  |  | 4 |  |
| M 1.16 A | Software Implementations of Telecommunication Protocols | 4 |  |  | 4 |  |
| M 1.16 B | Simulation and Verification of Parallel and Distributed Systems | 4 |  |  | 4 |  |
| Extracurricular courses[[3]](#footnote-3) |  |  |  |  |  |
| FTD 1 | Passive Testing of Components of Telecommunication Systems | 4 |  |  | 4 |  |
| M 2 Practical Training and Research | 54 |  |  |  |  |
| M 2.1 | Project and Research Practice  | 30 | 8 | 12 | 10 |  |
| M 2.2 | Pre-graduate practice | 24 |  |  |  | 24 |
| M 3 Final State Attestation | 6 |  |  |  | 6 |
| M 3.1 | Preparation and Defence of Master Thesis  | 6 |  |  |  | 6 |
| Total |  | 120 | 30 | 30 | 30 | 30 |

Notes:

All courses are delivered face-to-face.

Level of all courses is Master.

Since the Master’s Programme is a consecutive one, some courses have a number of prerequisites for successful participation: students should refresh their knowledge of certain basic computer science disciplines and particular subjects studied at the bachelor’s level. If you are not familiar with indicated subjects, you can acquaint yourself by using the TSU library or attending appropriate classes given by TSU academic staff for bachelor’s students. It is not a formal restriction but a recommendation to ensure that all students complete the course.

Assessment method for examinations:

50-60% – satisfactory

60-80% – good

80-100% – excellent

Assessment method for ordinary credit tests:

0-49% – failed

50-100% – passed

List of abbreviations

cr credits

h hours

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| Course unit title | History and Methodology of Natural Sciences |
| course unit code | M 1.1  |
| type of course unit (compulsory, optional) | Compulsory |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 2nd |
| semester/trimester when the course unit is delivered | 1st semester |
| number of ECTS credits allocated  | 3 |
| Workload | In class: 36 hSelf-study: 72 h |
| name of lecturer(s) | Prof. Irrina Chernikova |
| learning outcomes of the course unit | Upon completion of the course, students are able to:* know and to adequately assess the philosophical, general scientific and specific research methods and techniques;
* adequately assess own skills of philosophical and methodological analysis and the skills to organize their own research and development activities;
* adequately apply the general scientific and philosophical concepts;
* appropriately use the acquired knowledge in the scientific and practical activities.
 |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  | Lectures, seminars, written essays, individual counseling |
| prerequisites and co-requisites  | Basic knowledge of courses ‘Philosophy’, ‘History of Russia’, ‘The world history’ is necessary |
| recommended optional programme components | verification principles of conceptual models and the own research outcomes as well as courses in related disciplines |
| course contents | 1. The Philosophy of the scientific cognition.
2. The evolution of ideas about the human cognitive activity.
3. Development of science in the Western culture.
4. Classical methodology of science, the structure of scientific knowledge, the science organization.
5. Interdisciplinary and transdisciplinary strategies.
6. Science in a Changing World: socio-technical system, systematic thinking, ethics of responsibility.
7. Actual cognition problems of modern science.
 |  | 2 |
| form of examination and assessment methods | Examination:Written tests and questionnaires – 10%Course essay – 30%Final presentation – 20%Written examination – 40% |  | 2 |
| recommended or required reading | 1. Горохов В.Г. Технические науки: история и теория история науки с философской точки зрения [монография] Москва: Логос 2012. 511 с.
2. Черникова И.В. Философия и история науки. Томск.: НТЛ. 2011. 370 с.
3. Черникова И.В. Структура научного знания. /Учебно-методическое пособие. Томск. 2013. 36 с.
4. Лекторский В.А. Философия. Познание. Культура. М.: Канон+.2012. 384 с.
5. Степин В.С. Саморазвивающиеся системы и постнеклассическая рациональность. <http://filosof.historic.ru/books/item/f00/s00/z0000249/index.shtml>
6. Степин В.С. История и философия науки. М.: Академический проект. 2014.- 424 с.
7. Будущее фундаментальной науки: концептуальные, философские и социальные аспекты проблемы. М., 2011. 288 с.
8. Багдасарьян Н.Г. Горохов В.Г. Газаретян А.П. История, философия и методология техники. М. Юрайт.2014.
9. Кузнецова Н.И. Розов М.А. Шрейдер Ю.А. Объект исследования – наука. М. Новый хронограф. 2012.
10. Электронная библиотека по философии: <http://filosof.historic.ru> Философия науки и техники.
 |  | 4 |
| language of instruction | Russian |  | 2 |
| work placement(s) | - |  | 4 |

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| Course unit title | Computer Aided Technologies |
| course unit code | M 1.2  |
| type of course unit (compulsory, optional) | Compulsory |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 1st, 2d |
| semester/trimester when the course unit is delivered | 2d , 3d |
| number of ECTS credits allocated  | 5 |
| Workload | In class: 72 hSelf-study: 108 h |
| name of lecturer(s) | Associate Professor. Vladimir Meshcheryakov |
| learning outcomes of the course unit | Upon completion of the course, students are able to:- use the basic elements of the Internet technologies;- apply modern hardware and software tools for automation scientific research and technological processes in the fields of digital media, testing of logic circuits, encoding and compressing the information;- program hardware resources for automated experimental facilities, measuring equipment and devices; - use computer technologies for visual programming;- use remote access technologies for supercomputers; - use computer technologies for preparation of publications, reports and presentations.  |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  | Lectures, practices, written test, essay presentation, individual counseling (incl. online) |
| prerequisites and co-requisites  | Basic knowledge of courses ‘Digital control units’’ and ‘Programming languages’ is necessary |
| recommended optional programme components | * Digital electronics
* Architecture of microprocessor system
 |
| course contents | 1. Internet technologies. 2. Technologies for text information processing.3. Technologies for graphic information processing.4. Technologies for multimedia processing5. Visual programming technologies.6. Systems for experimental data collecting and processing.7. Experimental study automation.8. Developing applications using LabVIEW for real and virtual devices.9. Computer cluster and supercomputer technologies. |
| form of examination and assessment methods | Examination:Written tests and questionnaires – 20%Final presentation – 30%Written examination – 50% |
| recommended or required reading | 1. Беляков Н.С., Палош В.Е., Садовский П.А. TEX для всех. Изд.2. – М.: ЛИБРОКОМ, 2012. - 208 с.2. Дж. Трэвис, Дж. Кринг. LabVIEW для всех.Изд 4. - М.: ДМК Пресс, 2011. -904с.3. Аладьев В.З., Бойко В.К., Ровба Е.А. Программирование в пакетах Maple и Mathematica: Сравнительный аспект. - Беларусь: Гродно, Гродненский государственный университет, 2011, 517 c.4. Джон Уокенбах. Excel 2010: профессиональное программирование на VBA. – М.: ДИАЛЕКТИКА, 2012. - 960 с.5. Морозов В.К. Моделирование информационных и динамических систем. – М.: ACADEMIA, 2011, 384 с.6. Смоленцев Н.К. MATLAB: Программирование на Visual C#, Borland C#, JBilder, VBA. - М.: ДМК Пресс; Спб.: Питер, 2011. - 464с.6. Сагман С. Microsoft Office 2003 для Windows.. – М.: ДМК Пресс, 2009. - 542 стр.7. Гома Х. UML. Проектирование систем реального времени, параллельных и распределенных приложений. - М.: ДМК Пресс, 2011. - 704с. |

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| language of instruction | Russian |
| work placement(s) | – |

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| Course unit title | Intellectual Property Rights Protection |
| course unit code | M 1.3  |
| type of course unit (compulsory, optional) | Compulsory |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 1st |
| semester/trimester when the course unit is delivered | 1st semester |
| number of ECTS credits allocated  | 4 |
| Workload | In class: 36 hSelf-study: 36 h |
| name of lecturer(s) | Prof. Victor Belichenko |
| learning outcomes of the course unit | The objectives of the course are to disclosure important role of intellectual property in accordance with the Civil Code of the Russian Federation. As a result of the discipline among students should have a solid understanding of purpose and social value of laws in intellectual property sphere. They must understand the critical role of intellectual property in the handling of the results of R & D of high technology products in the market, the role of the patent system and the right to a secret (know-how) in the development and protection of intellectual property rights; to purchase skills of patent information and applications for patents on the subject of patent rights. |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  | Lectures, seminars, written test, essay presentation, individual counseling (incl. online) |
| prerequisites and co-requisites  | Basic knowledge of course ‘Jurisprudence‘ is necessary |
| recommended optional programme components | Study courses in related disciplines, in particular, economic |
| course contents | 1. Intellectual property rights in the Russian Federation (the basic concepts and laws). International conventions and intergovernmental agreements in the field of intellectual property. Requirements for patentability and priority date of an invention. Application for an invention. The rights of authors and other holders. The protection of utility models and industrial designs.2. The patent documentation types. International Patent Classification (IPC). The patent search strategy in the patent databases. The technique reading, analysis and synthesis of the patent document content.3. The rules of drawing up an application for an invention. Description of the application. Types of the claims.4. Copyright. The main provisions of the legislation in the field of copyright. Subjects of copyright. Objects of copyright. Legitimate uses of copyrighted works.5. The main provisions. Owners of neighboring rights. Legitimate uses of objects of rights related to copyright.6. The main provisions of the protection of trademarks (service marks), appellations of origin, trade names, commercial designations.7. General issues of the confidential information protection. The concept of trade secrets (know-how), and particularly its protection. Ways to prevent information leakage.8. The computer programs and databases. Protecting the rights of the author and copyright holder. Violations of the rights. Free use.9. The principles of the integrated circuits protection. Basic definitions and object of protection. Subjects of the right to a topology.10. General information about the agreement on alienation of the exclusive right and license agreement on the subject of patent rights. The concept of the author's contract and order the author's contract. Basic requirements for the execution of contracts.11. Court for intellectual property rights. Responsibility of the Code of Administrative Offences. Liability established by the Civil and Criminal Code. Jurisdiction disputes (general provisions). Dispute Resolution. |
| form of examination and assessment methods | Examination:Written tests and questionnaires – 10%Course essay – 30%Final presentation – 20%Written examination – 40% |
| recommended or required reading | 1. Яковлев В.Ф., Маковский А.Л., Суханов Е.А. и др. Комментарий к части четвертой Гражданского кодекса РФ / Под ред. А.Л. Маковского; вступ. ст. В.Ф. Яковлева. М.: Статут, 2008, 715 с.
2. Иванов А.В. Патентование изобретений в России: анализ законодательства и советы изобретателям / А.В. Иванов, А.И. Алчинов., М.: ИНИЦ «ПАТЕНТ», 2010, 204 с.
3. Китайский В.Е. Патентование изобретений и полезных моделей: пособие для заявителей. М.: ИНИЦ «ПАТЕНТ», 2010, 214 с.
4. Оформление заявки на выдачу патента на полезную модель. Справочное пособие / А.Д. Ишков, А.В. Степанов; под ред. А.Д. Ишкова. М.: МГСУ, 2012, 48 с.
5. Близнец И.А., Леонтьев К.Б. Авторское право и смежные права. М.: Проспект, 2011, 416 с.
6. Защита программного обеспечения: Пер. с англ. Д. Гроувер, Р. Сатер, Дж. Фипс и др. / Под ред. Д. Гроувера. М.: Мир, 1992, 286 с.
7. Завгородний В.И. Комплексная защита информации в компьютерных системах. Учебное пособие. – М.: Логос, 2001, 264 с.
8. Охрана ноу-хау (справочно-методические материалы). Санкт-Петербург: Госкомитет РФ по высшему образованию, 1995, 67с.
 |
| language of instruction | Russian |
| work placement(s) | – |

