DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION OF THE STUDY PROGRAMME				
1.1. Name of the study programme	**Geodesy and Geoinformatics**			
1.2. Provider(s) of the study programme	**Faculty of Geodesy, University in Zagreb**			
1.3. Type of study programme	Vocational study programme ☐		University study programme X	
1.4. Level of study programme	Undergraduate X	Graduate ☐	Integrated ☐	Postgraduate specialist ☐
1.5. Manner of implementation of the study programme	Classical X	Mixed (Classical + online) ☐	Online in entirety ☐	
1.6. Academic/vocational title earned at completion of study	**Bachelor (baccalaureus/baccalaurea) of Engineering in Geodesy and Geoinformatics**			

2. INTRODUCTION	
2.1. Reasons for starting the study programme	The important period for the development of academic education of geodesists, i.e. for the development of study programmes applied in their education, is the late 19. century when the Forestry Academy was founded at the Faculty of Philosophy of the University of Zagreb in 1898. Among other technical subjects, geodesy was also lectured at the Forestry Academy. Since the demand for adequately trained experts needed to regulate property relations, to divide land, perform land consolidation, cadastral surveys etc. was constantly increasing, a separate Geodetic Course was introduced in 1908 at the Forestry Academy. The Geodetic Course with the "teaching principles" completely identical to the curricula of geodetic studies at high schools in Prague and Vienna was held at the Forestry Academy until 1919 when it was moved as Geodetic Department to the Technical High School founded one year earlier. Higher education of geodesy experienced significant changes in 1926 when High Technical School became a component of the University in Zagreb as Technical Faculty with adequate departments. Geodesy was taught within the frame of Geodetic Cultural and Engineering Department. In 1929, this department was named Geodetic Cultural and Technical Department. The teaching activities thus organised were performed until 1946 when two new majors were introduced at the Technical Faculty: geodesy and land improvement. The teaching activities according to these curricula were performed until 1948. The economic and political circumstances of that time entailed the changes in further development of geodetic courses. It was the time of the post-war reconstruction and building requiring a larger number of geodetic engineers and the application of new geodetic methods conditioned by rapid development and the complexity of civil engineering. At the same time, the regulation of agrarian and legal relations, and consequently of land improvement activities came to halt, which resulted in abolishing the land improvement as major at the Technical Faculty in 1951.

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One of the more important events in the development of geodetic teaching activities is the division of the Technical Faculty made in 1956, when four new faculties were formed from previous departments. One of them was the Faculty of Architecture, Civil Engineering and Geodesy (AGG) that continued to operate in this capacity until 1962. In that period, new teaching and scientific units were founded, new subjects introduced, new teachers appointed, and new teaching tools and instruments provided at the Geodetic Department improving thus the teaching activities. Such development resulted in the foundation of the independent Faculty of Geodesy at the University in Zagreb in 1962.

In 1978, the Law on Higher Education was passed promoting the process of creating a new undergraduate study programme curriculum that significantly changed the teaching activities. The next new curriculum was adopted in 1985, and in 1995/96 anther curriculum that was significantly improved. The study programme for acquiring higher qualification lasting 5 semesters was introduced at the Faculty in 1981. The last generation of this study programme was enrolled in 1995/96.

After the regulations about the implementation of study programmes according to the Bologna Declaration had come into effect, the process of preparing the study programmes of Bachelor, Master and Postgraduate studies was initiated and they were introduced into teaching activities in the academic year 2005/06. The study programmes were prepared in accordance with the development of the profession and with international trends, and the accreditations were obtained for the following study programmes:

- Geodesy and Geoinformatics – university Bachelor study programme
- Geodesy and Geoinformatics – university Master study programme
- Geodesy and Geoinformatics – postgraduate university study programme (doctoral)
- Geodesy and Geoinformatics – postgraduate specialist university study programme

The above mentioned study programmes and the Faculty of Geodesy being the holder of these study programmes were involved in the process of external evaluation of programmes and reaccreditation and obtained the accreditation for the continuation of performing the mentioned study programmes (Summary Report of Reaccreditation of the Faculties at the University in Zagreb until the academic year 2012/13) earning high grade of 4,29.

