VILNIUS GEDIMINAS TECHNICAL UNIVERSITY

APPROVED
Vilnius Gediminas Technical University
Senate
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INNOVATIVE SOLUTIONS IN GEOMATICS

Measurement Engineering Master's Degree

Description of intended second cycle university degree study programme

Rector of Vilnius Gediminas Technical University ..... (signature) prof. dr. Alfonsas Daniūnas

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STUDY PROGRAMME PROFILE

Name	*Data*
1. Programme title	Innovative Solutions in Geomatics
2. Study field	Technological science study field
3. Study field (code)	*General Engineering H100*
4. Study programme branch	Measurement Engineering H140
5. Type of studies	University studies
6. Cycle of studies	Second
7. Mode and duration of studies (in years)	Full-time studies (1,5)
8. Implementation language	*English*
9. Scope of programme in credits	90
10. Intended degree and qualification	Measurement Engineering Master
11. Minimum education requirements	University bachelor's qualification degree in measurement engineering, geography, landscape management, forestry, land management, geology field of studies.

Programme development group

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1. STUDY PROGRAMME AIMS AND INTENDED LEARNING OUTCOMES

Innovative Solutions in Geomatics second cycle (Master's degree) university joint study programme, the implementation of which is intended at the Faculty of Environmental Engineering (hereinafter – FEE) of Vilnius Gediminas Technical University (hereinafter – VGTU) and Rigas Technical University (hereinafter – RTU).

The main purpose of the joint program is to enable students to acquire more knowledge, skills and experience than one institution's study program can give.

Through a joint degree program, each partner contributes to a study subjects which are best mastered in each of the partner institutions , for example VGTU has the equipment and experience in laser scanning and remote sensing, creating GIS databases, RTU staff have experience in researching gravity parameters of the Earth, satellite altimetry, GNSS and VLBI data processing and analysis.

The programme focuses on analytic applied and research activities. The programme curriculum is designed to provide specialized up-to-date knowledge on geomatics, geodesy, cartography and geoinformation systems, which can be used to develop scientific research, develop critical understanding of the areas of geodesy and cartography and understanding of knowledge interaction from other related areas; develop specialized geodesy and cartography, geoinformation systems problem solving skills, necessary for conducting scientific research; develop new knowledge, methodologies and technologies by integrating knowledge from different areas; develop managerial and teamwork skills, applicable in learning and professional environments, the latter being complicated, unpredictable and requiring solving complex problems consisting of multiple interrelated factors and globalisation processes.

Innovative Solutions in Geomatics study programme was developed considering:

- the provisions of *National Sustainable Development Strategy* and provisions of *Strategy of Lithuanian Regional Policy until 2013* (especially "promote development of human resources" and "promote the focus of university higher education on demand of highly qualified specialists in the regional centres");
- The major documents of the development of the European higher education area (*"The Bologna process – The European higher education area in the new decade"* and *"A framework for qualifications of the European higher education area"*);
- Order of the Minister of Education and Science "On approval of external assessment and accreditation procedures of study programmes", issued 24 July 2009, amendment No. V-1487 from 29 July 2011, approval of study cycles' descriptions (21 November 2011, No. V-

2212), approval of the intended study programme description development, its external assessment and accreditation methodologies (November 28 2011, No. 1-01-157);

- VGTU internal documents: Description of General Requirements for the Second Cycle Degree and Integrated Studies Study Programme Development, Description of the Full-time and Part-time Modes of Studies; Description of the Study Programme Reorganization Procedures. VGTU Rector's order No. 57-1.10 issued on 29 May 2012 and VGTU Study Provisions;
- Methodology for Assessing Implemented Study Programmes, Order of the Director of SKVC No. 1-01-162, issued on 20 December 2010;
- *UNESCO, OECD UNESCO, OECD Guidelines for Quality Provision in Cross-border Higher Education, 2005*;
- *EFMD Recommendations for Quality Assurance in Higher Education Business Schools, 2011* EQUIS – European Quality Improvement System, The EFMD accreditation for International Business schools. www.efmd.org).

In 2014 03 17 an agreement was signed on a joint master's degree program execution between the VGTU and RTU.

Expected results of the program of study to describe what graduates should know, understand and be able to / or be able to use the training of the long working life in accordance with their degree.

Learning outcomes of the study programme are divided into five groups (1) knowledge, its application, (2) abilities to conduct research, (3) special abilities, (4) social abilities, (5) personal abilities.

Table 1. Correlation of Study programme aim, study cycle learning outcomes, intended programme learning outcomes and study subjects' (modules)

Aim of the programme Train measurement engineering specialists, with the up-to-date specialized knowledge in geomatics, geodesy and cartography, related to creation, development and improvement of geodetic networks; creation, development and improvement of geographic information systems; who are able to comprehend and analyse interaction of different kinds of knowledge, come up with problems and their solutions based on the scientific research in the field of measurement engineering, conducted on the basis of the acquired knowledge, optimise geodetic and cartographic data mining, by modelling the analysed processes in geoinformation systems; with developed abilities to apply innovative solutions for complex industrial activities, related to cognate areas and technological advancement, scientific analysis and research skills, necessary to maintain and improve the acquired professional competence in the ever-changing technological environment, scientific research institutions, doctoral studies.		
Description of the study cycle learning outcomes	**Intended study programme outcomes**	**Study subjects (modules)**
Knowledge and its application	**Knowledge and its application:** know methodologies, methods, organizational issues, innovation planning and implementation related scientific research; know how to apply innovative solutions in geomatics, up-to-date research methods, the most appropriate means of scientific research, is able to apply the acquired knowledge in interdisciplinary studies and professional activities; knows the main development tendencies and application possibilities of modern electronic geodetic measurement systems; is aware of unified multi-purpose geodetic network design, digital landscape modelling and 3D spatial modelling methodologies and principal theoretical solutions; is aware of geoinformation systems' structure, technological and development trends and application for specialised needs of geodesy, cartography and cadastre; is aware of innovative remote sensing and photogrammetric	Computer graphics in Geomatics Global positioning satellite system Thematic cartography Digital terrain models Scientific researches and innovations Applied programs in Geomatics Geodetic Laser Scanning Technologies Building Information Modelling Remote Sensing Methods Digital Photogrammetry Geoinformation Systems Technology Geoinformation Systems on the Internet Final thesis 1,2,3

	methods; knows the structure and development methods of spatial geographic information infrastructure.	
Abilities to conduct scientific research	**Abilities to conduct scientific research:** is able to accumulate and, systemize, analyse and assess research data necessary for scientific and professional activities and introduction of innovations; is able to correctly choose efficient means of experimental research and equipment to solve the tasks of geomatics; is able to assess and investigate application of existing and measurement engineering technologies, as well as the ones being developed; understands the significance of scientific research in solving current and future problems of measurement engineering.	Computer graphics in Geomatics Global positioning satellite system Digital terrain models Scientific researches and innovations Applied programs in Geomatics Geodetic Laser Scanning Technologies Building Information Modelling Remote Sensing Methods Digital Photogrammetry Geoinformation Systems Technology Geoinformation Systems on the Internet Final thesis 1,2, 3
Special abilities	**Special abilities:** is able to interpret theoretical and experimental results, assess economic issues and patenting possibilities; is able to apply geomatics' novelties and harmonise application skills with the basics of business and management; is able to create and develop geodetic networks, develop digital landscape models, create special models of the Earth's surface, create digital maps, prepare GIS data and carry out precision and quality assessments; is able to use up-to-date electronic geodetic measurement systems and create and introduce modern tools for upgrading these systems; is able to apply geographical information systems for acquiring geodetic and cartographic data, accumulating, systemising, analysing and managing spatial geoinformation; is able to create specialised geodetic and cartographic geographic information systems' databases, by harmonizing geodetic measurements' data acquired through different methods and approaches; is able to improve development of specialised geodetic and cartographic databases, optimize cartographic and cadastre data mining and systemisation process, by modelling maps in geoinformation systems.	Computer graphics in Geomatics Land management Global positioning satellite system Thematic cartography Scientific researches and innovations Aplied programs in Geomatics Geodetic Laser Scanning Technologies Theoretic Cartography Building Information Modelling Remote Sensing Methods Digital Photogrammetry Geoinformation Systems Technology Geoinformation Systems on the Internet Final thesis 1,2, 3
Social abilities	**Social abilities:** is able to communicate and cooperate with his and other areas' specialists, work in a team; is able to communicate with his peers, specialists and the society, and convey results of his professional activities in an appropriate oral or written national language; is able to clearly and in a reasoned way convey generalised information to specialists and other people, and critically assess it; is able to assume responsibility for the quality of his work, as well as the work of his subordinates, considering professional ethics and public spirit; is able to acquire experience from specialists and share it with colleagues.	Scientific researches and innovations Land management Final thesis 1,2,3
Personal abilities	**Personal abilities:** is able to individually organize one's work in a responsible manner, make decisions; is able to think critically and constructively, assess qualitative and quantitative information, analyse it and frame conclusions; is able to apply knowledge acquired through lifelong learning in solving tasks of geodesy and geomatics; is able to critically assess innovative solutions of oneself and the others, realizing potential social and ethical consequences of one's activities; is	Global positioning satellite system Digital terrain models Scientific researches and innovations Applied programs in Geomatics Geodetic Laser Scanning Technologies Building Information Modelling Remote Sensing Methods Geoinformation Systems on the