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| Course unit title | English for Business Communication |
| course unit code | M 1.4 |
| type of course unit (compulsory, optional) | Compulsory |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 1st |
| semester/trimester when the course unit is delivered | 1st semester |
| number of ECTS credits allocated  | 3 |
| Workload | In class: 36 hSelf-study: 72 h |
| name of lecturer(s) | Senior lecturer Olga V. Kharapudchenko |
| learning outcomes of the course unit | Upon completion of the course, students are able to:In terms of knowledge and understanding:* to define special features of oral and written business communication in the English language;
* to understand particularities of the service in the English speaking countries;
* to understand particularities of the educational systems of English speaking countries;

In terms of accomplishments and competence;* to communicate effectively both orally and in writing in the business environment;
* to translate the written business texts from English into Russian;
* to develop cognitive and research skills using the resources of the English language;
* to understand a foreign speech in the academic and business environment;

In terms of attitudes and values* to discuss ethical questions related to business communication ;
* to comment on texts and presentations with business content;
 |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  |  Practical classes, essay presentation, individual counseling (incl. online), projects |
| prerequisites and co-requisites  | Basic knowledge of the course “English for Bachelors of Radiophysics” is necessary |
| recommended optional programme components | Read and Study various research papers and technical documentation  |
| course contents | 1. Comparing the systems of higher education in Russia and abroad. Applying for a degree course abroad: Master's programs. Different types of educational programs. The English language proficiency tests. Letters of request. Letters of inquiry.2. Job Hunting . Interview. Dos and DoN’Ts for job seekers. Skills and personal qualities of a successful engineer, scientist, businessman. Submitting a Resume. Letters of invitation. Career paths for Radiophysics department alumni.3. An international business trip. Business Etiquette. At a Passport and Customs Desk. Everyday life and service. 4. Organizing and conducting exhibitions and presentations. Preparing and delivering an effective presentation. Letters of thanks |
| form of examination and assessment methods | Examination:Course essay – 50%Final presentation – 40%Written examination – 10% |
| recommended or required reading |  1. Яшина Т.А., Жаткин Д.Н. . Английский язык для делового общения : Учебное пособие. – М. : Флинта, 2009. – 112 с.( <http://e.lanbook.com/books/element.php?pl1_id=2465>)2. Агабекян И.П. Деловой английский: Учебное пособие. – Ростов-на-Дону : Феникс, 2013. – 317с.3. Хомякова М.А*.* Английский язык. Деловая переписка . – М. : Живой язык, 2011. - [http://vital.lib.tsu.ru/vital/access/manager/Repository/vtls:000491127](http://vital.lib.tsu.ru/vital/access/manager/Repository/vtls%3A000491127)4. Артемова А.Ф., Леонович О.А*.* Английский язык для педагогов : Учебное пособие. – М. : Флинта, 2014. - 263с. (http://e.lanbook.com/books/element.php?pl1\_id=52001 )5. Jones L., . New International Business English: Communication skills in English for business purposes. – Cambridge University Press, 1996. – 176 p.6. *Cotton D., Falvey D., Kent S.* Market Leader: Intermediate business English. Course Book. – Pearson Education Limited, 2000. – 176 p. 7. *Barnard R., E Zemach D.* Writing for the Real World: An Introduction to Business Writing. – Oxford University Press, 2004. – 135 p.8. *Lougheed L.* Business Correspondence: Letters, Faxes, and Memos. – Addison-Wesly Publishing Company, Inc., 1993. -140 p. 9. *Богацкий И.С., Дюканова Н.М*.. Бизнес-курс английского языка: Словарь-справочник . – Киев: Логос, 1997. – 352 с. |
| language of instruction | English |
| work placement(s) | – |

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| Course unit title | Modern Problems of Technical Sciences |
| course unit code | M 1.5  |
| type of course unit (compulsory, optional) | Compulsory |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 2nd |
| semester/trimester when the course unit is delivered | 1st semester |
| number of ECTS credits allocated  | 3 |
| Workload | In class: 36 hSelf-study: 36 h |
| name of lecturer(s) | Prof. Boris Poizner |
| learning outcomes of the course unit | Upon completion of the course, students are able to:– understand the system of general concepts and main terms making conceptual base and working lexicon of modern physics as a necessary component of innovation activity in Master thesis;interaction points of physics and new synthesizing sciences in beginning XXI c.;directions of modern physics, their cognitive aspects, actual for radio-physics, photonics, and optoinformatics;– analyze levels of scientific knowledge, methodology and epistemology fundamentals of physical and mathematical sciences – with reference to radio-physics, photonics, and optoinformatics;– to evaluate critically boundaries of logic and physical models applicability in photonics and computer science, own and another's intellectual constructions in a science;– apply correct verbalization, substantial description, true generalization, logic modelling of observations, and sense interpretation of new phenomena in physical systems, and also unusual phenomena perception and own ideas generation in radio-physics, photonics, and optoinformatics;– develop reflexing mental procedures and verification means of models, outcomes, prognoses in the Master thesis;– prepare Master thesis according to its genre specifics. |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  | Lectures, seminars, written essay (interpretations of Master thesis), individual counseling |
| prerequisites and co-requisites  | Basic knowledge of courses ‘Electrodynamics’, ‘Solid state physics’, ‘Methods of mathematical physics’, and ‘Quantum mechanics’ is necessary |
| recommended optional programme components | verification principles of conceptual models and the own research outcomes as well as courses in related disciplines |
| course contents | 1. Preamble. Physics and the prophecy about the end of the science.2. The dialogue of physics and the nature: milestones and modern methodology of knowledge. 3. Cognitive principles in physics of XXI century. System view, complexity, evolution: new problems of knowledge. 4. Physics of evolution processes. A problem of time in modern physics.5. Physics and axiomatic theory of substantial bearers. 6. Physics as a driver of NBICS-technologies. Physics of nanoscale structures, processes, complex systems. 7. The unified theory paradigm in physics and its conflicts.8. Basic cognitive operation. Science ethical dimensions (E. Agacci). 9. Conclusions. New knowledge design in modern physics. |
| form of examination and assessment methods | Examination:Written essays and questionnaires – 30%Final presentation – 30%Written examination – 40% |
| recommended or required reading | 1. R. Dawkins The God Delusion. Lnd., Bantam Press, 2006.2. D. Deutsch. The Beginning of Infinity: Explanatations That Transform the World. Penguin Books Ltd., 2011.3. K.E. Drexler. Radical Abundance: How a Revolution in Nanotechnology Will Change Civilisation. NY, Public Affairs, 2013.4. Br.R. Green. The Fabric of the Cosmos: Space, Time, and Texture of Reality. N.Y., Alfred A. Knopf, 2004.5. Br.R. Green. The Hidden Reality: Parallel Unuverses and the Deep Laws of the Cosmos. N.Y., Alfred A. Knopf, 2011.6. M. Kaku. Physics of the Future: How Science Will Shape Human Destiny and Our Daily Lives by the Year 2100. NY, Lnd, Toronto, Sydney, Auckland, Doubleday Publ., 2011.7. M. Kaku. The Future of the Mind: The Scientific Quest to Understand, Enhance, and Empower the Mind. NY, Lnd, Toronto, Sydney, Auckland, Doubleday Publ., 2014.8. E.A. Sosnin, B.N. Poizner. From Non-existence to Being: Creativity as a Goal-seeking Activity. Tomsk: STТ Publ., 2011. (in Russian).9. E,A. Sosnin, A.V. Shuvalov, B.N. Poizner. The Leader and Management of System Life Cycle. – Tomsk: Tomsk State University Publ., 2013. (in Russian).10. E.A. Sosnin, B.N. Poizner. Meaningful Scientific Activity: for Author of Thesis about the Life of Knowledge in the Form of Scientific Propositions. Moscow: RIOR; INFRA-M Publ., 2015. (in Russian). |
| language of instruction | Russian |
| work placement(s) | – |