Referring to the above mentioned, this documents do not present the proposal for the initiation of new study programme, but related to a series of circumstance in the recent years, the intention of the Faculty of Geodesy to

	create and present complete documentation for Bachelor study programme of Geodesy and Geoinformatics in its effort to prepare the proposal for the amendments to the existing Bachelor Study Programme of Geodesy and Geoinformatics. The reasons for the amendments to the existing Bachelor Study Programme of Geodesy and Geoinformatics derive from the following items: - the notions (findings and recommendations) deriving from the Self-analysis of the Faculty of Geodesy, University in Zagreb that was carried out during the year 2011 and accepted at the 4. special meeting of the Faculty Council of the Faculty of Geodesy, University in Zagreb in the 343. academic year 2011/12 held on 12. January 2012, - the accreditation recommendation of the Agency for Science and Higher Education in the procedure of re-accreditation of the Faculty of Geodesy, University in Zagreb of 7. January 2013, - the report and recommendation of the Expert Committee for Re-accreditation of the Faculty of Geodesy, University in Zagreb made in June 2012, and - rapid technological changes occurring in numerous technologies and systems used by geodesists in their practice, which has also resulted with the changes related to the methods of geodetic work, i.e. to the understanding of spatial information and to the remarkable growth of its significance in modern society and sustainable development. The detailed description of the amendments to the existing Bachelor Study Programme of Geodesy and Geoinformatics is given in the Form 7.
2.2. Assessment of the study programme's usefulness relative to the demand in the labour market in the public and private sectors	The demand for highly educated engineers of geodesy and geoinformatics is very high, both in Croatia and abroad. The economy related to geodesy and geoinformation, as well as the entire professional activity flourished from the end of the Homeland War until the world economic crisis in 2008 that was followed by the economic crisis in Croatia. In the period between 1998 and 2008, the entire "production" of geodetic and geoinformation experts at the Faculty of Geodesy hardly met the market demands, although it was doubled. The average annual number of unemployed engineers of geodesy/Bachelors of Engineering in Geodesy and Geoinformatics was smaller than 20 at the annual level in the period between 2004 and 2009. The average number of unemployed graduate engineers of geodesy/Master of Engineering in Geodesy and Geoinformatics was 12 (the data from the Croatian Employment

Institute – HZZZ).

The economic crisis has had a great impact on the employment of highly educated experts in geodesy and geoinformatics ever since 2010 and on. The crisis coincided with the effects of short-term hyperproduction of staff that was caused by unobjective increase of enrolment quotes at the beginning of applying new Bologna study programmes (from the academic year 2005/06 until 2009/2010). These two effects were joined in 2010 and caused the growth of unemployment of highly educated geodesists for more than 100 in only three years (106 Masters of Engineering in Geodesy and Geoinformatics in 2012 and almost as many engineers (HZZZ data)).

Nevertheless, the needs of the society for spatial data, regulation of property register and proprietorship registers, i.e. of various spatial registers are persistent, and these factors along with bringing the enrolment quotes down to real frames (80-90 in the academic year 2011/12) resulted in the reduction of unemployment of Masters in Engineering and Geoinformatics by 34% (70). In 2013 there were more engineers employed that those having completed the studies (HZZZ data).

It can be seen from HZZZ data today that there were 23 engineers of geodesy and 11 Bachelors in Engineering of Geodesy and Geoinformatics unemployed at the end of October 2014, i.e. there were 25 graduate engineers of geodesy and 46 Masters in Engineering of Geodesy and Geoinformatics unemployed.

Due to the incompatibility of the education system (Bologna) with the economic system, about 100-120 students who graduate from the Bachelor Study Programme of Geodesy and Geoinformatics in Zagreb and Split, 80 of them are admitted at the Master Study Programme of Geodesy and Geoinformatics in Zagreb, hence, only one third enters the labour market, and the number of unemployed Bachelors in Engineering of Geodesy and Geoinformatics is still relatively small today related to the number mentioned above and to the given circumstances.

The above mentioned illustrates that the education of Bachelors in Engineering of Geodesy and Geoinformatics related to the needs of labour market and further education is purposeful and contributes to the community, because in spite of relatively small employment, the geodetic and geoinformation sector of economy operates

	positively even in the crisis situation. It is generally obvious that there is a demand for Bachelors in Engineering of Geodesy and Geoinformatics, i.e. for the Bachelor Study Programme of Geodesy and Geoinformatics at the Faculty of Geodesy, University in Zagreb, considering the fact that this profession is one of the basic technical professions whose beginnings are connected with the beginnings of urban civilization.
2.3. Compatibility of the study programme with the University mission and the strategy of the proposer, as well as with the strategy statement of the network of higher education institutions.	The Faculty of Geodesy is the constituent member of the University in Zagreb. As such, the Faculty of Geodesy is an important factor in implementing the vision and mission of the University in Zagreb. With its study programmes, research activities, the promotion of knowledge and ethics at the national level, as well as with nurturing and developing the international collaboration, the Faculty of Geodesy as the institution of the University in Zagreb contributes actively in the implementation of the University's vision and mission. Apart from carrying out its planned activities, the Faculty of Geodesy being the institution of the University exercises its rights and duties also by active participation in the work of University bodies (Senate, Technical Field Council, committees,...) being an essential element of the integration and contribution of the Faculty to the development of University. Following the guidelines of the Strategy of Study Programmes and Studying at the University in Zagreb from May 2014, the Bachelor Study Programme of Geodesy and Geoinformatics complies with the mission of the University in the field of study programmes and studying: - *The University will be developing comprehensively with the wide spectrum of research, art and studying programmes:* - *the University shall maintain its leading academic and research role at the national level and shall develop into internationally recognisable and one of the leading regional centres;* - *the University shall engage in public activities as an initiator of technological, economic, cultural and social development in accordance with the needs of the Republic of Croatia;* - *the University shall develop and provide various types of life-long learning;* - *the University shall provide stimulating, creative and motivating environment for learning and teaching. Motivated students and motivated teachers are in the focus of educational process;* - *Students acquire skills according to learning outcomes of study programmes that are recognisable and applicable in the society as a whole and contribute to the personal development of students.* In the context of the Bachelor Study Programme of Geodesy and Geoinformatics, the above mentioned is related specially to the last two items of mentioned mission.