	able to adapt activities to unusual circumstances, when there is lack of comprehensive information, instructions or experience.	Internet Final thesis 1,2,3

2. DEMAND FOR THE STUDY PROGRAMME

EuroGeographics Association , the Board of Surveyors (The Council of European Geodetic Surveyors (CLGE)) and Geometer Europas (GE) in order to raise the prestige of the surveyors profession and to assess the need for such professionals , conducted a study which showed that the labor market has a great demand for highly-qualified geoeducated staff, but, at the same time, requires a lot of effort at both national and European level in order to be prepare the best qualified professionals able to collect, process, analyze, and present spatial data and to aply innovative technologies and data processing techniques (http://ec.europa.eu/social/main.jsp?catId=738&langId=en&pubId=7267&type=2&furtherPubs=yes and http://ec.europa.eu/social/main.jsp?catId=955&langId=en). Various spatial data sets are increasingly being used for decision-making , process modeling , and other purposes. The study shows that there is a very noticable gap between labor market demand and supply of specialists and institutions of higher education study programs.

In Lithuania and Latvia until 2008-2009, a steadily growing demand for professionals in the measurement engineering associated with intensive real estate and construction sectors growth, decreased in recent years and has stabilized. However, the emergence of new needs related to new innovative technologies in the field of measurement (laser scanning technology , remote sensing , unmanned aircraft data , digital spatial databases and their use and so on.) . It can be concluded that the todays market needs more than traditional surveying specialists, an professionals able to collect , process, analyze and present the large amounts of spatial information gathered using latest technologies. To produce graduates who are able to apply innovative technologies and geomatics techniques VGTU and RTU joint Master's Degree program was developed. It should be noted that the VGTU and the RTU is the only university level higher education institutions in Lithuania and Latvia, preparing measurement engineering professionals.

The intention is to carry out a joint study program “Innovative Solutions in Geomatics” reflects the European Union (EU) initiative for the creation of a spatial data infrastructure in each of the EU member countries. In 2007 . March 14 . European Parliament and Council Directive 2007/2/EC (OJ 2007 L 108, p . 1) establishing an Infrastructure for Spatial Information (INSPIRE) has to be implemented in Lithuania by 2019. http://inspire.ec.europa.eu/.

It is expected that the development of new construction technologies, as well as through international projects Lit Pol Link, Rail Baltica , Via Baltica , need for skilled professionals who are able to use innovate techniques further will increase. The older generations of practitioners are not always able to respond adequately to technological developments and changes in technology and adapt to current needs. Professionals need is researched in Daujotis V. et al . (2008) study " Professionals needs analysis in Lithuania". The total estimated trend – the demand of people with higher education will increase.

In view of the above discussed trends, it can be said that the need to develop a highly skilled engineering measurement specialists who are able to use innovative technologies, geospatial data and information technology is going to rise, and education and research institutions of international cooperation is particularly significant.

Main Department of Geodesy and Cartography of ongoing research areas are:

1. GIS technology and its application;
2. Geodetic measurements of theoretical and experimental research and applications.

Geodesy or surveying engineering education was a part of Riga Polytechnic Institute’s (from 1990 Riga Technical University) programme already in previous century. At that time it was held

within the Faculty of Civil Engineering in Construction Department of Roads, Bridges and Aerodromes, but later in Department of Roads, Bridges and Geodesy, Department of Roads and Bridges, Department of Transportation Structure. From 1991 Department of Geodesy up to 2003 and from 2003 up to now it is called as Department of Geomatics within Faculty of Civil Engineering.

It has to be emphasized, that Geodesy/geomatics engineering higher education system in Latvia after winning of independency was reformed. Instead of continental study scheme was introduced anglo-saxon study system, i.e., were introduced academic bachelor and academic master study programs with nominal study length 3 years and 2 years respectively. However, after 3 year long bachelor studies graduates were not ready to enter labor market. In 2003 we have introduced bachelor and master professional studies in Geomatics engineering. The Department of Geomatics Civil Engineering Faculty of RTU is the sole department in Latvia to provide two cycle Geomatics Engineering specialists.

The main directions of scientific researches pursued by the Department of Geomatics are the following:

1. Cadastral, topographical surveying and land management systems;
2. Geographic information systems and open source software;
3. Geodetic networks adjustment and with use of GNSS, evaluation;
4. Research on earth gravity field, geoid modelling and earth tides;
5. Deformation monitoring of historical buildings.

Research activities of Geomatics department personnel have a positive influence on implementation of the academic programme. First of all it gives an opportunity for students to participate in different projects as well as to familiarize themselves with a modern equipment, software and testing knowledge on fieldworks.

3 doctoral theses with on issues related to geomatics engineering have been defended at the Department of Geomatics Faculty of Civil Engineering of Riga Technical University during the last four years.

The analysis of specialist training environment showed that „Innovative Solutions in Geomatics" degree program is unique; there is no such program in other Lithuanian and Latvian universities.

Exchange visits of stuff and students to other universities gives he positive impact for the study program These exchange visits allows to compare studies in different schools, while improving the realization of program execution quality. Students have the opportunity to study at one of the VGTU or RTU partner universities through Erasmus exchange program.

3. STRUCTURE OF THE STUDY PROGRAMME

Joint degree master study program "Innovative Solutions in Geomatics" will be carried out in Lithuania, Vilnius Gediminas Technical University and in Latvia, Riga Technical University.

Joint degree master study program "Innovative Solutions in Geomatics" includes 90 (ECTS) credits. Studies will be held in semesters. Under the Partnership Agreement for the first semester, students will study in RTU second semester classes will be held in Vilnius Gediminas Technical University. One-semester covers - 30 ECTS credits. Postgraduate studies are completed by master's thesis, which comprises 30 ECTS credits. One ECTS credit is equal to 26.67 contractual working hours. Master's thesis public defence will take place in VGTU or RTU with participation of postgraduate theses supervisors.

Table 2. Master's degree full-time study programme Innovative Solutions in Geomatics study plan (scope – 90 credits). Scientific programme.