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| Course unit title | High level programming languages in software engineering  |
| course unit code | M 1.6  |
| type of course unit (compulsory, optional) | Compulsory |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 1st |
| semester/trimester when the course unit is delivered | 1st semester |
| number of ECTS credits allocated  | 5 |
| Workload | In class: 36 hSelf-study: 144 h |
| name of lecturer(s) | Prof. Nina YevtushenkoPhD Natalia Kushik |
| learning outcomes of the course unit | Upon completion of the course, students should be able to:- understand the basic methods and techniques of developing software using high level languages;- produce a software in a team, taking into account the project planning and the task distribution;- apply various methodologies and techniques for design and testing of programs written in high level language |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  | Lectures, labs, reports on labs, oral tests, individual counseling (incl. online) |
| prerequisites and co-requisites  | Basic knowledge of courses ‘C Programming’, ‘Programming methods’, ‘Information Systems’ and ‘Databases’ is necessary |
| recommended optional programme components | Other high level programming languages that are not covered upon this course |
| course contents  | 1. Introduction. Different types of software, including system software, application software, and programming tools. 2. Software development steps, in particular, analysis of software/project requirements, project resources, specification, architecture, and implementation of the project, verification and testing. 3. Software distribution and support. 4. Programming paradigms, including aspect-oriented programming, declarative programming, object-oriented programming, etc. 5. Discussion on making the choice when selecting languages, platforms and programming tools.6. Project management starting from the technical specification, planning and task distribution and finishing with software reclamation. 7. Individual/team projects for the development.  |
| form of examination and assessment methods | Examination:Oral tests and questionnaires – 20%Individual/team lab – 30%Report on the lab – 30%Final examination – 20% |
| recommended or required reading | 1. Б. Страуструп. Программирование. Принципы и практика использования C++. М: Вильямс. – 2011. – 1238 с. (и предыдущие издания) (Bjarne Stroustrup. Programming principles and practice using C++).2. Избачков Ю. С., Петров В. Н., Васильев А. А., Телина И. С. Информационные системы: Учебник для вузов. 3-е изд. — СПб.: Питер, 2011. — 544 с.3. Павловская Т. А. C/C++. Программирование на языке высокого уровня : для магистров и бакалавров : учебник для вузов по направлению подготовки дипломированных специа-листов «Информатика и вычислительная техника». — СПб.: Питер, 2014. — 460 с.4. Dos Reis G., Stroustrup B. Specifying C++ concepts. – Conference record of the 33rd ACM SIGPLAN-SIGACT symposium on Principles of programming languages (POPL '06). – ACM, 2006, – 295-308 pp. 5. Алексеев Е.Г., Богатырев С.Д. Информатика. Мультимедийный электронный учебник. http://inf.e-alekseev.ru/text/.6. **Project reports that are stored at the department of Information Systems.**7. http://ru.wikipedia.org/wiki/. |

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| language of instruction | Russian |
| work placement(s) | – |

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| Course unit title | Elements of Coding Theory |
| course unit code | M 1.7  |
| type of course unit (compulsory, optional) | Compulsory |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 1st |
| semester/trimester when the course unit is delivered | 1st semester |
| number of ECTS credits allocated  | 4 |
| Workload | In class: 36 hSelf-study: 108 h |
| name of lecturer(s) | Prof. Nina Yevtushenko |
| learning outcomes of the course unit | Upon completion of the course, students are able to:- understand the basic concepts and main methods of information encoding and compression including the main concepts of the theory of error correcting codes;- analyze advantages and disadvantages of different methods for information encoding and compression;- apply different approaches for information compression;- apply different approaches for reliable information transmission;- develop effective techniques for the information compression;- develop effective techniques for reliable information transmission |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  | Lectures, seminars, written test, essay presentation, individual counseling (incl. online) |
| prerequisites and co-requisites  | Basic knowledge of courses ‘Linear algebra’ and ‘Discrete mathematics’ is necessary |
| recommended optional programme components | Study of various protocols for information transmission as well as courses in related disciplines |
| course contents | 1. Alphabetic coding. Graphic representation, leter by letter coding, prefix codes, separable codes, necessary and sufficient conditions for the separable code existence. 2. Code features. Strong separable codes, recognizing the separability and strong separability, code completeness, automata based encoding and decoding. 3. Optimal codes. Fano, Shannon and Haffmen methods.4. Arithmetic compression. Effectiveness, techniques for arithmetic encoding and decoding. Comparing the effectiveness of different methods for information compressing. 5. Error correcting by linear codes. Linear codes, generation and checking matrices, necessary and sufficient conditions fort he code existence with the given code distance, standard distribution, linear code correcting possibilities.6. Case study. Hamming codes, Reed-Maller codes. 7. BCH codes. Cyclic codes, cyclic code avantages, cyclic codes with the given code distance. 8. Reed-Solomon codes. Deriving Reed-Solomon codes over Galois Field GF(2*k*), *k* > 1. 9. Tree codes. Error correcting by tree codes, linear tree codes, generation and checking matrices. 10. Convolutional codes. Hardware implementation of convolutional codes. 11. Arithmetic codes. Arithmetic distance, arithemtic error correcting codes, MN codes and their correcting possibilitie. . 12. Using error correcting codes for easily testable and self testing circuits, Berger and equilibrium codes for self testing circuits.  |
| form of examination and assessment methods | Examination:Written tests and questionnaires – 10%Course essay – 30%Final presentation – 20%Written examination – 40% |
| recommended or required reading | 1. У. Питерсон, Э. Уэлдон. Коды, исправляющие ошибки. М., Мир, 1976 (и предыдущие издания) (W.W. Peterson, E.J. Weldon. Error-Correcting Codes, Wilsey, 1972).2. В.М.Сидельников. Теория кодирования. М., Физматгиз, 2008.3. Морелос-Сарагоса Р. Искусство помехоустойчивого кодирования. Методы, алгоритмы, применение. М.: Техносфера, 2005.4. Соловьева Ф.И. Введение в теорию кодирования: Учебное пособие.. – Новосибирск: Новосибирский государственный университет, 2010. 5. Ф.А.Новиков. Дискретная математика для программистов. СПб (и другие), 2006.6. **Guang** Xuan, **Zhang** Zhen. Linear Network Error Correction Coding. Springer, 2014.7. Ruud Pellikaan, Xin-Wen Wu, Stanislav Bulygin, Relinde Jurrius. Error-correcting codes and cryptology. Cambridge University Press (the preliminary version published online January, 23, 2012). |
| language of instruction | Russian |
| work placement(s) | – |
| Course unit title | Computer Systems Security  |
| course unit code | M 1.8  |
| type of course unit (compulsory, optional) | Compulsory |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 1st |
| semester/trimester when the course unit is delivered | 1st semester |
| number of ECTS credits allocated  | 4 |
| Workload | In class: 36 hSelf-study: 108 h |
| name of lecturer(s) | PhD Svetlana Prokopenko |
| learning outcomes of the course unit | Upon completion of the course, students should be able to:- understand the most commonly used models for describing the behavior of modern computer systems;- know methods and technique for model based security checking of computer systems;- guarantee the security of a given computer system based on formal models  |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  | Lectures, seminars, written test, essay presentation, individual counseling |
| prerequisites and co-requisites  | Basic knowledge of courses ‘Informatics’, ‘Automata theory’ and ‘Information security’ is necessary |
| recommended optional programme components | Study of tools and techniques for providing the information security as well as related disciplines |
| course contents | 1. Backgrounds of the information security. Mathematical models in the domain of information security.2. Formal models of computer systems. Methods and techniques for deriving/extracting such models.3. Security policies in computer systems; various techniques to check these policies. |
| form of examination and assessment methods | Examination:Written tests and questionnaires – 10%Course essay – 30%Final presentation – 20%Written examination – 40% |
| recommended or required reading | 1. В.Ф. Шаньгин. Информационная безопасность компьютерных систем и сетей (учебное пособие). Москва : Форум, 2014, 415 с.2. В.А. Сердюк. Организация и технологии защиты информации: обнаружение и предотвращение информационных атак в автоматизированных системах предприятий (учебное пособие). Москва : Государственный университет – Высшая школа экономики, 2011, 571с.3. П.Н. Девянин. Анализ безопасности управления доступом и информационными потоками в компьютерных системах. Москва : Радио и связь , 2006, 175 с.4. Б. Шнайер. Секреты и ложь. Безопасность данных в цифровом мире. СПб. Питер, 2003. 5.http://citeseer.ist.psu.edu/viewdoc/download?doi=10.1.1.99.2838&rep=rep1&type=pdf |
| language of instruction | Russian |
| work placement(s) | – |

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| Course unit title | Software Verification and Testing |
| course unit code | M 1.9  |
| type of course unit (compulsory, optional) | Compulsory |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 1st |
| semester/trimester when the course unit is delivered | 2nd semester |
| number of ECTS credits allocated | 4 |
| Workload | In class: 36 hSelf-study: 108 h |
| name of lecturer(s) | PhD Maxim Gromov |
| learning outcomes of the course unit | Upon completion of the course, students:* should know basic steps of software lifecycle;
* should know basic methods of software verification and testing;
* should be able to test and verify software;
* should be to develop a formal model for a system under investigation;
* should be able to use tools for software testing and verification.
 |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods | Lectures, labs, written test, project presentation |
| prerequisites and co-requisites | “Automata theory”, “Algorithms and programming languages”, “Discrete mathematics”,  |
| recommended optional program components | “Algebra”, “Informatics” |
| course contents | 1. Software lifecycle.
2. Software Verification.
3. BLAST and SPIN software tools.
4. Types of Software Testing.
* Random Testing.
* Bounded Analysis.
* Code Covering.
1. Unreachable Code Problem.
2. Model Based Testing.
3. Tools for Software Testing (xUnit, UniTESK, TorX, FSMTesting1.0).
 |
| form of examination and assessment methods | Examination:Written tests and questionnaires – 10%Project defense – 50%Written examination – 40% |
| recommended or required reading | 1. Wagner, F., "Modeling Software with Finite State Machines: A Practical Approach", Auerbach Publications, 2006.
2. Журнал «Программирование» – М.: МАИК, 1998 – 2015.
3. И.Б. Бурдонов, А.С. Косачёв, В.В. Кулямин Теория соответствия для систем с блокировками и разрушениями. – М.: ФИЗМАТЛИТ, 2008.
4. Glenford J. Myers, Tom Badget, Corey Sandler. The Art of Software Testing. The 3d edition. John Wiley & Sons, 2012.
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| language of instruction | Russian |
| work placement(s) | – |