	In accordance with the Strategy of Study Programmes and Studying at the University in Zagreb containing the values promoted also by the Faculty of Geodesy, **learning and teaching is based on the following educational postulates:** - Students are in the focus of educational process that provides for them a responsible approach and active studying in acquiring knowledge and skills and in adopting new concepts. - Learning and teaching are based on research and on solving the problems with tutor support in the professional context, which stimulates the students to approach the problems holistically, supports creativity, innovation, initiative behaviour, interdisciplinarity, critical thinking, analyticity and responsibility, as well as ethical conduct and professional independence; - The acquisition of knowledge and skills, as well as accompanied independence and responsibility, are stimulated by means of individual learning and cooperative teaching strategies. In this process, only motivated competent teacher can be student's partner, which is connected with the **quality culture** that is reflected in excellence in learning and teaching, in the activity complied with the mission and vision, in reaching strategic goals, but also in the satisfaction of students, teachers, researchers and other employees, as well as of external assistants with the activity of the University and the Faculty of Geodesy. In accordance with the guidelines of the Strategy of Study Programmes and Studying, page 5.: *In the implementation of the study programmes, the connection of educational process with research and creative activities is applied taking care that the studies are relevant in professional sense, but also provide additional values that will contribute to the development of economy and society with the responsibilities taken over. The University in Zagreb cannot increase the number of students in short time (until 2016), but it should aim for the redistribution in levels (more students in Master study programmes) and in areas (more students in STEM). In long-term planning, it is necessary to establish efficient cooperation with state authorities and economic partners in the development of national development strategy and of understanding the role of the University in EU and wider* .that comply with the intentions of the **Innovation Strategy of the Republic of Croatia 2014.-2020.** The Faculty of Geodesy has created and organised the Bachelor Study Programme of Geodesy and Geoinformatics in the manner that shall contribute to the implementation of these goals, and further provide the education of high-quality and broadly educated geodetic and geoinformation experts in the Master Study Programme of Geodesy and Geoinformatics, Postgraduate study programme of Geodesy and Geoinformatics, and Postgraduate Specialist Study Programme of Geodesy and Geoinformatics in accordance with the guidelines of the **Research, Technology Transfer, and Innovation Strategy of the University in Zagreb** (February 2014) and the **University Internationalisation Strategy 2014-2025** (May 2014), contributing thus to the development of our country.

	Hence, the **vision of the Faculty of Geodesy:** *Highly educated experts in the field of geodesy and geoinformatics who shall essentially improve the production of geoinformation and its usage in the society,* complies completely with the mission, vision and strategic guidelines of the University in Zagreb. The Faculty of Geodesy, University in Zagreb is one of two higher education and research institutions in the field of geodesy and geoinformatics in Croatia. This provides certain advantages, but also presents some threats. The comparison with similar institutions in the region indicates the leading role of the Faculty, but also wider. The Faculty has therefore focused its vision in wider area. The quality of teaching and of research and professional work has so far provided equal international collaboration for students and teachers. Graduate students continue their studies at prominent universities in the world without having to prove their knowledge, and there is a great demand for those who want to work outside of Croatia. In such circumstances, the realisation of the vision requires only diligent work along with the increase of quality and influence on wider social community. Similar can be applied for the **mission of the Faculty of Geodesy** as well**:** *To provide superior knowledge based on ethically acknowledged notions and practical skills at the national and international level to all users as one of the leading institutions of recognisable and prominent University using sustainable systematic activities based on the regulations and good experience with constant improvement of quality in collaboration with all interested parties.* The realisation of the mission is supported by the programmes of international collaboration and exchange of teachers and students, as well as the development of systems at the Faculty. It refers especially to the quality assurance system and the system of financial management and control.
2.4. Comparability of the study programme with other accredited programmes in higher education institutions in the Republic of Croatia and EU countries (name two programmes at most, of which one is from an EU country, and compare it with the proposed programme (provide internet	Since the academic year 2010/2011, the Faculty of Civil Engineering, Architecture and Geodesy in Split has been running similar, almost identical study programme because it took over the existing Bachelor Study Programme of Geodesy and Geoinformatics from the Faculty of Geodesy and performs teaching activities with the help of the teachers employed at the Faculty of Geodesy. It is therefore objectively not possible to compare the suggested study programme with any other similar institution in the Republic of Croatia. Since it used to be a unique institution of that kind in Croatia, the Faculty of Geodesy always compared the contents