Subject code	Subject (course)	Scope of studies per term							
		I		II		III		Total	
		hours	credits	hours	credits	hours	credits	hours	credits
1. Study field subjects *(no less than 60 credits)*									
1.1. Mandatory courses		**587**	**22**	**587**	**22**			**1174**	**44**

BGE325	Computer graphics in Geomatics	160	6					160	6
BGE427	Fundamentals of Land Management	160	6					160	6
BGE510	Global Positioning Systems	133	5					133	5
BGE503	Digital Terrain Models	133	5					133	5
APHIM11102	Scientific researches and innovations			107	4			107	4
APGDM11023	Geodetic laser scanning technologies			133	5			133	5
APGDM11009	Remote Sensing Methods			160	6			160	6
APGDM11027	Building Information Modeling			187	7			187	7
1.2. Optional courses		**133**	**5**	**133**	**5**	**160**	**6**	**426**	**16**
BGE508	Thematic cartography	133	5					133	5
BGE295	Application Programms in Geomatics	133	5					133	5
APGDM11003	Digital photogrametry			133	5			133	5
APGDM11020	Geoinformation Systems Technology			133	5			133	5
APGDM11021	Geoinformation Systems on the Internet					160	6	160	6
BGE504	Theoretical Cartography					160	6	160	6
Total (Study field courses):		**720**	**27**	**720**	**27**	**160**	**6**	**1600**	**60**
2. Preparation and defence of the final thesis *(no less than 30 ECTS)*									
		80	**3**	**80**	**3**	**640**	**24**	**800**	**30**
AP	Final thesis 1	80	3					80	3
RTU	Final thesis 1	80	3					80	3
AP	Final thesis 2			80	3			80	3
RTU	Final thesis 2			80	3			80	3
AP	Final thesis 3					640	24	640	24
RTU	Final thesis 3					640	24	640	24
Total:		**80**	**3**	**80**	**3**	**640**	**24**	**800**	**30**
Overall theoretical courses:		**720**	**27**	**720**	**27**	**160**	**6**	**1600**	**60**
Overall for the final thesis:		**80**	**3**	**80**	**3**	**640**	**24**	**800**	**30**
Programme total:		**800**	**30**	**800**	**30**	**800**	**30**	**2400**	**90**

The curriculums of a joint study program “Innovative solutions in geomatics” are provided in Appendix 1. The course arrangement plan is presented in Annex 4.

Students' self- regulated by the scope of work for each course module provided with the total course credits aligned self-employment form - control and laboratory work, papers , colloquia , course projects , independent study .

First semester students choose a Master's thesis supervisor. Supervisor may be stuff member from VGTU or RTU. Superviser over the entire period of the Master studies, consults and supervises the student (during the consultation, e-mail , video conferencing , and so on.) in the performance of investigative and analytical work and the preparation of a Master's thesis . The entities (VGTU - head of the Geodesy and Cartography Department, RTU - head of the Geomatics department) at the request of the student or other special circumstances may change the supervisors.

The departments carrying out the joint degree program forms the topics and contents of Masters' theses. During the study process, internal procedures of both universities will be followed. The head of one of the departments coordinates and controls preliminary Master's theses topics choice, experimental work progress and master's theses preparation and defence arrangements. The supervisor formulates the tasks of final Master's theses, Dean of the Faculty of Environmental Engineering at VGTU and Dean of the Faculty of Engineering at RTU approves the topics of master theses.

To defend and assess the Master's final thesis the Dean will appoint a master's degree granting commission , which will include specialists in the field and practice (by manufacturers),teachers and other education bodies. Qualifying master's degree-granting commission during the master's final thesis defence will give a grade.

The right to defend a Master's thesis is given only to a graduate student who has successfully performed all the masters program scheduled tasks, passed all the tests and proved that he has the requisite knowledge and skills .

A graduate student’s thesis must be analytical, based on independent research or experimental and applied research. A graduate student’s thesis cannot be merely descriptive or synoptic. Final work of a graduate student must demonstrate their ability not only to analyze the topic of their choice, evaluate other earlier corresponding theses on the subject, successfully conduct research in that field , but also clearly and reasonably articulate their studies findings , describe his research work in accordance with the requirements approved by the University .Assessing the thesis the research performance level, working clearance, thesis presentation and overall postgraduate education are evaluated. A graduate student who successfully defends master's thesis, measurement engineering degree is given.

4. STUDY PROGRAMME STAFF

Innovative Solutions in Geomatics study programme staff consists of university teachers from VGTU Department of Geodesy and Cadastre (1 professor and 3 associate professors), VGTU Department of Hydraulics (1 associate professor), and Riga Technical University Department of Geomatics (the list of the university teachers is provided in Table 3). The teachers working in the study programme have 10-41 years of professional experience. It is important to note that most of the teachers have been actively working in the fields of science, furthermore, they have a lot of experience in the field of measurement engineering, as well as in pedagogical and practical work.

Table 3. The list of teachers to work in Innovative Solutions in Geomatics study programme

Name, surname	**Qualification degree or academic degree, currently held or prospective position**	**Course to be delivered**	**The fields of scientific research**	**Number of years of professional (practical) work experience**
1	2	3	4	5
The teachers of the subjects of the general study programme				
1.1 Compulsory subjects of the study programme				
Eimuntas Kazimieras Paršeliūnas	**Prof. Dr Professor**	Online Geographic Information Systems Geographic Information Systems Databases	10T	35
Darius Popovas	**Dr Associate Professor**	Geodetic Laser Scanning Technology	10T	16
Birutė Ruzgienė	**Assoc. Prof. Dr Associate Professor**	Digital Photogrammetry Remote Sensing Methods	10T	41
Jūratė Sužiedelytė-Visockienė	**Assoc. Prof. Dr Associate Professor**	Digital Structure Models	10T	20
Andrius Litvinaitis	**Assoc. Prof. Dr Associate Professor**	Scientific Research and Innovations	04T	16
Jānis Štrauhmanis	**Prof. Dr Professor**	Thematic Cartography	10T	40
Māris Kaļinka	**Dr Associate Professor**	Application Programms in Geomatics Terrestrial/Architectural Photogrammetry	10T	15
Armands Auziņš	**Dr Associate Professor**	Fundamentals of Land Management	10T	12
Jānis Zvirgzds	**Dr Associate Professor**	Global Positioning Systems	10T	10
Mārtiņš Reiniks	**Mg.sc.ing. Associate Professor**	Local Geodetic Networks Digital Terrain Models	10T	15
Olita Metuma	**Mg.sc.ing. Lecturer**	Computer graphics in Geomatics	10T	10
1.2 The optional subjects of the study programme				

Eimuntas Kazimieras Paršeliūnas	**Prof. Dr Professor**	Digital Cartography GIS Technologies Technology of Geographic Information Systems	10T	35
Birutė Ruzgienė	**Assoc. Prof. Dr Associate Professor**	Digital Photogrammetry	10T	41
Jānis Štrauhmanis	**Prof. Dr Professor**	Theoretical Cartography	10T	40

The VGTU teachers have prepared the subjects for *Innovative Solutions in Geomatics* study programme. They also deliver lectures on similar disciplines and work on innovative projects in the field of measurement engineering. The teachers have written a number of scientific publications on measurement engineering. In addition, the teachers are academic advisors, supervising dissertations and final theses. The study programme teachers' qualification complies with the requirements indicated in: the Law on Higher Education; the provisions of the Basic, Specialised Professional and Integrated Study Programmes; the description of the general requirements for Master's Degree Study Programmes. It is planned that *Innovative Solutions in Geomatics* study programme is to be conducted by 2 professors and 8 associate professors and 1 lector. The scientists are improving their educational and academic qualification by carrying out their qualification degree programmes, conducting their charter works and scientific researches, going on traineeships abroad, participating in international teacher exchange programmes, working on international projects and preparing publications for 'ISI Proceedings' and other reviewed journals.

. The teachers who are going to work under *Innovative Solutions in Geomatics* study programme conducted their lectures in higer education institutions of Germany, Spain, Norway, Slovenia, Poland, Switzerland, Great Britain, Latvia, Austria, Sweden and Finland in 2008-2013.