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| Course unit title | Hardware Verification and Testing  |
| course unit code | M 1.10  |
| type of course unit (compulsory, optional) | Compulsory |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 1st |
| semester/trimester when the course unit is delivered | 2nd semester |
| number of ECTS credits allocated | 4 |
| Workload | In class: 36 hSelf-study: 108 h |
| name of lecturer(s) | PhD Maxim Gromov |
| learning outcomes of the course unit | Upon completion of the course, students* should know basic phases of digital circuit design;
* should know methods of testing and verification of digital circuit;
* should be able to use software tools for digital circuit verification and testing.
 |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods | Lectures, labs, written test, project defense |
| prerequisites and co-requisites | “Discrete mathematics”, “Automata Theory” |
| recommended optional program components | “Mathematical Logic” |
| course contents | 1. Combinatorial and Sequential (logical) Circuits.
2. Structural Methods of Test Generation for Combinatorial Circuits.
3. Testing Sequential Circuits.
4. Verification and Testing of logical circuits designed using FPGA technology.
5. Easy-testable and self-checking circuits’ design.
6. Modeling digital circuits.
 |
| form of examination and assessment methods | Examination:Written tests and questionnaires – 10%Project defense – 50%Written examination – 40% |
| recommended or required reading | 1. Бибило П.Н., Романов В.И. Логическое проектирование дискретных устройств // Минск: Беларуская навука, 2011. – 279 с.
2. Логические основы проектирования дискретных устройств / А.Д. Закревский, Ю.В. Поттосин, Л.Д. Черемисинова. – Москва: Физматлит, 2007. – 589 с.
3. J. H. R. Jiang, R. K. Brayton. On the verification of sequential equivalence. V. 22(6), June 2003, pp. 686-697.
4. http://www.eecs.berkeley.edu/~alanmi/abc/
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| language of instruction | Russian |
| work placement(s) | – |

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| Course unit title | Model-based Testing of Protocol Implementations |
| course unit code | M 1.11  |
| type of course unit (compulsory, optional) | Compulsory |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 1st |
| semester/trimester when the course unit is delivered | 1st semester |
| number of ECTS credits allocated  | 4 |
| Workload | In class: 36 hSelf-study: 108 h |
| name of lecturer(s) | PhD (dozent) Natalia Shabaldina |
| learning outcomes of the course unit | Upon completion of the course, students should be able to: - understand finite transition systems that are used for describing the protocol behavior (Finite State Machines (FSMs) and automata, extended FSMs, timed FSMs, Input-Output automata); - know the main test suite derivation methods base on these models;- describe a given application-level protocol by a finite transition system; - derive FSM based test suites and locate soma FSM faults |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  | Lectures, labs, written test, essay presentation, individual counseling (incl. online) |
| prerequisites and co-requisites  | Basic knowledge of courses ‘Discrete mathematics’, ‘Automata/FSM theory’, ‘Internet-programming’ and the basic system administrator skills are necessary |
| recommended optional programme components | Study of various sofware tools for testing protocol implementations |
| course contents | 1. Telecommunication protocols. Basic steps of developing telecommunication protocols.
2. Finite transition systems (FSMs and automata, extended FSMs, timed FSMs, Input-Output automata). Composition of the above models.
3. Test suite derivation methods for finite transition systems.
4. Conformance testing of software protocol implementations.
5. Interoperability testing of software protocol implementations.
6. Deriving model-based test suites for the real protocols (SCP, IRC, TFTP, etc).

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| form of examination and assessment methods | Examination:Written tests and questionnaires – 10%Course essay – 30%Final presentation – 20%Written examination – 40% |
| recommended or required reading | 1. Евтушенко Н.В., Петренко А.Ф., Ветрова М.В. Недетерминированные автоматы: анализ и синтез. Часть 1. Отношения и операции: учебное пособие.– Томск: ТГУ, 2006. - 142 с.3. В.В. Кулямин. Технологии программирования. Компонентный подход. М.: Интернет-университет информационных технологий - БИНОМ. Лаборатория знаний, 2007. http://www.ispras.ru/~kuliamin/lectures-sdt/Lecture01.pdf.4. И.Б. Бурдонов, А.С. Косачев, В.В. Кулямин. Теория соответствия для систем с блокировками и разрушениями. М.: ФИЗМАТЛИТ, 2008. – 412 с.5. *Chow T. S.* Testing software Design Modelled by Finite State Machines / T. S. Chow // IEEE Trans. Software Eng., vol. 4, no. 3, 1978. P. 178-187.6. Dorofeeva, R., El-Fakih, K., Maag, S., Cavalli, A. R., Yevtushenko, N.: FSM-based con-formance testing methods: a survey annotated with experimental evaluation. Information and Software Technology, 52, pp. 1286-1297, Elsevier (2010)7. Rose M. Post Office Protocol - Version 3. RFC 1460, June 1993. URL: http://www.faqs.org/rfcs/rfc1460.html. |

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| language of instruction | Russian |
| work placement(s) | – |

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| Course unit title | English for Computer Science  |
| course unit code | 1.12 A |
| type of course unit (compulsory, optional) | Optional |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 1st |
| semester/trimester when the course unit is delivered | 2 d semester |
| number of ECTS credits allocated  | 4 |
| Workload | In class: 36 hSelf-study: 108 h |
| name of lecturer(s) | Senior lecturer Olga V. Kharapudchenko |
| learning outcomes of the course unit | Upon completion of the course, students are able to:In terms of knowledge and understanding:* to define specific features of oral scientific discourse;
* to define specific features of written scientific discourse;
* to reproduce thesaurus used in the texts related to the specialty;
* to understand the rules of making reviews of scientific literature and writing abstracts/ papers;

In terms of accomplishments and competence* to communicate effectively both orally and in writing in the professional environment;
* to make scientific reports at international conferences, round table discussions, public discussions
* to translate the written scientific texts from English into Russian ;
* to develop cognitive and research skills using the resources of the English language;
* to write and present research results in the form of abstracts, reviews, papers in English
* to write and present technical texts (technical documents, research reports, patents);
* to understand a foreign speech in the academic and professional environment;
* to use lexical, stylistic and genre resources to create foreign language oral and written discourse;
* to apply reading strategies dealing with scientific and technical texts

In terms of attitudes and values* to discuss ethical questions related to innovation, information technology, etc;
* to discuss the development of modern technologies;
* to comment on texts and presentations with scientific and technical content;
* to interpret and explain scientific data
 |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  |  Practical classes, essay presentation, individual counseling (incl. online), projects |
| prerequisites and co-requisites  | Basic knowledge of the courses «English for Bachelors in Radiophysics» and «English for Business Communication» is necessary |
| recommended optional programme components | Read and study various research papers and technical documentation  |
| course contents | 1. Innovations: history of innovation; the aim of innovation; the sources of innovation; the development of modern technologies. Making a review of research papers.2. Computer science. . Relationship of computer science with other sciences, history of development of computer science; the role of mathematics in computer science, practical aspects of computer science, current state and prospects for development of computer science in Russia and abroad Writing abstracts of the scientific texts related to the specialty. 3. My Research Field. A goal and objectives of Master thesis. The procedure of research. Written and oral presentation of research results in the English language.  |
| form of examination and assessment methods | Examination:Course essay – 30%Final presentation – 40%Written examination – 30% |
| recommended or required reading |  1. Милеева М.Н. Innovations and Inventions : учебное пособие. – М.: Флинта 2013, 122 с. http://e.lanbook.com/view/book/20283/
2. Гуриков С.Р. Информатика: учебник для студентов образовательных учреждений высшего образования. – М.: Форум 2014, 460 с.
3. Бобылева С.В.,Жаткин Д.Н. Английский язык для сферы информационных технологий и сервиса : учебное пособие. - М.: Флинта 2014, 246 с <http://e.lanbook.com/view/book/62952/>
4. J. Glenn Brookshear. Computer Science: An Overview, 11/E – Pearson education, 2012. – 624 p.
5. Andrian Wallwork. English for Writing Research Papers: manual.- New York.: Springer Science+Business Media 2011, 324p.
6. Миньяр-Белоручева А.П Учимся писать по-английски : Письменная научная речь : учебное пособие.- М.: Флинта : Наука 2011, 128 с <http://e.lanbook.com/view/book/3369/>
7. Миньяр-Белоручева А.П Англо-русские обороты научной речи : методическое пособие - М.: Флинта 2012, 144 с <http://e.lanbook.com/view/book/3371/>
8. Шахова Н.И. Learn to read science : учебное пособие.- М.: Флинта 2014, 360 с <http://e.lanbook.com/view/book/51863/>
9. Сафроненко О.И., Макарова Ж.И., Малащенко М.В. Английский язык для магистрантов естественных факультетов университетов. – М.: Высшая школа, 2005.- 173 с.
10. Курашвили Е.И. Английский язык: Пособие по чтению и устной речи для технических вузов. – М, 2003. – 380 c.
11. Харапудченко О.В., Кочеткова Т.Д. Инфинитив: Учебно-методическое пособиe. - Томск, ТГУ, 2005. – 34 c.
12. Харапудченко О.В., Кочеткова Т.Д. Причастие: Учебно-методическое пособие. - Томск, ТГУ, 2006. – 30 с.
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| language of instruction | English |
| work placement(s) | – |