addresses of the programmes)	and form of its study programmes with the similar study programmes in Europe. Moreover, as the heirs of central European tradition, we made comparisons and coordinated our activities with the most prestigious academic institutions in Germany, Austria and Switzerland inheriting mutually geodetic experts having high level of technical knowledge and skills needed to perform the tasks in geodesy and geoinformatics. The tradition of several decades shows that a part of teaching staff of the Faculty of Geodesy made their doctoral degree exactly at these institutions. Recently, two teachers at the Faculty of Geodesy made their doctoral degree at the Leibnitz University Hannover, three at the Technical University in Vienna, and one at the Technical University in Graz. The proposed Bachelor Study Programme of Geodesy and Geoinformatics can be compared with the Bachelor study programmes of the above mentioned universities, as for example the Technical University in Munich or ETH Zürich, i.e. other academic institutions in Central Europe, but also in the world, that educate students at Bachelor study programmes. We would also like to point out that the teachers of the Faculty of Geodesy analysed a series of study programmes and their contents, which is presented in the work by Frančula N. and Lapaine M.: Studiji geodezije i geoinformatike u Europi (Study Programmes of Geodesy and Geoinformatics in Europe), Geod. list 2011, 2, 145–156. http://hrcak.srce.hr/index.php?show=clanak&id_clanak_jezik=107193 and revised in the work by Frančula N: Studiji geodezije, geoinformatike i geomatike u svijetu (Study Programmes of Geodesy and Geoinformatics in the World), Faculty of Geodesy, September 2013, 1-39. http://www.geof.unizg.hr/mod/forum/discuss.php?d=135 . For comparison, there are Internet addresses attached related to the Bachelor Study Programme of Geodesy and Geoinformatics at the Technical University in Vienna, Austria: http://www.tuwien.ac.at/fileadmin/t/rechtsabt/downloads/Studienplaene_ab_Oktober_2011/Bachelorstudium_Geodasie_und_Geoinformatik.pdf and Leibnitz University Hannover, Germany: http://www.uni-hannover.de/en/studium/studienfuehrer/geodaesie/studieninhalt/ and http://www.uni-hannover.de/en/studium/studiengaenge/geodaesie/
2.5. Openness of the study programme to student mobility (horizontal, vertical in the	Bachelor Study Programme of Geodesy and Geoinformatics provides the possibility to acquire knowledge, skills and competences in accordance with all standards of studying at the European universities and with the Bologna process.

Republic of Croatia, and international)	The horizontal mobility within the Republic of Croatia can be achieved with the Bachelor Study Programme of Geodesy and Geoinformatics at the Faculty of Civil Engineering and Geodesy, University in Split. At the international level, the horizontal mobility is possible within the EU member countries and with the countries in the region (B&H, Serbia, Macedonia). Vertical mobility is possible at the Master study programme and postgraduate study programme of the Faculty of Geodesy and with the related study programmes at technical and other faculties (Faculty of Science, and similar) provided that candidates pass a certain number of supplemental exams.
2.6. Relationship with the local community (economy, entrepreneurship, civil society, etc.)	Geodetic and Geoinformation activity is closely connected with the community, either when speaking of the structures at the national, regional or local level or of individual citizens. It is reflected in performing the majority of tasks performed by geodetic and geinformation experts and it connects more subjects of local community. Geodetic and geoinformation experts often have, together with the representatives of other professions (lawyers, civil engineers, architects, urban planners, agronomists, foresters) the task to connect the subjects of local communities and to find the solutions that will be of mutual interest and acceptable to everyone. The connection of the study programme with local communities is reflected in the application of acquired knowledge in the units of local self-government and in economy. The cooperation with the organisations of civil society outside of the professional context is based on two factors: - external incentives originating from the change of circumstances (legal and economic) where the legalisation process in the period between 2011 and 2014 can be used as an example, - external incentives originating from the changes in environment, natural disasters and other threats, where the floods in Slavonia in 2014 can be taken as an example. In both cases, the cooperation was developed with various types and forms of organisation, and thereby certain concrete activities were performed. The connection with seven vocational schools educating the technicians of geodesy and geoinformatics is very important for the Bachelor Study Programme of Geodesy and Geoinformatics since a part of students comes exactly from these schools. The cooperation and exchange of information has been developed for many years, and in the last two years, there were also professional workshops organised where experience and knowledge of the teachers from the Faculty of Geodesy and from secondary schools are exchanges at the higher level in order to increase the number of admitted students who come from vocational schools that educate the technicians of geodesy and geoinformatics.
2.7. Compatibility with requirements of professional organizations	The Faculty of Geodesy constantly collaborates with the professional (Croatian Geodetic Society, Croatian Chamber