Besides, the teachers are constantly improving their skills and qualification by participating in various national and international conferences and exhibitions, as well as working on international projects together with foreign experts in the fields of their interests. Therefore, when they are preparing for their lectures, the teachers can constantly develop and update their teaching resources, which makes a direct positive impact on the level of students' knowledge and the quality of studies.

The Faculty of Environmental Engineering periodically (every 3 years) organizes international science conference called 'Environmental Engineering'. All the teachers working under the study programme visit the conference. Every year at the end of October, a conference for young scientists named 'Civil Engineering and Geodesy' is held by the Department and Cadastre and the Department of Urban Engineering. Master's and Doctoral degree students read their reports during the conference.

Since 1963 the scientific journal 'Geodesy and Cartography' has been published by the initiative of the employees of the Department of Geodesy and Cadastre. Since 2011 only articles in foreign languages have been published in this journal. The teachers of the Department of Geodesy and Cadastre are involved in the editorial college of this journal and publish their own articles on their latest scientific achievements and experience. The journal is indexed in international databases. The teachers of the Department of Geodesy and Cadastre are also members of editorial colleges of journals published abroad. The teachers take part in the activity of Education Exchanges Support Foundation (NORDPLUS), modernisation of higher school education (TEMPUS) and EFECK programmes, as well as in activities of other programmes.

Riga Technical University publishes the scientific journal "Geomatics", which is indexed in international databases EBSCO, ProQuest and VINITI, https://ortus.rtu.lv/science/lv/publications/search

5. MATERIAL RESOURCES OF THE STUDY PROGRAMME

5.1. Facilities

Students, studying in the geodesy study programme, have academic classes at the faculty of Environmental Engineering (11 Saulėtekio Ave.) and Riga Technical University (Azenes g. 16/20.

.).

According to the data of 2013, the faculty of Environmental Engineering can provide 8838.39 m^2 of the premises for studies and scientific activities. The classrooms, laboratories, computer classrooms and scientific laboratories (hereafter - teaching premises) cover an area of 2627.45 m^2 for 1368 workplaces. The largest part of the teaching premises area is occupied by classrooms (70.0%) and laboratories (19.7%). Classrooms are fitted for 1099 students (80.3% of workplaces in all teaching premises). Workplaces in the laboratories and computer classrooms account for 15.1% and 4.6% respectively. One full-time student and a postgraduate are provided the area of 4.93 m^2 of teaching premises.

Specialised technical equipment in department's direct disposition: Electronic tachometer (11 units), Stoichiometry gauge, GPS receiver kit (18 units), Theodolite WILD T2, Theodolite WILD T1000, Distomat1000, Angle measurement calibration stand, Digital level NA-3003 (131391) (2 units), Camera Canon EOS 350D kit (1 unit), Electronic planimeter Sokkia KP-90N (3 units), Laser level kit Rugby 100 (4 units), Cable finder Digicat 200 (4 units), Optical automatic level SELT AT 20D (36 units), Optical theodolite with a plummet 4T30P (24 units), Laser distance gauge (12 units), Multifunctional camera YC-400.

In addition, the department uses the Geodesy Laboratory's equipment from the Institute of Geodesy and the Civil Engineering Research Centre for teaching purposes: Leica ScanStation C10 laser scanner, Leica tacheometer TS30 0,5 sek., Magnetometric devices kit ENVI PRO (2 units), Amagnetic theodolite MinGeo 010A (2units), Gravimeter CG-5, GNPS receiver Leica Viva GS15, Software GNPS for nets processing Bernese 5.0, Level kit Leica DNA 0,3 mm, GNPS receiver Trimble 5700 (2 units).

The software used to create, develop and exploit geoinformation systems takes an important place in the activities of the department of Geodesy and Cadastre. A major part of the software is installed in the Computing centre laboratory (2316 a.), Geodesy and Cadastre teaching laboratory (2715 a.). The specialised software Delta, MatLab, Networked licence ArcGIS (15 units), Software *Inventorizacija* for teaching institutions (15 units) belong directly to the department.

The department of Geodesy and Cadastre is equipped with the most necessary and up-to-date equipment and actively uses it for academic and scientific purposes.

Academic sessions of the *Innovative Solutions in Geomatics* study programme students in Latvia will take place at Civil Engineering Faculty, located at the address 16/20 Azenes Street, Riga. 477m^2 area are allocated for research and educational purposes at Civil Engineering Faculty is the Geomatics Department's disposal. Classrooms and computer room (hereinafter - the training room) to cover 318 m^2 and contains 150 workplaces. An important area of training rooms occupy the classrooms. Department of Geomatics computer room cover about 10% area. The public training rooms of RTU and Civil Engineering Faculty computer rooms 118 m^2 and contains 35 workplaces are accessible, if necessary.

All training rooms have enough space to ensure proper quality of work sessions. All session rooms are in accordance with safety and hygiene regulations. Individual tasks by the students can be done at RTU library branch in the reading-room. In case a computer is required for individual tasks, the students are encouraged to use the Geomatics Department computer room with 10 workplaces or computer class of faculty with 25 workplaces.

5.2. Methodological resources

The availability of publications necessary for VGTU students during their studies is ensured by the VGTU library, which is one of the most modern libraries in Lithuania. The Central Library holdings exceed 0.5 million publications. Students can read books in the library or take them home; they can also use scientific journals and the Internet. In addition, methodological publications and methodological aids are available online at http://e-stud.vgtu.lt/ and http://moodle.vgtu.lt/..

. VGTU has developed an e-book platform http://www.ebooks.vgtu.lt/. This website offers 400 academic books using the iPublishCentral™ newest technologies. The number of such publications is to be regularly increased, as these technologies allow to read books online or download them and read without the

access to the Internet. Some of the books are published and available in bookshops, others are available in the digital format only (e-books). The website also contains books of earlier publications that are no longer in circulation but they are still necessary for students.

The website of Lithuanian academic libraries (http://www.labt.lt/) contains many references to other e-libraries, such as the Lithuanian academic e-library (eLABa) http://www.elaba.lt/; the Lithuanian virtual library www.lvb.lt; the association of Lithuanian scientific libraries http://www.lmba.lt/. Readers may also use the database of the Lithuanian national M.Mažvydas library.

. The reading - room of the Central library provides the wireless Internet, access to the database of the VGTU staff publications, the database of the VGTU scientific journals, the database of patents, the access to subscribed and limited databases and the publications that cannot be taken away. So students are guaranteed appropriate conditions for taking books from the library. Printing, scanning and binding services are also available in the library.

Students and teachers may access databases using the wireless Internet at the VGTU and in the library. The latest information and the possibility to order publications are available on the VGTU library website http://biblioteka.vgtu.lt/ after having browsed the electronic catalogue http://aleph.library.lt/F?func=find-b-0&local_base=vgt01..

The list of the basic methodological books and textbooks issued by the staff of the department of Geodesy and Cadastre which are necessary for the study programme *Innovative Solutions in Geomatics* and issued in the publishing house *"Technika"* is: EK Paršeliūnas. Geoinformation Systems: Technology: Teaching Aid. 2001. 229 p. El. form, Ž. Stankevičius. Digital Maps. Study book. 2002. 150 p., J. Skeivalas. The Theory and Practice of GPS Networks. Monograph. 2008. 292 p. El. form, Ž. Stankevičius. Digital Maps: Symbolisation and Annotation. Study book. 2011. 74 p., A. Stanionis, R. Puzienė. Technologies of Cadastre Information Systems. Study book. 2012. 148 p. El. form, etc.