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| Course unit title | English for IT Professionals |
| course unit code | 1.12 B |
| type of course unit (compulsory, optional) | Optional |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 1st |
| semester/trimester when the course unit is delivered | 2 d semester |
| number of ECTS credits allocated  | 4 |
| Workload | In class: 36 hSelf-study: 108 h |
| name of lecturer(s) | Senior lecturer Olga V. Kharapudchenko |
| learning outcomes of the course unit | Upon completion of the course, students are able to:In terms of knowledge and understanding:* to define specific features of oral scientific discourse;
* to define specific features of written scientific discourse;
* to reproduce thesaurus used in the texts related to the specialty;
* to understand the rules of making reviews of scientific literature and writing abstracts, papers;

In terms of accomplishments and competence* to communicate effectively both orally and in writing in a professional environment;
* to make scientific reports at international conferences, round table discussions, public discussions
* to translate the written scientific texts from English into Russian;
* to develop cognitive and research skills using the resources of the English language;
* to write and present research results in the form of annotations, abstracts, reviews, papers in English
* to write and present technical texts (technical documents, research reports, patents);
* to understand a foreign speech in the academic and professional environment;
* to use lexical, stylistic and genre resources to create foreign language oral and written discourse;
* to apply reading strategies dealing with scientific and technical texts

In terms of attitudes and values* to discuss ethical questions related to innovation, information technology, etc;
* to discuss the development of modern technologies;
* to comment on texts and presentations with scientific and technical content;
* to interpret and explain scientific data
 |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  |  Practical classes, essay presentation, individual counseling (incl. online), projects |
| prerequisites and co-requisites  | Basic knowledge of the course ‘English for Bachelors in Radiophysics’ is necessary |
| recommended optional programme components | Read and Study various research papers and technical documentation  |
| course contents | 1. Innovations: history of innovation; the aim of innovation; the sources of innovation; the development of modern technologies. Making a review research.2. Information technology. Relationship of information technology with other sciences, history of development of information technology; the impact of the Internet on the development of society. Writing abstracts of the scientific texts related to the specialty. 3. My Research Field. A goal and objectives of Master thesis. The procedure of research. Written and oral presentation of research results in the English language.  |
| form of examination and assessment methods | Examination:Course essay – 30%Final presentation – 40%Written examination – 30% |
| recommended or required reading | * 1. Милеева М.Н. Innovations and Inventions : учебное пособие. – М.: Флинта 2013, 122 с. <http://e.lanbook.com/view/book/20283/>
	2. J. Glenn Brookshear. Computer Science: An Overview, 11/E – Pearson education, 2012. – 624 p.
	3. Гуриков С.Р. Информатика: учебник для студентов образовательных учреждений высшего образования. – М.: Форум 2014, 460 с.
	4. Бобылева С.В.,Жаткин Д.Н. Английский язык для сферы информационных технологий и сервиса : учебное пособие. - М.: Флинта 2014, 246 с http://e.lanbook.com/view/book/62952/
	5. Andrian Wallwork. English for Writing Research Papers: manual.- New York.: Springer Science+Business Media 2011, 324p. Миньяр-Белоручева А.П Учимся писать по-английски : Письменная научная речь : учебное пособие.- М.: Флинта : Наука 2011, 128 с <http://e.lanbook.com/view/book/3369/>
	6. Миньяр-Белоручева А.П Англо-русские обороты научной речи : методическое пособие - М.: Флинта 2012, 144 с <http://e.lanbook.com/view/book/3371/>
	7. Шахова Н.И. Learn to read science : учебное пособие.- М.: Флинта 2014, 360 с <http://e.lanbook.com/view/book/51863/>
	8. Сафроненко О.И., Макарова Ж.И., Малащенко М.В. Английский язык для магистрантов естественных факультетов университетов. – М.: Высшая школа, 2005.- 173 с.
	9. Курашвили Е.И. Английский язык: Пособие по чтению и устной речи для технических вузов. – М, 2003. – 380 с.
	10. Харапудченко О.В., Кочеткова Т.Д. Инфинитив: Учебно-методическое пособие- Томск, ТГУ, 2005. – 34 c.
	11. Харапудченко О.В., Кочеткова Т.Д. Причастие: Учебно-методическое пособие. - Томск, ТГУ, 2006. – 30 c.
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| language of instruction | English |
| work placement(s) | – |

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| Course unit title | System analysis |
| course unit code | M 1.13 A  |
| type of course unit (compulsory, optional) | Optional |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 1st |
| semester/trimester when the course unit is delivered | 2st semester |
| number of ECTS credits allocated  | 4 |
| Workload | In class: 36 hSelf-study: 108 h |
| name of lecturer(s) | Prof. Nina YevtushenkoPhD Natalia Kushik |
| learning outcomes of the course unit | Upon completion of the course, students should be able to:- know basic notions regarding system analysis, including systems, models, management engines, etc.;- perform analytical activities receiving the surroundings as a “World of systems”;- apply system analytic skills for solving problems in various domains |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  | Lectures, seminars, oral tests, individual counseling (incl. online) |
| prerequisites and co-requisites  | The course is interdisciplinary and does not require any specific knowledge to follow |
| recommended optional programme components | Study of various management techniques applied to real case studies for telecommunication companies |
| course contents ?-why plural? | 1. Introduction to the course. System analysis as a science. 2. The notion of a system. Descriptive definition. 3. System properties. 4. Methods and models of the systems theory. 5. Scales for system modelling.6. Management background.7. Investigating the system: methods and techniques applied in systems theory. 8. Analysis and synthesis of control systems.  |
| form of examination and assessment methods | Examination:Oral tests and questionnaires – 20%Presentations during the seminars – 40%Written examination – 40% |
| recommended or required reading | 1. Б Ф.П. Тарасенко. Прикладной системный анализ: учебное пособие. – М.КНОРУС, 2010. – 224 с.2. Теория систем и системный анализ: учеб. пособие / В.Н. Чернышов, А.В. Чернышов. – Тамбов: Изд-во Тамб. гос. техн. ун-та, 2008. – 96 с. – 150 экз. – ISBN 978-5-8265-0766-7.3. М.Л. Калужский. Общая теория систем: учебное пособие. – Омский государственный технический университет, 2001. – 177 с.4. English The Free Encyclopediahttp://ru.wikipedia.org/wiki/ |

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| language of instruction | Russian |
| work placement(s) | – |

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| Course unit title | Logics |
| course unit code | M 1.13 B  |
| type of course unit (compulsory, optional) | Compulsory |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 1st |
| semester/trimester when the course unit is delivered | 2d semester |
| number of ECTS credits allocated  | 4 |
| Workload | In class: 36 hSelf-study: 108 h |
| name of lecturer(s) | Prof. Nina Yevtushenko |
| learning outcomes of the course unit | Upon completion of the course, students should be able to:- understand the logical form of cognitive activity and its identification, correct and incorrect conclusions; logical rules and laws;- know the fundamentals of propositional and predicate logic; the initial concepts of the algorithm theory;- construct and justify the validity of logical reasoning; - formulate and justify hypothesizes.  |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  | Lectures, seminars, written test, individual counseling (incl. online) |
| prerequisites and co-requisites  | Basic knowledge of courses ‘Algebra’ and ‘Boolean algebra’ is necessary |
| recommended optional programme components | Study of different logics |
| course contents | 1. Introduction. Logic and reasoning. The methods and principles of cognitive activity. True and false judgments. Correct and incorrect conclusions. Logical laws.
2. Logic and language. The meaning and significance of linguistic expressions. Language as a system of signs and symbols. Functions of language. Natural and artificial languages.
3. The structure of simple propositions; compound propositions. The negation of simple and compound propositions.
4. Mathematical logic: Propositional logic. The history of the mathematical logic. Logical paradoxes. The formulae of the propositional logic and their interpretation, universally valid, feasible and unrealistic formulae. Resolution method.
5. Predicate logic. Limitations of propositional logic, predicates. Universally valid, feasible and unrealistic formulae. Resolution method in the predicate logic, deduction problem solving.
6. Axiomatic systems. Definition and properties of axiomatic systems. Application areas of axiomatic systems. Axiomatic systems with Modus Ponens. The first order theories.
7. Background of the algorithm theory. Informal definition of the algorithm, termination of the algorithm, the complexity problems, intractable problems. Algorithmically solvable and unsolvable problems, examples of algorithmically unsolvable problems.
 |
| form of examination and assessment methods | Examination:Written tests and questionnaires – 20%Final presentation – 60%Written examination – 20% |
| recommended or required reading | 1. Гетманова А.Д. Логика. М., Омега-Л, 2010.2. Клини С.К. Математическая логика. М.: Едиториал УРСС, 2005, 2007.3. Гуц А.К. Математическая логика и теория алгоритмов. М.: ЛИБРООМ, 2009.4. Brown, Frank Markham (2003), *Boolean Reasoning: The Logic of Boolean Equations*, 1st edition, Kluwer Academic Publishers, Norwell, MA. 2nd edition, Dover Publications, Mineola, NY.5. Hurley, Patrick (2014). *A Concise Introduction to Logic 12th edition*. Wadsworth Publishing. p. 392. |

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| language of instruction | Russian |
| work placement(s) | – |