	of Chartered Engineers of Geodesy, Croatian Cartographic Society) and economic associations (Croatian Employers' Association – Geodetic Geoinformatics Association and ICT Association). The representatives of geodetic and geoinformatics profession are permanent members of the Committee for Quality, and there are continuous consultation sessions performed related to the needs of the profession and of professional associations, i.e. to the study programmes performed at the Faculty of Geodesy.
2.8. Name possible partners outside the higher education system that expressed interest in the study programme	The partners that the Faculty of Geodesy cooperates with in the implementation of study programmes and activities are state authorities, first of all the State Geodetic Administration and the City Bureau for Surveying and Cadastral Affairs of the City of Zagreb, and other ministries and government agencies) and the institutes (Croatian Hydrographic Institute). Former and future partners who are interested in study programme are (larger) geodetic and geoinformation companies who will help in the realisation of the professional practice and in organising the visits to geodetic sites (cadastral survey, land consolidation, large infrastructural projects, large industrial objects...). Former and future partners who are also interested in the study programme are IT companies that the Faculty of Geodesy collaborates with and uses their programme packages in teaching activities.
2.9. Other (as the proposer wishes to add)	

3. GENERAL INFORMATION	
3.1. Scientific/artistic area of the study programme	Technical
3.2. Duration of the study programme (is there an option of distance learning, part-time studying, etc.)	3 years = 6 semesters Distance studying is not possible Part-time studying is not organised.
3.3. The minimum number of ECTS required for completion of study	180
3.4. Enrolment requirements and admission procedure	Admission requirements and the elements of classification procedure are defined in the document of the Faculty of Geodesy: Decision about admission to the Bachelor Study Programme of Geodesy and Geoinformatics (e.g. in the academic year 2015/16).

	In the fall application cycle, the admission quota for the Croatian and EU citizens is 85, the quota for foreign citizens is 5. The applications are made through the application portal **"postani student".** The classification procedure for the candidates applying for the **Bachelor Study Programme of Geodesy and Geoinformatics** is organised in the following way (rank list is composed according to the following scoring system): a) Based on secondary school achievements – **up to 400 points** b) Based on the school leaving exams • Croatian (higher level) – **up to 100 points** • Mathematics (higher level) – **up to 300 points** • Foreign (or classical) language – **up to 100 points** • Physics of Computer Science* - **up to 100 points** *According to the admission requirements, at least one of the mentioned exams should be passed. If a candidate has passed both exams, better results will be included in scoring). c) Based on capability test – **no points** d) Based on additional achievement of candidates • winning one of the first three prizes in the state competitions in the Republic of Croatia in Mathematics or Physics or Computer Science or Geodesy (geodetic technician) • participation in the international Olympiad in Mathematics or Physics or Computer Science **DIRECT ADMISSION (1 000 points)**
3.5. Learning outcomes of the study programme (name 15-30 learning outcomes)	**Knowledge and understanding** • Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. • Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. • Demonstrate competences in real estate registers and interests in real estates, understand land development measures and methods of land evaluation. • Demonstrate competences in regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy right, publishing and exchange of spatial data. • Understand mathematical methods and physical laws applied in geodesy and geoinformatics. **Applying knowledge and understanding** • Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of

	problems in the field of geodesy and geoinformatics. • Handle geodetic instruments and appropriate measuring equipment properly, and perform geodetic measurements. • Solve practical tasks in surveying, spatial data collection, real estate evaluation and management. • Establish geodetic networks needed in surveying and stakeout in order to provide the required quality of the works performed in certain space. • Prepare geodetic documents needed to establish and maintain cadastral records and land registry, as well as the documents for engineering works. • Make plans, maps and related presentations using modern methods and technologies on the basis of measured data and other sources. • Determine and interpret the size, properties and relations of objects in space on the basis of measured data, spatial databases, plans and maps. • Maintain topographic, cartographic, maritime and navigation, and land information systems, integrate and visualise spatial information. • Use information technology in solving geodetic and geoinformation tasks. **Making judgements** • Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. • Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution. **Communication skills** • Prepare official public documents, reports, graphic and cartographic presentations using the surveying results related to objects in space. • Communicate the results obtained by means of geodesy and geoinformation to clients and experts of geodetic and other related professions **Learning and ethical skills** • Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards. • Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.