The list of the methodological material prepared by the Geodesy and Cadastre department's employees according to the project "Updating of Sustainable Residential Environment Study Area Programmes, by Applying Innovative Learning Methods through Reinforcing Interdisciplinary Interrelations and Introducing the Concept of Sustainable Development" (project code VPl-2.2-ŠMM-07-K-01-048) and placed in the Moodle system:
A. Zakarevičius. Higher Geodesy. Study material. 2011. 243 p. El. form, B. Ruzgienė. Photogrammetry: Orthophotographic photo. Study book. 2011.170 p. El. form, R. Bagžiūnaitė, B. Ruzgienė, J. Sužiedelytė-Visockienė. Complex project: Mapping and Planning of Territories. Study material. 2012. 205 p. El.form, E.Paršeliūnas. Geoinformation Systems. Study book. 2012. 115 p. El. form, E. Paršeliūnas. Geodetic and Cartographic Databases. Study book. 2011. 128 p. El. form.

The VGTU library has developed its database containing the most relevant journals for the speciality: Journal of Civil Engineering and Management (ISSN 1392-3730 print / ISSN 1822-3605 online), Journal of Geodesy (ISSN: 0949-7714 print / ISSN: 1432-1394 electronic version), Journal of Geodynamics (ISSN: 0264-3707), Journal of Geodetic Science (ISSN: 2081-9919 print version/ ISSN: 2081-9943 electronic version), Geophysical Journal International (ISSN 1365-246X online), ZFV : Zeitschrift für Geodäsie, Geoinformation und Landmanagement (ISSN 1618-8950), Journal of Geodesy and Geoinformation.

VGTU also subscribes Lithuanian databases: Lithuanian Database of Periodical Bibliographic Articles, Verslo žinios and foreign databases: ACM Digital Library, ACS (American Chemical Society) Publications, American Institute of Physics (AIP)/ American Physical Society (APS), Annual Reviews: Physical Sciences Collection, Computers & Applied Sciences Complete (access through/via EBSCO Publishing), EBSCO Publishing, Emerald Engineering eJournals Collection, Emerald Management eJournals Collection, Environment Complete (Access through/via EBSCO Publishing), ICONDA, IEEE Xplore, IOPscience EXTRA(Institute of Physics) and IOP Publishing Archive collection 1874-1999, Oxford University Press Journals Collection, Oxford Reference Online: The Premium Collection, Grove Art Online, Grove Music Online,Passport GMID (Global Market Information Database), SAGE Journals Online, Science Direct, Science Online, Springer LINK ir Springer Link Archive, Taylor & Francis, Wiley Online Library (Science Technology Medicine).

Teachers use a wide range of methodological aids: from handouts to demonstration of DVD films. A popular way of teaching among the teachers of the programme is the demonstration of slides and comments on them by means of multimedia. Some teachers place study material (PDF) on their personal webpages on the University's website. The teachers continuously improve their methodological material, supplement and update it in accordance with the latest information sources.

The RTU Scientific Library (SL) (at Azenes Street 10) is the oldest higher school library in Latvia. The history of the Library is closely connected with the history of RTU. The formation of the Library dates back to 1862 with the establishment of the library of the Riga Polytechnic – the first higher school in Latvia – based on the donation of 1048 books by the Riga Manufacturing and Stock Exchange Committee, which laid the foundation of the Library collection.

Today RTU SL is the only library in Latvia with such an extensive collection of literature on engineering and architecture (2,3 million units), that can be drawn on as a relevant source of information and reference for developing the Latvian national economy. RTU SL is an essential element in the National Integrated Library Information Network and National Library Stock. The fields covered by SL stock include mathematics, physics, chemistry and chemical technologies, computer science, power engineering, electronics, telecommunications, mechanical engineering and machine building, production technologies, transport, materials science, different fields of construction, commerce, architecture, etc. Significant changes in the operation of the RTU SL were brought about by automation of the Library, starting in 1993. The RTU SL gradually introduced the first integrated library information system ALISE, which was created in Latvia.

In 2000 the RTU SL started using the integrated library information system ALEPH500. Since 2000, the electronic catalogue of the Library is part of the integrated electronic library catalogue of 8 libraries of national importance. This new system also includes an integrated reader database of the libraries of national importance, including RTU SL users. The RTU SL is a member of the Association of Latvian Academic Libraries (LATABA) and Association of International Technological University Libraries (IATUL).

From 2013 the e-readers are available in the RTU SL. In e-readers are placed the collections acording branches of RTU study programs. The electronic resources – A-to-Z, EBSCHOST, Ebrary, ScienceDirect, EBSCOhost eBook Academic Collection, ProQuest Dissertations & Thesis. The Sciences and Engineering, SCOPUS, WILEY Online Library etc. are available in RTU SL for students and teachers.

6. INTENDED STUDY PROCESS

Graduates from the following fields are admitted to the "Innovative Solutions in Geomatics" programme, intended to be implemented by the VGTU Faculty of Environmental Engineering in collaboration with RTU: Measurement Engineering, Geography, Landscape Management, Forestry, Land Management and Geology. Compulsory Bachelor's level subjects and their minimal volume in credits is foreseen for students, who have completed a Bachelor's programme similar to the intended study programme.

Core subjects: Mathematics 13 ECTS, Physics 6 ECTS, Information technology 4 ECTS;

Programme-specific subjects: Geodesy, Advanced Geodesy, Geodetical Measurements Processing, Cartography, Photogrammetry, Geographic Information Systems, Global Positioning systems, Digital Maps, Land Management, Land Cadastre - 21 ECTS.

A joint-Master's degree is granted to graduates of the full-time second cycle *Innovative Solutions in Geomatics* university study programme. The diploma allows the graduates to apply for doctoral degree programmes.

To enter the program is necessary to have good knowledge of English language.

Anyone wishing to study in the program, may apply in one of the partner institutions online. Application form is available and can be completed in English, Lithuanian and Latvian.

Partners maintains its own database for applications processing, storage, provides technical assistance, undertakes to provide all necessary information to study the program.

Student admission is authorized by national accreditation bodies approved the procedures and rules governing the admission to the Master's programs. Students will be registered by the original university, which applied for and was accepted, but later will be registered for the period of the

second mobile partner institution. Each university students undertake to register, create and manage their personal files and information about other university students' achievements.

Masters' academic load is governed by the structure of the program, subjects studied and thesis. Self-employment is governed by a particular subject module. Fixed- graduate studies consists of 3 semesters. Each volume contains 30 semester credits. First and second semester provides 15 weeks of lectures, 4 week session and one week of self-learning. In the third semester provides 3 weeks of lectures (one selected module), 1-week session and the remaining 16 weeks are the thesis and defence. First semester classroom hours will be held in RTU second in VGTU, and the third, depending on the student's chosen module VGTU or RTU.

Lectures, practical work, laboratory work and other classes are evenly distributed through the semester - it is expected that graduate students acquire theoretical knowledge in order to conduct practical and course work. In our opinion, the workload is distributed in a rational manner.

The examination session's timetables are saved in the University's information system's database. The Vice-Dean for Education has the right to change the examination date, time and place, settled between students and lecturers, notifying lecturers and students about the changes.

Timetables of exams and consultation hours are published on the VGTU website - https://medeine.vgtu.lt/pazymiai/login.jsp and the Faculty's bulletin board.

Criteria for students' achievement evaluation depend on the programme's intended learning outcomes. Evaluation criteria are traits that prove the achievement of estimated results. A link between evaluation criteria and estimated learning outcomes is relevant for the entire study programme. The evaluation of the students' knowledge is regulated by the *Vilnius Gediminas Technical University student knowledge evaluation procedures description*, approved by the VGTU Senate's decree No. 51-2.4 of 2011/05/31. Students' achievement evaluation criteria is linked to the estimated learning outcomes of the programme. The knowledge assessment system is criteria-proportionate, according to which the students' knowledge level is evaluated according to the module's criteria and each grade accounts for achieved learning outcomes. A decimal evaluation scale is used in order to evaluate VGTU students' knowledge; the obtained knowledge is evaluated according to the ECTS scale. Knowledge is evaluated and assessed using VGTU and RTU grade equivalents according to the ECTS scale, which are presented in tables 4 and 5.

Table 4. VGTU grade equivalents according to the ECTS scale.