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| Course unit title | Logical Background of Knowledge Bases |
| course unit code | M 1.14 A  |
| type of course unit (compulsory, optional) | Optional |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 2st |
| semester/trimester when the course unit is delivered | 3st semester |
| number of ECTS credits allocated  | 4 |
| Workload | In class: 36 hSelf-study: 108 h |
| name of lecturer(s) | PhD (dozent) Svetlana Prokopenko |
| learning outcomes of the course unit | Upon completion of the course, students should be able to:- understand the logical models for knowledge representation;- optimize and develop knowledge bases. |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  | Lectures, seminars, written test, essay presentation, individual counseling (incl. online) |
| prerequisites and co-requisites  | Basic knowledge of courses ‘Mathematical analysis’, ‘Informatics’, ‘Logics’, ‘Data Bases’ and ‘Discrete mathematics’ is necessary |
| recommended optional programme components | Study of various languages of knowledge base programing as well as related disciplines |
| course contents | 1. The main concepts of Propositional and Predicate logics. 2. Axiomatic systems. 3. Analysis of reasonings.4. Knowledge representation: Propostions, Predicates, Semantical networks, Frames. Deduction rules for various knowledge representations. 5. Developing knowledge bases: Examples, Requirements to knowledge bases. 6. Studying the ‘PROLOG‘ language. |
| form of examination and assessment methods | Examination:Written tests and questionnaires – 15%Course essay – 25%Final presentation – 20%Written examination – 40% |
| recommended or required reading | 1. И.Д. Сидоркина. Системы искусственного интеллекта (учебное пособие). Москва : Кнорус , 2011, 245 с.2. В.А. Каймин. Информатика. Москва : ИНФРА-М, 2014, 283 с.3. Г.Б. Евгенев. Интеллектуальные системы проектирования (учебное пособие). Москва : Изд-во МГТУ им. Н.Э. Баумана, 2012, 410 с.4. Г.С. Осипов. Методы искусственного интеллекта. Москва : Физматлит , 2011, 295 с.5. Язык программирования ПРОЛОГ. http://progopedia.ru/language/prolog/6. www.aaai.org/ocs/index.php/AAAI/AAAI11/paper/viewFile/3659/3898 |
| language of instruction | Russian |
| work placement(s) | – |

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| Course unit title | Logic Synthesis for Digital Circuits |
| course unit code | M 1.14 B  |
| type of course unit (compulsory, optional) | Optional |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 2nd |
| semester/trimester when the course unit is delivered | 3rd semester |
| number of ECTS credits allocated  | 4 |
| Workload | In class: 36 hSelf-study: 108 h |
| name of lecturer(s) | Prof. Nina YevtushenkoPhD Stanislav Torgaev |
| learning outcomes of the course unit | Upon completion of the course, students should be able to:- understand the basic methods and techniques of logic synthesis applied to a design of digital circuits;- apply mathematical methods and techniques for logic synthesis and verification;- utilize modern software tools for logic synthesis, simulation and verification |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  | Lectures, labs, reports on labs, oral tests, individual counseling (incl. online) |
| prerequisites and co-requisites  | Basic knowledge of courses ‘Discrete Mathematics’, ‘Automata Theory’, together with the background on high level programming languages are necessary |
| recommended optional programme components | Study of various high hardware description languages and tools for effective synthesis and verification that are not covered along the course |
| course contents ?-why plural? | 1. Introduction to the course, motivation and objectives. 2. Development steps for digital circuits and digital devices. 3. Logic synthesis for digital circuits’ design. 4. Various ways, options and means for describing the behavior of logic networks. 5. Hardware description languages (HDL). HDL ‘Verilog’. 6. Logic synthesis methods and techniques. 7. Logic synthesis using Verilog language.8. Methods and techniques for logic circuit optimization.9. Verification of logic networks. Simulation using hardware implementations of logic circuits. |
| form of examination and assessment methods | Examination:Oral tests and questionnaires – 20%Individual/team lab – 30%Report on the lab – 30%Written examination – 20% |
| recommended or required reading | 1. Логические основы проектирования дискретных устройств / А.Д. Закревский, Ю.В. Поттосин, Л.Д. Черемисинова. – Москва: Физматлит, 2007. – 589 с.2. Основы языка VHDL / П.Н. Бибило. – СОЛОН-Р, 2002. – 224 с.3. Official Website oft he ABC tool http://www.eecs.berkeley.edu/~alanmi/abc/ 4. Proceedings of the international conferences ICCAD, CAD DD, IWLS и DATE. |

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| language of instruction | Russian |
| work placement(s) | – |

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| Course unit title | Implementing Combinatorial Algorithms |
| course unit code | M 1.15 A |
| type of course unit (compulsory, optional) | Optional |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 2nd |
| semester/trimester when the course unit is delivered | 1st semester |
| number of ECTS credits allocated  | 4 |
| Workload | In class: 36 hSelf-study: 108 h |
| name of lecturer(s) | PhD Maxim Gromov |
| learning outcomes of the course unit | Upon completion of the course, students should be able to:* develop and implement precise and approximate algorithms for a given combinatorial problem;
* evaluate the complexity of a developed algorithm.
 |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  | Lectures, labs, project execution and presentation |
| prerequisites and co-requisites  | Basic knowledge in “Informatics”, “Algorithms and Programming Languages” and “Discrete Mathematics” is necessary |
| recommended optional programme components | “Algebra” as well as courses in related disciplines |
| course contents | 1. Introduction to the complexity theory.
2. Algorithms for solving classical combinatorial problems.
3. Approaches for solving combinatorial problems.
4. Data representation and the algorithms effectiveness.
5. Implementation of precise and approximate algorithms for solving combinatorial problems
 |
| form of examination and assessment methods | Written tests and questionnaires – 10%Project defense – 55%Written examination – 35% |
| recommended or required reading | 1. Michael Garey and David S. Johnson. Computers and Intractability: A Guide to the Theory of NP-Completeness (М. Р. Гэри, Д. С. Джонсон Вычислительные машины и труднорешаемые задачи – М.: Медиа, 2012)
2. J.E. Hopcroft, Radjeev Motvani, Jeffrey D. Ullman. Introduction to automata theory, Lnaguage and Computation, The 3d Edition, John Wiley & Sons, new edition.
3. Д. Кнут. Искусство программирования, том 2. Получисленные методы — 3-е изд. — М.: «Вильямс», 2007. — С. 832.
4. Д. Кнут. Искусство программирования, том 4, выпуск 2. Генерация всех кортежей и перестановок — М.: «Вильямс», 2008. — С. 160.
5. Д. Кнут. Искусство программирования, том 4, выпуск 3. Генерация всех сочетаний и разбиений — М.: «Вильямс», 2007. — С. 208.
6. Д. Кнут. Искусство программирования, том 4, выпуск 4. Генерация всех деревьев. История комбинаторной генерации — М.: «Вильямс», 2007. — С. 160.
 |
| language of instruction | Russian |
| work placement(s) | – |

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| Course unit title | Evaluating the Complexity of Combinatorial Problems and Algorithms |
| course unit code | M 1.15 B |
| type of course unit (compulsory, optional) | Optional |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 2nd |
| semester/trimester when the course unit is delivered | 1st semester |
| number of ECTS credits allocated  | 4 |
| Workload | In class: 36 hSelf-study: 108 h |
| name of lecturer(s) | PhD Maxim Gromov |
| learning outcomes of the course unit | Upon completion of the course, students:* should know the difference between the problem complexity and algorithm complexity;
* should know the main principles of effective algorithm development;
* should be able to evaluate the problem complexity;
* should be able to evaluate the algorithm complexity;
* should be able to develop precise and approximate algorithms for solving a problem.
 |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods | Lectures, seminars, written test, essay presentation, individual counseling (incl. online) |
| prerequisites and co-requisites | “Discrete mathematics”, “Algorithms and Programming Languages” |
| recommended optional program components | „Algebra“, „Informatics“ and other correlated disciplines |
| course contents | 1. Introduction to the complexity theory.
2. Basic notions of the complexity theory.
3. NP-complete problems.
4. How to solve NP-complete problems?
5. Effective algorithms and data structures.
6. Recipes for effective algorithms.
7. Examples of combinatorial problems and algorithms for their solution.
 |
| form of examination and assessment methods | Examination:Written tests and questionnaires – 10%Course essay – 40%Written examination – 50% |
| recommended or required reading | * 1. Michael Garey and David S. Johnson. Computers and Intractability: A Guide to the Theory of NP-Completeness (М. Р. Гэри, Д. С. Джонсон Вычислительные машины и труднорешаемые задачи – М.: Медиа, 2012).
	2. J.E. Hopcroft, Radjeev Motvani, Jeffrey D. Ullman. Introduction to automata theory, Language and Computation, The 3d Edition, John Wiley & Sons, new edition.
	3. Д. Кнут. Искусство программирования, том 2. Получисленные методы — 3-е изд. — М.: «Вильямс», 2007. — С. 832.
	4. Д. Кнут. Искусство программирования, том 4, выпуск 2. Генерация всех кортежей и перестановок — М.: «Вильямс», 2008. — С. 160.
	5. Д. Кнут. Искусство программирования, том 4, выпуск 3. Генерация всех сочетаний и разбиений — М.: «Вильямс», 2007. — С. 208.
	6. Д. Кнут. Искусство программирования, том 4, выпуск 4. Генерация всех деревьев. История комбинаторной генерации — М.: «Вильямс», 2007. — С. 160.
 |
| language of instruction | Russian |
| work placement(s) | – |