3.6. Employment possibilities (list of potential employers) and opinion of three organizations associated with the labour market on the adequacy of anticipated learning outcomes (attach)	- **Economy** – legal and natural persons authorized to perform state and cadastral survey tasks at the territory of the Republic of Croatia in accordance with the Law on Performing Geodetic Activities (National Gazette /2007) – 500 subjects - **Economy** – IT companies having geonformatics, i.e. programming, installation, maintenance and support services of GIS systems for users in their activity portfolio, as well as the representation of the producers of GIS programme solutions (dozens of companies like Ericsson-Nikola Tesla, Zagreb; GDI-GISdata, Zagreb; KING ICT, Zagreb; IN2, Zagreb; Infodom,Zagreb; IGEA, Varaždin; MCS, Čakovec; Oikon, Zagreb; APIS, Zagreb; .... - **Economy** – legal and natural persons outside of the system of authorization for performing the tasks of state and property cadastre survey and IT sector that deal with the processing and interpretation of spatial information, i.e. use spatial information and geodetic and geoinformation knowledge and skills as an essential part of their activities (civil engineering companies, architectural companies and offices, shipyards, telecommunication companies...) - **State administration** – central professional authority of the state administration – State Geodetic Administration - **State administration –** other central authorities of the state administration, institutes and agencies (in accordance with the Internal Organisation Rules): Ministry of Construction and Physical Planning, Ministry of Ministry of Environmental Protection, Ministry of Defence, Agency for Payments in Agriculture, State Office for State Property Management, Croatian Hydrographic Institute, Croatian Demining Center,... - **Regional and local self-government**– counties, towns and municipalities, i.e. their professional services and their public institutions (e.g. spatial development institutes, utility companies, development agencies,...) - **Public sector** – national public companies and systems: Hrvatske vode, Hrvatska elektroprivreda, Hrvatske željeznice, Hrvatske ceste, Hrvatske autoceste, Jadranski naftovod, Plinacro, ...
3.7. Possibilities of continuing studies at a higher level	- Master Study Programme of Geodesy and Geoinformatics at the Faculty of Geodesy, University in Zagreb, - Master study programmes at other technical faculties of the University in Zagreb after taking certain supplemental exams in accordance with the adequate decision of individual faculties, - Master technical study programmes of other universities in Croatia after taking certain supplemental exams

	in accordance with the decisions of individual faculties, - Master study programmes of geodesy and geoinformatics at the majority of the universities in Europe without the necessity of taking supplemental exams in accordance with adequate decision of individual study programmes, faculties, i.e. universities, and - Master study programmes of geodesy and geoinformatics at the majority of the universities in the world, with required supplemental exams or without them in accordance with the decisions of individual study programmes, faculties, i.e. universities.
3.8. If submitting proposals for graduate studies, name undergraduate studies of the proposer or other institutions that qualify for admission to the proposed graduate study	

4. DESCRIPTION OF THE STUDY PROGRAMME	
4.1. List of mandatory and elective courses and/or modules with class hours and ECTS credits (appendix: Table 1)	
4.2. Description of each course (appendix: Table 2)	
4.3. Structure of the study (number of semesters, trimesters, class size for lectures, seminars, exercises)	The study programme is performed in 6 semesters **Obligatory subjects** The number of students enrolled in each semester is about 80 – 100, with smaller variations related to individual subjects and depending on the number of students who attend certain subjects again, so that the number of students attending courses in obligatory subjects is about 70 – 110. The same rules apply to all subjects: - lectures - one group (70 – 110 students) - seminars – three groups (25 – 35 students) - exercises – professional geodetic, geoinformation and information subjects, and the subject Computer Geometry – eight groups (10 – 15 students) - exercises in mathematical and physical subjects – four groups (20 – 25 students) **Optional subjects** The number of students enrolled in each semester is about 80 – 100, which indicates that the courses in these