VGTU grade	ECTS scale		
	Grade	Evaluation	Percent of students receiving this grade
10	A	EXCELLENT: outstanding performance with only minor errors	10 %
9	B	VERY GOOD: above the average standard but with some errors	25 %
8	C	GOOD: generally strong work with some notable errors	30 %
7			
6	D	SATISFACTORY: fair but with significant shortcomings	25 %
5	E	SUFFICIENT: performance meets the minimum criteria	10 %
4	EX	FAIL: some more work required before the credit can be awarded	–
3, 2, 1	F	FAIL: considerable further work is required	–

The Latvian national standard uses a decimal evaluation scale for student knowledge assessment.

Table 5. RTU grade equivalents according to the ECTS scale.

Achievement level	Grade	Value	Approximate grade according to ECTS
Very high	10	*izcili* (exceptional)	A
	9	teicami (excellent)	A
High	8	ļoti labi (very good)	B
	7	labi (good)	C
Average	6	gandrīz labi (sufficient good)	D
	5	*viduvēji* (sufficient)	E
	4	*gandrīz viduvēji* (sufficiently satisfactory)	E/FX
Low	3-1	negatīvs vērtējums (insufficient)	Fail

Every module ends with a knowledge assessment test. The test is graded by a grade or a Pass/Fail. Such methods of knowledge assessment are foreseen in the programme: exam (E), course project (CP), course work (CW), final thesis/project (GT). Information on the learning outcomes' evaluation criteria and procedures is published on the VGTU website http://www.vgtu.lt/media/files/5/51-2-4-studentu-ziniu-vertinimo-tvarka--1.pdf, as well as on the website for students "Mano.vgtu.lt" ((http://mano.vgtu.lt/informacija-studentams/studiju-procesas).

The composition of the final grade is described in "VGTU student knowledge evaluation procedures description". Every teaching professor explains the composition of the final grade for his subject during the first lecture. Assessment criteria is published on the MOODLE page of each VGTU lecturer.

E-type exams are assessed by a grade. Time before the examination session is allocated to prepare and take the exam. The examination grade can be composed from three or two parts. An examination grade consisting of three parts is required for the first cycle study modules, the scope of which, excluding the credits for the course project or work, is larger than four credits (here one credit equals to one week of student work, i.e. 40 hours). A two-part exam grade consists of the grade accumulated from the assessment of the module's practical tasks completed during the semester and the module's exam mark.

The grade is calculated in the following manner:

$E = W1(A1x1 + A2x2 + ... + Anxn) + W3(C1z1 + C2z2 + ... + Ckzk)$,

where: E - student's grade according to the decimal scale: W1 - weight ratio of the assessment accumulated during the semester; W3 - weight ratio of the exam grade (W1 + W3 = 1.00); A1, A2, ..., An - weight ratio of practical assignments, assigned during the semester (A1 + A2 + ... + An =1.00); xi - assessment of a separate assignment according to the decimal system (e.g.: x1 - test mark; x2 - homework assignment mark; x3 - laboratory work mark, etc.); C1, C2, ..., Ck - weighted ratios of the exams taken during the examination session, assignments (C1 + C2 + ... + Ck =1.00); z - assessment of a separate exam assignment according to the decimal system (e.g.: z1 - examination's first question score; z2 - examination's second question score; z3 - examination's third question score, etc.). The grade, consisting of three parts, is calculated in the same manner.

Parts that compose the exam and their weight ratio values are set by the department, responsible for the module, in accordance with the fact that the grade accumulated by the student during the semester for practical assignments must amount up to 30 % of the final grade. Grades accumulated for practical assignments of the module during the semester are included only if each of them meets minimal requirements. Adequately completing and accounting for assignments provided in the module card before the deadline can yield a 10% increase of the student's grade. An exam is graded positively if the grade, accumulated by the student during the semester for practical assignments of the module, meets minimal requirements, and if grades for other knowledge assessments (theoretical knowledge tests, examination session exam) or their total meets the requirements for a positive grade. The student must participate in the exam session regardless of the portion of the grade accumulated from tests and completed practical assignments. The student is not allowed to take the examination session's examinations, if he has not completed the assignments provided in the module card.

Submitted and defended course project (CP) and course work (CW) are assessed by a grade. The final thesis 1, 2 (FT 1, 2) is graded for the submitted and defended research paper's report. The final thesis/project 3 (FT 3) is graded for the prepared final thesis or project that have been defended in front of the degree awarding commission (hereafter - DAC). The specified grade composition is adequate for thorough and objective assessment of the student's achievements.

The process of writing the Master's theses begins in the first semester of the second cycle studies. The Dean approves topics and academic advisors for the final theses before the due date provided in the study plan. The final thesis is the generalised and final assignment of the second cycle studies. When preparing the thesis, the student analyses a particular technical problem and applies the deepened knowledge and skills acquired during the studies. The final thesis is defended only after accounting for the tests provided in the study programme modules.

The Master's degree DAC is formed in accordance with the VGTU Rector's decree No. 80. of 2007/02/19. The Master's degree DAC is formed of 6 competent expert scientists in the particular field, professional practitioners, prospective employers. It is provided that at least one member of the Commission (preferably the Chairperson of the Commission) has to be someone who has not worked at the University for the past three years. The Head of the Commission must have a degree and (or) a title. There has to be at least one scientist from a different academic field. Graduate student's thesis supervisor must be a member of the Commission. Defence of final theses is organised simultaneously in VGTU and RTU. The choice of place for the defence of final thesis depends on which department supervises the student's final thesis. The Commission consists of 4 members from the institution where the thesis is defended and 2 delegated members from the program's associate institution.

Relations between the intended learning outcomes and evaluation methods for studies and achievements are presented in Table 6.

Table 6. Relations between intended learning outcomes, study subject (module) results and evaluation methodology for the studies and student achievements

Intended learning outcomes of the programme	**Learning outcomes of the study subject (module)**	**Subject study methods**	**Student achievement evaluation methods**
Knowledge, its application: knows scientific research methodologies methods, organisation, planning and introduction of innovations; knows about the application of innovative solutions in geomatics, latest research methods, most appropriate scientific research tools, is able to apply the acquired knowledge to interdisciplinary studies and professional activities; knows the application possibilities and main development tendencies of contemporary electronic geodesic measuring systems; knows the methodologies of and principal theoretic solutions for unanimous, multi-purpose and different type geodesic network design, digital relief and three-dimensional model	Z1. Will know scientific research methodologies, methods, organisation, innovation planning and implementation. Z2.Will know about innovative solutions application in geomatics, latest research methods, and most appropriate scientific research tools. Abilities to apply the acquired study knowledge to interdisciplinary studies and professional activities. Z3.Will know about the possibilities of contemporary electronic geodetic measurement system application and their main development trends. Z4. Will know about the methodologies of and principal theoretic solutions for unanimous, different purpose and type geodetic network	Lecture, seminar, discussion, individual and group work, individual scientific literature study, listener presentations, research report preparation, consultation, writing of the final thesis	Particular case study, presentation (public speech), methods of evaluations in writing (written survey, test, control tests, colloquium, etc.), practical evaluation methods (exams, reports, etc.), observation of group and individual presentations, essay analysis, interview, report analysis, testing by half-open and close-ended questions, research project defence, individual and group homework, processing of research project studies and acquired results, final thesis supervisor's evaluation (review).