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| Course unit title | Software Implementations of Telecommunication Protocols |
| course unit code | M.16 A  |
| type of course unit (compulsory, optional) | Optional |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 2nd |
| semester/trimester when the course unit is delivered | 3rd semester |
| number of ECTS credits allocated  | 4 |
| Workload | In class: 36 hSelf-study: 108 h |
| name of lecturer(s) | PhD (dozent) Natalia Shabaldina |
| learning outcomes of the course unit | Upon completion of the course, students are able to: - understand the basic concepts of distributed applications in Internet; - understand basic functions of ‘socket’ library; - understand basic stages of establishing connection between two components of the application-level protocol;- understand approaches to testing implementations of telecommunications protocols; - apply functions from the ‘socket’ library for developing distributed applications that are working in Internet;- apply functions from the ‘socket’ library for implementing application-level protocols;- test software protocol implementations using the tool NModel |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  | Lectures, labs, written test, essay presentation, individual counseling (incl. online)Using software tool ‘Tester’ for checking student implementations |
| prerequisites and co-requisites  | Basic knowledge of courses ‘Base of informatics’, ‘Algorithms and Programming languages’, ‘Object-oriented programming in C++’, ‘Internet-programming’ and ‘Introduction to the system administration’ is necessary |
| recommended optional programme components | Study of various sofware tools for testing protocol implementations |
| course contents | * 1. Basic principles of data transfer on the Internet.
	2. Socket’ library.
	3. Software tool NModel («white box» testing).
	4. Using software tool ‘Tester’ for testing telecommunication protocol implementations («black- box» testing).
	5. Overview of technologies that allow to develop communicated distributed applications.
	6. Implementing application-level protocol according to individual task.
 |
| form of examination and assessment methods | Examination:Written tests and questionnaires – 10%Course essay – 30%Final presentation – 20%Written examination – 40% |
| recommended or required reading | 1. Спицына Н.В., Шабалдин А.В. Интернет-программирование. Лабораторные работы. Часть 1: Методическое пособие. Томск, 2007. Электронный ресурс: http://kitidis.tsu.ru/ip/
2. А.Ю. Матросова, Ю.В. Седов. Интернет-программирование: учебно-методический комплекс. Томск, ИДО ТГУ, 2007. Электронный ресурс: http://ido.tsu.ru/iop\_res2/internetprogr/
3. http://nmodel.codeplex.com
4. http://www.csedays.ru/application2010/program/kuliamin/component-technologies
5. Кришнамурти Б., Рексфорд Дж. Web-протоколы. Теория и практика. – М.: ЗАО "Изд-во БИНОМ", 2002. – 592 с.
6. Ногл М. TCP/IP. Иллюстрированный учебник. – 2001. – 480 с.
7. Теренс Чан. Системное программирование на C++ для UNIX. – Киев: Издательская группа BHV, 1999. – 592 c.
8. J. Myers, etc . Post Office Protocol - Version 3. RFC 1939, May 1996. URL: http://tools.ietf.org/html/rfc1939.
9. J. Klensin. Simple Mail Transfer Protocol. RFC 5321, October 2008. URL: http://tools.ietf.org/html/rfc5321.
10. R.Fielding, etc. Hypertext Transfer Protocol – HTTP/1.1. RFC 2616, June 1999. URL: http://tools.ietf.org/html/rfc2616.
11. B.Kantor, etc. Network News Transfer Protocol. RFC 977, February 1986. URL: http://tools.ietf.org/html/rfc977.
12. S. Barber. Common NNTP Extensions. RFC 2980, October 2000. URL: http://tools.ietf.org/html/rfc2980
 |
| language of instruction | Russian |
| work placement(s) | – |

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| Course unit title | Simulation and Verification of Parallel and Distributed Systems |
| course unit code | M 1.16 B  |
| type of course unit (compulsory, optional) | Optional |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 2nd |
| semester/trimester when the course unit is delivered | 3rd semester |
| number of ECTS credits allocated  | 4 |
| Workload | In class: 36 hSelf-study: 108 h |
| name of lecturer(s) | PhD (dozent) Natalia Shabaldina |
| learning outcomes of the course unit | Upon completion of the course, students should be able to: - know formal models of parallel processes and distributed systems such as Petri nets, dynamic and temporal logic;  - apply the known methods for simulation, analysis, verification and testing of parallel processes and distributed systems;- use modern software tools for simulation and verification of parallel processes and distributed systems |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  | Lectures, labs, written test, essay presentation, individual counseling (incl. online) |
| prerequisites and co-requisites  | Basic knowledge of courses ‘Discrete mathematics’, ‘General algebra’, ‘Informatics’, ‘Algorithm theory’, ‘Programming languages’, ‘Numerical methods’, ‘Probability theory and mathematical statistics’ and ‘Parallel programming’ is necessary |
| recommended optional programme components | Study and explore various architectures of parallel processes and distributed systems |
| course contents | * Parallel processes and distributed systems.
* Formal models for parallel processes.
* Petri nets.
* Analysis of parallel processes using temporal logic.
* Formal models for distributed systems.
* Describing a system of parallel processes in PROMELA language; verifying the description using SPIN software.

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| form of examination and assessment methods | Examination:Written tests and questionnaires – 10%Course essay – 30%Final presentation – 30%Written examination – 30% |
| recommended or required reading | 1. Ломазова И. А. Вложенные сети Петри: моделирование и анализ распределенных систем с объектной структурой. М.: Научный мир, 2004 – 207 с. (и другие издания).
2. Питерсон Дж. Теория сетей Петри и моделирование систем / Пер. с англ. М.: Мир, 1984 – 264 с. (любое издание).
3. Карпов Ю.Г. MODEL CHECKING. Верификация параллельных и распределенных программ и систем. – СПб.: БХВ-Петербург, 2010. – 560 с.
4. Миронов А.М. Теория процессов. М.: МГУ. Доступна на <http://intsys.msu.ru/staff/mironov/processes.pdf>.
5. Ben-Ari M. Principles of the Spin Model Checker. – Springer-Verlag, 2008. – 216 p.
6. 5. Jensen K. and Kristensen L. M. Coloured Petri Nets Modelling and Validation of Concurrent Systems, Springer-Verlag, 2009.
7. Гергель В. П., Стронгин Р. Г. Основы параллельных вычислений для многопроцессорных вычислительных систем: Учебное пособие – Н-Н.: Изд-во Нижегородского ун-та, 2001 – 122 с.
8. Макконелл Дж. Основы современных алгоритмов. М.: Техносфера, 2006 – 366 с.
9. http://www.spinroot.com/ — сайт, посвященный работе со свободно распространяемым программным обеспечением SPIN.
10. И. В. Шошмина, Ю. Г. Карпов. Введение в язык PROMELA и систему комплексной верификации SPIN: Учебное пособие — СпГПУ, 2009 – 66 с. ([http://rff-moodle.tsu.ru/file.php/79/SPIN\_20Manual .pdf](http://rff-moodle.tsu.ru/file.php/79/SPIN_20Manual%20.pdf)).
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| language of instruction | Russian |
| work placement(s) | – |

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| Course unit title | Passive Testing of Components of Telecommunication Systems  |
| course unit code | FTD 1 |
| type of course unit (compulsory, optional) | Extracurricular course |
| level of course unit (according to EQF: first cycle Bachelor, second cycle Master) | Master |
| year of study (if applicable) | 2nd |
| semester/trimester when the course unit is delivered | 1st semester |
| number of ECTS credits allocated  | 4 |
| Workload | In class: 36 hSelf-study: 108 h |
| name of lecturer(s) | PhD. Jorge Eleázar López Coronado |
| learning outcomes of the course unit | Upon completion of the course, students are able to:* know the basic principles of network protocols and testing focusing on “non-intrusive” methods of testing;
* know the theoretical principles of parsing languages with regular grammars to obtain data structure;
* know basic notions of static code analysis principles, motivation and applications;
* use of the most common tools for trace analysis when testing components of telecommunication systems;
* adequately apply the deep packet inspection principles;
* appropriately use the acquired knowledge in the scientific and practical activities.
 |
| mode of delivery (face-to-face, distance learning) | face-to-face |
| planned learning activities and teaching methods  | Lectures, labs, written essays, individual counseling |
| prerequisites and co-requisites  | Basic knowledge of courses ‘Programming languages’, ‘Discrete mathematics’’ is necessary |
| recommended optional programme components | verification principles of conceptual models and the own research outcomes as well as courses in related disciplines |
| course contents | 1. Introduction to Communication Protocols and Non-intrusive Test Methods.
2. Static Analysis Principles – Lexical and Syntactical Language Analysis.
3. Static Analysis Principles – Abstract Syntax Trees (AST).
4. Static Analysis – Notions, Techniques and Formal Methods.
5. Passive Testing & Network Trace Analysis.
6. In Depth Passive Testing using Network Traces.

Labs:1. Communication protocols: case Study.
2. Static analysis.
3. Passive Testing of Communication Protocols.
 |  | 2 |
| form of examination and assessment methods | Examination:Written tests and questionnaires – 30%Course essay – 30%Written examination – 40% |  | 2 |
| recommended or required reading | 1. Charles Kozierok: The TCP/IP Guide: A Comprehensive, Illustrated Internet Protocols Reference, No Starch Press San Francisco, CA, USA, , 2005.
2. Andrew W. Appel, Maia Ginsburg: Modern Compiler Implementation in C, Cambridge University Press New York, NY, USA, 1998.
3. Wissam Mallouli, Bachar Wehbi, Edgardo Montes de Oca, Michel Bourdelles, Online Network Traffic Security Inspection Using MMT Tool. In: the 9th workshop on system testing and validation (STV’2012), 2012.
4. Jorge Lopez, Stephane Maag, Gerardo Morales. Behavior evaluation for trust management based on formal distributed network monitoring, Springer World Wide Web, 19 (1), pp. 21-39, 2015.

Web resources:1. Flex user manual:

<https://www.cs.princeton.edu/~appel/modern/c/software/flex/flex_toc.html>1. Bison user manual:
2. <https://www.cs.princeton.edu/~appel/modern/c/software/bison/bison_toc.html>
3. Libpcap documentation:

<http://www.tcpdump.org/#documentation>1. Snort Documentation:

<https://www.snort.org/#documents> |  | 4 |
| language of instruction | English |  | 2 |
| work placement(s) | - |  | 4 |

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| Course unit title | Project and Research Practice  |
| course unit code | M 2.1 |
| type of course unit (compulsory, optional) | Compulsory |
| year of study (if applicable) | 1st, 2nd  |
| semester/trimester when the course unit is delivered | 1st, 2nd , 3d semesters |
| number of ECTS credits allocated  | 30 |
| workload | In class: 108 hSelf-study: 1116 h  |
| name of lecturer(s) | Prof. N. YevtushenkoPhD (dozents)S. ProkopenkoM. GromovN. Kushik.N. ShabaldinaS. Torgaev |
| learning outcomes of the course unit | Upon completion of this practice, students are able to:- use modern technologies to collect, process and interpret the empirical data in the field of hardware and software verification and testing;- be aware of technologies and tools used for research work aimed at solving master thesis problems;- state the objectives and milestones for solving master thesis problems;- analyze the obtained results, draw relevant conclusions and prepare scientific and technical documentation;- write research papers and present the obtained results at the conferences;- solve practical and theoretical problems when doing research in the field of verification and testing for telecommunication systems;- interact with other specialists involved in research or work teams. |
| planned learning activities and teaching methods  | Tutorials, case study, individual counseling.When dealing with practical tasks, master students use different research technologies and program tools (for details please refer to the Programmes of appropriate courses). |
| prerequisites and co-requisites  | – |
| recommended optional programme components | – |
| course contents[[4]](#footnote-4) | 1. Preparatory stage: instruction in general issues, formulation and adjustment of the research topic, research planning.

2. Working with sources of scientific and technical information on the research subject.3. Research conducting.4. Preparing presentations and reports for seminars, conferences, etc.5. Preparing journal and conference publications based on the research results.6. Technical report on the research and/or practical work. |
| form of examination and grading procedure | Credit test with giving a mark:Defense of a research abstract – 20%Interim presentation of the findings – 40%Written report on practice – 20%Oral test – 20% |
| recommended or required reading | Federal laws and university regulations:1. Закон Российской Федерации «Об образовании» от 10.07.1992 №3266-1 (с последующими изменениями и дополнениями);
2. Федеральный закон «О высшем и послевузовском профессиональном образовании» от 22.08.1996 №125-ФЗ (с последующими изменениями и дополнениями);
3. Федеральные государственные образовательные стандарты высшего образования;
4. Устав и локальные нормативные акты университета;
5. Учебный план по магистерской подготовке по направлению радиофизика.
6. Приоритетный национальный проект Образование» URL: http://www.rost.ru/projects/education/ed6/docs.shtml http://www.dvgu. ru/u m u/M o\_R F/concept/con 1 \_02.htm
7. Федеральные целевые программы, государственным Минобрнауки России http://mon.gov.ru/pro/fcpMkoor
8. Концепция Закона Российской Федерации об образовании. URL: http://mon.gov.ru/dok/proi/6648/
9. Структура проекта федерального закона "Об образовании в Российской Федерации". URL: <http://mon.gov.ru/dok/proj/6649/>
10. The main and additional references of the research topic
 |
| language of instruction | Russian |
| work placement(s) | Research labs of Tomsk State University; state, municipal, non-government, profit and nonprofit organizations where proficiencies related to the Master’s thesis are possible; educational and research departments of TSU associated with specialization of the master’s Programme. |

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| Course unit title | Pre-Graduation Practice |
| course unit code | M 2.2 |
| type of course unit (compulsory, optional) | Compulsory |
| year of study (if applicable) | 2  |
| semester/trimester when the course unit is delivered | 4th semester |
| number of ECTS credits allocated  | 24 |
| workload | 864 h |
| name of lecturer(s) | Prof. N. YevtushenkoPhD (dozents)S. ProkopenkoM. GromovN. Kushik.N. ShabaldinaS. Torgaev |
| learning outcomes of the course unit | Upon completion of this practice, students are able to:- deal with modern literature sources, use modern technologies to interpret the empirical data in the field of hardware and software verification and testing;- be aware of technologies and tools used for research work aimed at solving master thesis problems;- state the objectives and milestones for solving master thesis problems;- analyze the obtained results, draw relevant conclusions and prepare scientific and technical documentation;- prepare the final version of the master thesis and its presentation;- interact with other specialists involved in research or work teams. |
| planned learning activities and teaching methods  | 1. Preparatory stage.
2. Analytical survey.
3. Preparations of mail chapters of the master thesis.
4. Examination stage.
5. Final stage (report and presentation of the master thesis).
 |
| prerequisites and co-requisites  | Project and research practice |
| recommended optional programme components | – |
| course contents | The pre-graduation practice of the master’s programme is carried out in research laboratories and organizations related to the qualification objectives of the programme. The content of the pre-graduation practice is defined by its supervisor in terms of the Federal educational standard and programme’s curriculum and is fixed in master student’s individual plan of work. Students’ practical work is organized in accordance with the logic of master’s thesis and skills to be acquired. Assessment is a master thesis and its presentation. |
| form of examination and grading procedure | Credit test with giving a mark:Presentation of research results at a scientific seminar – 40%Presentations – 20%Written test – 40%\*\*\*Am not sure that we have anything save for the defence itself\*\*\* |
| recommended or required reading | Federal laws and university regulations:1. Закон Российской Федерации «Об образовании» от 10.07.1992 №3266-1 (с последующими изменениями и дополнениями);
2. Федеральный закон «О высшем и послевузовском профессиональном образовании» от 22.08.1996 №125-ФЗ (с последующими изменениями и дополнениями);
3. Федеральные государственные образовательные стандарты высшего образования;
4. Устав и локальные нормативные акты университета;
5. Учебный план по магистерской подготовке по направлению психология.
6. Розов М.А. Рефлексия и деятельность // Наука глазами гуманитария / Отв. ред. В.А. Лекторский. - М.: Прогресс-Традиция, 2005. - С. 384^110.
7. Приоритетный национальный проект Образование». URL: http://www.rost.ru/projects/education/ed6/docs.shtml http://www.dvgu. ru/u m u/M o\_R F/concept/con 1 \_02.htm
8. Федеральные целевые программы, государственным Минобрнауки России. URL: http://mon.gov.ru/pro/fcpMkoor
9. Концепция Закона Российской Федерации об образовании. URL: http://mon.gov.ru/dok/proi/6648/
10. Структура проекта федерального закона "Об образовании в Российской Федерации". URL:http://mon.gov.ru/dok/proj/6649/
 |
| language of instruction | Russian |
| work placement(s) | Research labs of Tomsk State University; state, municipal, non-government, profit and nonprofit organizations where proficiencies related to the Master’s thesis are possible; educational and research departments of TSU associated with specialization of the master’s Programme. |

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| Course unit title | Preparation and Defence of master thesis |
| course unit code | M 3.1 |
| type of course unit (compulsory, optional) | Compulsory |
| year of study (if applicable) | 2nd  |
| semester/trimester when the course unit is delivered | 4th semester |
| number of ECTS credits allocated  | 6 |
| workload | In class: 36 hSelf-study: 180 h  |
| name of lecturer(s) | Prof. N. YevtushenkoPhD (dozents)S. ProkopenkoM. GromovN. KushikN. ShabaldinaS. Torgaev |
| learning outcomes of the course unit | Final attestation on the Master's programme has to determine whether educational objectives of the program aimed at preparing qualified specialists ready for professional careers in telecommunications have been achieved.Upon the defence students have to:- present themselves;- present their research results orally and in written;- make a well-reasoned presentation;- debate scientific issues. |
| planned learning activities and teaching methods  | Self-study, individual counseling, presentation, discussions.Final attestation is completed through the defense of the final project in the form of Master's thesis. Master’s Thesis is prepared during the research practice. It is an independent and logically complete final qualifying technical report containing solutions to research problems, practical applications, and, as a rule, appropriate parts of this thesis should be published in scientific journal and presented at conferences. |
| prerequisites and co-requisites  | Completion of the academic cycles M1 “Disciplines” and M2 “Practical Training and Research” in line with the curriculum.The preliminary text of the master thesis. |
| recommended optional programme components | It is recommended to have presentations of parts of the thesis during the whole study cycle and a preliminary thesis presentation (pre-defense) – 2-3 weeks prior to the defense. It is of great help for students and their supervisors to get the approval on thesis parts and the whole.  |
| course contents[[5]](#footnote-5) | 1. Final edition of the master thesis.
2. Preparation of the required papers.
3. Preparation of the thesis presentation and the defence.
4. Defence of the master thesis in the form of presentation and discussions.
 |
| form of examination and grading procedure | Final attestation with awarding a master degree: presentation and discussions at the session of the State Examination Board.Assessment criteria:Presentation – 14%Novelty – 14%Research design and quality of master thesis – 16%Quality of illustrative materials – 14%Quality of presentation at the session of the State Examination Board – 14%Correct and convincing answers to the asked questions– 14%Special knowledge in the sphere of professional activity – 14% |
| recommended or required reading | – |
| language of instruction | Russian |
| work placement(s) | – |

1. One credit is equivalent to 36 hours of student work, including all forms of class and out of class work and exam preparation. 1hour = 45 minutes. [↑](#footnote-ref-1)
2. Optional course units are a component part of the Module M1 "Disciplines" and are divided into pairs. In each case students have to choose at least one of two (either course A or B) to complete the module. [↑](#footnote-ref-2)
3. Courses offered outside the regular curriculum on a voluntary basis, the academic achievement, if any, is to be recorded in the Diploma Supplement. [↑](#footnote-ref-3)
4. For details please refer to the Programme of the Research Practice. [↑](#footnote-ref-4)
5. For details please refer to the Programme of the Final Attestation. [↑](#footnote-ref-5)