development; knows the composition of geoinformational systems, technological and developmental trends and their application to specialised geodesic, cartographic and cadastre needs; knows the innovative remote sensing and photogrammetry methods; knows the structure of geographic information infrastructure and its development technologies.	design, digital relief and three-dimensional model development. Z5. Will know about the structure of geoinformational systems, technological and developmental trends and their application to specialised geodesic, cartographic and cadastre needs. Z6. Will know about innovative remote sensing and photogrammetry methods. Z7. Will know the structure of geographic information infrastructure and developmental technologies.		
Capacities for conducting research: is able to collect, organize, analyse and evaluate research data required for scientific and professional activities and innovations; is able to correctly choose effective experimental research tools and equipment for solving problems in geomatics; is able to evaluate and research the application of new and currently developed technologies to measurement engineering; comprehends the importance of scientific research in solving current and future problems of measurement engineering.	GV1. Will be able to collect, organize, analyse and evaluate research data required for scientific and professional activities and implementation of innovations. GV2. Will be able to correctly choose effective experimental research tools and equipment for solving geomatic problems. GV3.Will be able to evaluate and research the application of new and currently developed technologies to measurement engineering. GV4. Will comprehend the importance of scientific research in solving current and future problems of measurement engineering.	Lecture, seminar, discussion, individual and group work, individual scientific literature study, listener presentations, research report preparation, consultation, writing of the final thesis	Particular case study, presentation (public speech), methods of assessment in writing (written survey, test, control tests, colloquium, etc.), practical assessment methods (exams, reports, etc.), observation of group and individual presentations, essay analysis, interview, report analysis, testing by half-open and closed-ended questions, research project defence, individual and group homework, processing of research project studies and acquired results, final thesis supervisor's evaluation (review).
Special competences: is able to interpret theoretical and experimental results, evaluate economic concerns and patenting possibilities; is able to apply geomatics innovations and harmonize application competences with the basics of business and management; is able to develop and expand geodetic networks, design digital relief models, design spatial Earth surface models, design digital maps, prepare GIS data and conduct accuracy and quality evaluation; is able to utilise contemporary electronic geodesic measurement systems and develop and implement new technologies	SG1. Will be able to interpret theoretical and experimental results, evaluate economic concerns and patenting possibilities. SG2. Will be able to apply geomatics innovations and harmonize application abilities with the basics of business and management. SG3. Will be able develop and expand geodesic networks, compose digital relief models, compose spatial Earth surface models, compose digital maps, prepare GIS data and conduct accuracy and quality evaluation. SG4. Will be able to utilise contemporary electronic geodesic measurement systems, develop and implement new	Lecture, seminar, discussion, individual and group work, individual scientific literature study, listener presentations, research report preparation, consultation, writing of the final thesis	Particular case study, presentation (public speech), methods of evaluations in writing (written survey, test, control tests, colloquium, etc.), practical evaluation methods (exams, reports, etc.), observation of group and individual presentations, essay analysis, interview, report analysis, testing by half-open and closed-ended questions, research project defence, individual and group homework, processing of research project studies and acquired results, final thesis supervisor's evaluation

of their improvement; is able to apply geographic information systems to geodetic and cartographic data, spatial geoinformation accumulation, organization, analysis and control; is able to compose specialised databases of geographic information systems by combining geodesic measurement data acquired via various methods and techniques; is able to improve the composition of specialised geodetic and cartographic databases, optimise the cartographic and cadastral data mining and organization by modelling maps in geoinformational systems.	technologies of their improvement. SG5. Will be able to apply geographic information systems to geodetic and cartographic data, spatial geoinformation accumulation, organization, analysis and control. SG6. Will be able to compose specialised databases of geographic information systems by combining geodetic measurement data acquired via various methods and techniques. SG7. Will be able to improve the composition of specialised geodetic and cartographic databases, optimise the acquisition and organization of cartographic and cadastral data by modelling maps in geoinformational systems.		(review).
Social competences: is able to communicate and collaborate with experts in his field and other fields, work in a team; is able to communicate with his colleagues, experts, the public, and convey the results of professional activities in correct, oral and written official language; is able to convey generalised information to experts and other persons clearly and argumentatively, evaluate it critically; is able to take responsibility for the quality of his own and his subordinates' work in accordance with professional ethics and the public spirit; is able to obtain experience from experts and convey it to colleagues.	CG1. Will be able to communicate and collaborate with experts in his field and other fields, work in a team. CG2. Will be able to communicate with his colleagues, experts, the public and convey the results of professional activities in correct, oral and written official language. CG3. Will be able to convey generalised information to experts and other persons clearly and argumentatively, evaluate it critically. CG4. Will be able to take responsibility for the quality of his own and his subordinates' work in accordance with professional ethics and the public spirit. CG5. Will be able to obtain experience from experts and convey it to colleagues.	Lecture, seminar, discussion, individual and group work, individual scientific literature study, listener presentations, research report preparation, consultation, writing of the final thesis	Particular case study, presentation (public speech), methods of evaluations in writing (written survey, test, control tests, colloquium, etc.), practical evaluation methods (exams, reports, etc.), observation of group and individual presentations, essay analysis, interview, report analysis, testing by half-open and closed-ended questions, research project defense, individual and group homework, processing of research project studies and acquired results, final thesis supervisor's evaluation (review).
Personal competences: is able to organise his work and make decisions responsibly and independently; is able to think critically and constructively, evaluate qualitative and quantitative information, analyse it and formulate conclusions; is able to apply expertise acquired through lifelong learning to solve geodetic and geomatic problems; is able to critically	AG1. Will be able to organise his work and make decisions responsively and independently. AG2. Will be able to think critically and constructively, evaluate qualitative and quantitative information, analyse it and formulate conclusions. AG3. Will be able to apply his expertise acquired through lifelong learning to solve geodetic and geomatic	Lecture, seminar, discussion, individual and group work, individual scientific literature study, listener presentations, research report preparation, consultation, writing of the final thesis	Particular case study, presentation (public speech), methods of evaluations in writing (written survey, test, control tests, colloquium, etc.), practical evaluation methods (exams, reports, etc.), observation of group and individual presentations, essay analysis, interview, report analysis, testing by half-

evaluate his innovative solutions as well as those of the others, understanding possible social and ethical consequences of his activities; is able to organise activities in unusual circumstances, when comprehensive information, instructions and experience are lacking.	problems. AG4. Will be able to critically evaluate his innovative solutions as well as those of others, understanding possible social and ethical consequences of the activity. AG5. Will be able to organise activities in unusual circumstances, when comprehensive information, instructions and experience are lacking.		open and closed-ended questions, research project defence, individual and group homework, processing of research project studies and acquired results, final thesis supervisor's evaluation (review).

7. PROGRAMME MANAGEMENT

The study programme and its update is under the supervision of the Programme Committee, which acts in accordance with the VGTU Study Programme Committee Provisions, approved by the Resolution No. 62-2.2. of 19 February, 2013. Study Programme Committee is subordinate and accountable to the Dean of the Faculty and the Faculty Study Committee. Apart from the Department of Geodesy and Cadastre, other departments of the university also participate in the implementation of the programme. The departments cooperate systematically with the Department of Geodesy and Cadastre to implement this programme: the study modules, including their contents and scope, submitted by these departments are considered; and the comments regarding the studies quality improvement made by the teachers of these departments are taken into account.

Study quality assurance and programme managers' responsibilities are described in the documents of various levels of significance, such as the VGTU vision; the description of the study quality management system module; the long-term development plans; the Statute; the study provisions adopted by the Senate Decree No. 58-3.1 of 26 June, 2012; the provisions of Study Programme Committee; the descriptions of the programme and the modules; the guidelines and other internal and external documents related to studies.

The rules of the study procedure determine the programme management at RTU. The rules of the study procedure are the collection of normative acts including decisions of RTU Senate, Orders of Rector and Vice-Rector and other documents, supplemented with comments and explanations.

Riga Technical University quality policy is focused on the implementation of the RTU mission and strategic objectives – research activities, studies, infrastructure, excellence of organization and recognition of achievements. RTU internal quality assurance system is based on the RTU Senate Decision (Protocol No. 553, 31st October, 2011) "RTU quality policy" University Quality Policy harmonizes with the standards and guidelines and preconditions of ISO 9001: 2008 of the European Association for Quality Assurance in Higher Education (ENQA – European Association for Quality Assurance in Higher Education). The program director, the Council of the Faculty of Civil Engineering and the Commission of Architecture and Civil Engineering Branch are responsible for program management and quality.

The management of RTU and VGTU joint study programme *Innovative Solutions in Geomatics* will be implemented by Council of Programme (Council), which will be in charge for quality, constitution and structure of the study programme, manages the development and implementation of programme, carry out the tasks of the program budget and its amendments. Council acts on the basis of consultation and cooperation, in order to ensure the implementation of the programme. The Council of Programme is matching VGTU and RTU Study programme committee functions.

Students' opinions on the study programme, its implementation and update are expressed through the University Students Representation Council and its representatives on the Study Committees, the Faculty Council and the Senate. Apart from representatives from the university departments, representatives of social partners also take part in the Study Committee decision-making process, therefore, the execution and development of the study programme is performed considering the comments and requests of all the parties involved in the process.

The internal university study quality assurance system and the documents according to which it is regulated are based on the provisions of the European Higher Education Study Quality Assurance, the Law on Science and Studies and the orders of the Minister of Education and Science .

The Study Programme Committee, the Faculty Study Committee and the Council assure the study programme quality maintenance. The internal study quality assurance is executed by controlling various study processes, monitoring, assessing and applying feedback and self-assessment methods.

The Department of Geodesy and Cadastre cooperates closely with various Lithuanian and foreign science and educational institutions, as well as other institutions and industrial organizations. The educational institutions – partners could fall into two categories: partner institutions in Socrates/Erasmus programme and partners who concluded mutual partnership agreements with the Department. The Department cooperates with some organizations in conducting research, consulting and exchanging scientific-technical information. Meetings with representatives of the largest industrial organizations, such as SE ʻThe Centre of Registersʼ, JSC ʻInžineriniai tyrinėjimaiʼ, ʻCorporation Matininkai Ltdʼ, ʻThe Institute of Aerogeodesy Ltdʼ, PI Lithuanian Land Fund, SE The National Center of Remote Sensing and Geoinformatics ʻGIS-Centrasʼ, HNIT – BALTIC GeoInfoService, ʻInfoEra Ltdʼ and others are organized. Close relationships are maintained with SE the National Land Service under the Ministry of Agriculture, the National Association of Geodesy, Cartography and Land Use Enterprises, the Lithuanian Association of Surveyours and the Lithuanian Cartographic Society.

During the meetings with social co-partners, study quality and student theoretical and practical preparation issues are discussed. The social co-partners comments are very useful for the development of the contents in separate module of the study programme, expanding the contents of each module by supplementing time with topics related to the industry.

The Department of Geomatics organizes every year Career days and invites their social co-partners to give lectures and practical demonstrations at the RTU Faculty of Civil engineering. A considerable number of graduates of the Department, their employers and partners from foreign countries participate in annual international conferences organized in the Faculty. The regular contacts with governmental, scientific, private companies help to form and develop innovative study programme. Also department is a full and active member of International Federation of Surveyors – FIG and Latvian surveying society – LMB.

The social co-partners regularly suggest current and worthwhile topics related to modern geodesy and cadastre for the theses of basic academic studies. The topics they suggest to be analysed in theses aim at solving important practical issues. By the Rector's order, master's degree-granting commissions, chaired by social co-partners, are formed for thesis defence and evaluation. The social co-partners' comments on the themes, contents and defence of theses contribute to thesis quality improvement.

The close cooperation with social co-partners completely extends its benefits in the implementation and development of the study programme, as well as the improvement of the study and the prospective specialists' quality. Therefore, the Department of Geodesy and Cadastre is not planning to decrease its attention to the relationships with social co-partners in the future. During the execution of the study programme, study quality assessment and development are performed constantly by using the knowledge of the Department of Geodesy and Cadastre obtained over many years of experience in preparing specialists in geodesy.

. The quality of the study programme execution corresponds to the provisions of the European Higher Education Area.

8. CAREER OPPORTUNITIES FOR PROGRAMME GRADUATES

The graduates who complete *Innovative Solutions in Geomatics* study programme can work at state institutions, as well as for private companies, such as: SE the National Land Service under the Ministry of Agriculture; HNIT-BALTIC GeoInfoService; ʻInžineriniai Tyrinėjimai Ltd', ʻThe Institute of Aerial Geodesy Ltd', SE ʻThe Centre of Registers', SE Lithuanian Land Fund, SE The National Centre of Remote Sensing and Geoinformatics ʻGIS-Centras', scientific industrial company ʻCad ir F Projektservisas Ltd', ʻCadastre for You Ltd', ʻGPS Partneris Ltd', ʻCorporation Matininkai Ltd', ʻGeodera Ltd', ʻGeomatininkas Ltd', ʻHidrostatybos Projektai Ltd', ʻKordimatas Ltd', ʻAristoma Ltd', ʻGeoplanas Ltd' and others. Graduates can also work for companies specialising in surveying instruments, such as: ʻTPI Ltd'; ʻGeo Systems Baltija Ltd'; ʻGeomax Ltd'; ʻGPS Partneris Ltd', ʻGeovzija Ltd', ʻNetkada Ltd' and others.
The graduates who successfully complete *Innovative Solutions in Geomatics* study programme and have two-years' experience in working for geodetic companies, can start their own (individual) companies.

VGTU Integration and Career Office implement a graduate filing project for students and employers. It helps students get jobs in their favourite fields and take first steps into the labour market, while employers get an easier way to find young, energetic and talented specialists who are willing to work. The aim of the project is to: introduce the best graduates from VGTU to Lithuanian and foreign companies and organizations; enhance Lithuanian technical university students' interest in Lithuanian and foreign companies' needs; improve professional skills; promote technology science; create favourable conditions for building relationships between business representatives and young specialists.

The Department of Geodesy and Cadastre closely cooperates with companies - social partners, such as PI the National Land Service under the Ministry of Agriculture, PI ʻThe Centre of Registers', PI Lithuanian Land Fund, PI The National Center of Remote Sensing and Geoinformatics ʻGIS-Centras', HNIT-BALTIC GeoInfoService, JSC ʻInžineriniai tyrinėjimai' and ʻThe Institute of Aerogeodesy Ltd'. At least once a year meetings with the social partners are held, where current issues and employers' needs are discussed and taken into consideration during the course of teaching.

An international experience developed throughout the studies open up good opportunities to apply the mastered knowledge and skills in Lithuania, Latvia and other EU member states and to be employed by multidisciplinary companies and organizations involved in the supply of consulting, planning and design services or different kinds of surveying or GIS applications.

Graduates of common master programme would be specialists in demand at the State Land Service of Latvia. The State Land Service (hereinafter - "SLS") is a governmental institution of the Republic of Latvia which was established in 1992 to implement land reform. SLS is in charge of real property object data accumulation and dissemination to institutions responsible for land management and supervision. Also graduates would be very welcome at the Latvian Geospatial Information Agency (LGIA), which is one of the leading institutions in the realizing of the national policy in the field of geodesy, cartography and geospatial information. Pursuant to the competence the LGIA cooperates with state and local authorities, with the NATO member states, with European Union institutions and competent international organizations, as well as provides to these organizations and to the public geodetic, cartographic and geospatial information. As well our graduates work at the Rural Support Service (RSS), which is state administration institution and operates under the supervision of the Ministry of Agriculture in accordance with the Law on Rural Support Service. The Rural Support Service is responsible for implementation of a unified state and EU support policy in the sector of agriculture, forestry, fisheries and rural development; it supervises compliance of the sector with the laws and regulations and fulfils other functions connected with agriculture and implementation of rural support policy. Besides that our graduates work at Latvian State Forest service, Maritime Administration of Latvia, State Joint Stock Company Latvijas Gaisa Satiksme (LGS), which provides to the users optimum Air Navigation Services in Riga Flight Information region, etc.

Graduates of *Innovative Solutions in Geomatics* Master programme has the access to Doctoral (PhD) studies.