	subjects will be performed with the number of students varying between 10 – 60 taking into consideration the offered optional subjects in single semesters and the character of optional subjects. Since the same rules are defined for the performance of teaching activities, the number of seminar groups, exercise groups and field work groups will depend on the number of enrolled students: - lectures - one group (10 – 60 students) - seminars – one/two groups (up to 30 students in one group, more than 30 students two groups) - exercises – professional geodetic, geoinformation and information subjects – one to four groups (up to 10-15 enrolled students one group, in case of more than that number one more group is added for the next 10-15 students up to the maximum of 4 groups) - exercises – mathematical subjects – one/two groups (up to 20-25 enrolled students one group, in case of more students, the next 20-25 students form another group).		
4.4. Requirements for enrolment in successive semesters or trimesters	The requirements for enrolment are defined by programme connectivity. The attendance of curses in winter term for the courses in summer term, and for the courses in winter term the attended courses and/or passed examination from the previous academic year.		
4.5. List of courses and/or modules that the student can take in other study programmes			
4.6. List of courses and/or modules offered in a foreign language as well (name which language)	All courses can be performed in English, and it will be implemented on the basis of the students' interests in accordance with the implementation plan		
4.7. Completion of study:			
a. *Final requirement for completion of study*	Final thesis ☐	Diploma thesis ☐	Final exam **X** Diploma exam ☐
b. *Requirements for final/diploma thesis or final/diploma/exam*	All examinations in the Bachelor study programme passed, which is verified by entering the grade and attaching teacher's signature in student book, by entering the grade in ISVU system and locking the subject, and by verifying the last VI. semester in the student office.		
c. *Procedure of evaluation of final/diploma exam and evaluation and defence of final/diploma thesis*	Students take the final exam in written form. The written exam consists of 40 questions from the fields based on mathematical, physical, geodetic and geoinformation material. The written exam lasts 90' and students need to write the answers to each question. The questions can be theoretical, as well as computational tasks in order to evaluate		

	the knowledge level achieved by the students during the Bachelor study programme in adequate way. The length of the questions is adjusted to that kind of exam and should not be longer than one paragraph, a few formulas with the interpretation of tags, i.e. of problem task that is intended to show the understanding of the problem and its solution and not lengthy calculation. The written exam is conducted by the appointed committee with the vice-dean for academic and students affairs being its chair. Each answer is scored with 5 points and it is possible to earn the total of 100 points. In order to pass the final exam, students must answer correctly 50% of question (earn 50 points). The final exam grade is derived from the number of earned points: - sufficient: 101 – 125 points - good: 126 – 1 50 points - very good: 151 – 175 points - excellent: 176 – 200 points. 2 ECTS points stand for the Final exam – written exam (basic mathematical, physical, geodetic and geoinformation knowledge)

DETAILED PROPOSAL OF THE STUDY PROGRAMME

Table 2. Course description

1. GENERAL INFORMATION			
1.1. Course teacher	Jelka Beban Brkić	1.6. Year of the study programme	First, 1st semester
1.2. Name of the course	Analytical Geometry and Linear Algebra	1.7. Credits (ECTS)	5
1.3. Associate teachers	Željka Tutek	1.8. Type of instruction (number of hours L + S + E + e-learning)	30 (L) + 30 (E)
1.4. Study programme (undergraduate, graduate, integrated)	Bachelor Study	1.9. Expected enrolment in the course	90
1.5. Status of the course	compulsory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	e-learning level: 2
2. COUSE DESCRIPTION			
2.1. Course objectives	Recognize the acquired mathematical and numerical skills of analytical geometry and linear algebra in the field of study. Use of acquired mathematical and numerical skills of analytical geometry and linear algebra to solve problems in the field of study.		
2.2. Course enrolment requirements and entry competences required for the course	Admission requirements: High school graduation. Faculty enrolled. Competencies: knowledge of high school mathematics curriculum.		
2.3. Learning outcomes at the level of the programme to which the course contributes	Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. Understand mathematical methods and physical laws applied in geodesy and geoinformatics. Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of problems in the field of geodesy and geoinformatics. Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.		
2.4. Learning outcomes expected at	• Master the fundamental vector algebra and analytic geometry concepts and apply them in solving tasks;		

the level of the course (4 to 10 learning outcomes)	• Identify and differentiate between types of second order surfaces; • Explain the concepts of matrices and determinants, list their properties and use them in computations with matrices and determinants; • Distinguish methods for solving systems of linear equations and apply the appropriate method to solve a given system; • Describe the method of least squares and argue its application in solving tasks; • Define the terms of eigenvalues and eigenvectors and know their typical applications; • Describe and implement the concepts of diagonalization and orthogonal diagonalization of a matrix. • Use the system for e-learning.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Vector algebra. 3h Analytical geometry. 3h Equation, sketch and recognition of surfaces of the second order. 1h Matrix algebra. 2h Elementary transformations and elementary matrices. 1h Review of previous work. 1h 1st preliminary exam 1h Reduced form of the matrix, inverse matrix. 2h Solving linear systems using the Gauss-Jordan reduction. Homogeneous linear systems. The Kronecker-Capelli theorem. 2h The concept and calculation of determinants. Cramer's rule. 2h Least squares method. 1h Review of previous work. 1h 2nd preliminary exam 1h Vector space. Linear independence. 2h Coordinates and change of basis. Eigenvalues and eigenvectors. 2h Linear transformations. Matrix diagonalization. 2h Quadratic forms. Diagonalization of quadratic forms. 2h The final exam. 1h

2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning	☒ independent assignments ☒ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:

	☐ field work					
2.8. Student responsibilities	Regular school attendance. Monitoring of e-learning. Writing tasks. Consultations (teacher / student assistant)					
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	Requirement for the signature	Research		Practical training	
	Experimental work		Report		independent assignments	4%
	Essay		Seminar essay		interactive tasks	4%
	Tests	92%	Oral exam	optional	(other)	
	Written exam	100%	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	50-61 credits	sufficient (2)
	62-74 credits	good (3)
	75-87 credits	very good (4)
	88-100 credits	excellent (5)

	Title	**Number of copies in the library**	**Availability via other media**
2.11. Required literature (available in the library and via other media)	Beban Brkic, J., Tutek, Ž.: *Analytical Geometry and Linear Algebra*, Textbook for students, Faculty of Geodesy, Zagreb 2012	in preparation	
	Beban Brkic, J.: *Analitička geometrija i linearna algebra*, Textbook for students (on the web), Faculty of Geodesy		http://e-ucenje.geof.unizg.hr/
	Elezović, N.: *Linear Algebra*, Element, Zagreb, 1995 (multiple editions)	some ten	
	Elezović, N., Aglić, A.: *Linear Algebra Workbook*, Element, Zagreb, 1995 (multiple editions)	some ten	

2.12. Optional literature (at the time of submission of study programme proposal)	Anton, H., Rorres, C.: *Elementary Linear Algebra*, John Wiley & Sons, N.Y.2000. Slapničar I.: *Matematika 1*, www.fesb.hr/~mat1

2.13. Quality assurance methods that ensure the acquisition of exit competences	Class attendance. In revising during lectures. Problem solving during exercises. Activity on the system for e-learning. Individual assignment. Interactive tasks. Consultations attendance. Preliminary exams. Exams. The implementation of a single university Questionnaire for evaluating teachers prescribed by the Senate.
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Vida Zadelj-Martić	1.6. Year of the study programme	1/I
1.2. Name of the course	Mathematical Analysis	1.7. Credits (ECTS)	5 ECTS
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	30+3+25+2
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	100
1.5. Status of the course	obligatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	1, 10%
2. COUSE DESCRIPTION			
2.1. Course objectives	Understanding the key topics and problems of Mathematical Analysis. Also it is necessary to develop many skills between abstract entities according to certain rules and apply it into Geodesy		
2.2. Course enrolment requirements and entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. Understand mathematical methods and physical laws applied in geodesy and geoinformatics. Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of problems in the field of geodesy and geoinformatics. Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.		
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- Define and implement the tasks terms of mathematical logic, sets, sets of numbers and mathematical induction - Define, analyze and relate the concepts and properties of real functions of a real variable, as well as terms related to a sequences (limit of a sequence, limit of a function)		

	- Define and apply the concepts tasks derivatives, indefinite and definite integrals - Define and apply the concepts tasks series of numbers, functional series and power series, as a Taylor series expansion and Mac Lauren series - Define, analyze and apply the tasks terms of functions of several variables, as well as Taylor and Maclaurin series for two variables, and to determine the extreme values of functions of two variables - Define the term and solve differential equations method of separation of variables
2.5. Course content broken down in detail by weekly class schedule (syllabus)	1st Mathematical logic and sets; Sets of numbers and mathematical induction (P1h + V1H) 2nd Real functions of a real variable (function definition, the term of natural domain, injections, surjective, bijective function of function, monotony, parity and periodicity of functions, composition of functions, inverse function) (P1h + V1H) 3rd Elementary functions (polynomial, rational, exponential and logarithmic functions, general power, trigonometric functions, inverse trigonometric, hyperbolic, area functions; properties and graphs) (P2h + V2H) 4th Sequences and limit of s sequence (term series, bounded and monotone sequences, limit of sequence, properties of convergent sequences,) (P1h + V1H) 5th Limit and continuity of functions (limit of function, performance limit of a function, continuity of functions, properties) (P2h + V2H) 6th Derivative and some theorems of differential calculus (speed problem, the problem of tangents, the definition of derivatives, higher order derivatives, differential function, differentiation rules, derivative composition of a function, derivation of elementary functions, logarithmic differentiation, derivative of implicit functions, derivation of a parametric function, equation of tangents and normals at the point in the curve, the equation of the tangent from the point outside of the curve, the concept of local minima and maxima functions, Taylor's formula, Maclaurin formula) (P3H + V3H) 7. Application of derivation (intervals of monotony, a necessary condition for extreme of the functions, the notion of stationary or critical points, a sufficient condition for extreme function, L`Hospital rules, concavity, convexity, inflection point, the definition of the asymptote function, horizontal asymptote, vertical asymptote, hair asymptote , elements of the plotting

	functions) (P3H + V3H) 8th Indefinite integral and properties (the notion of primitive functions, indefinite integral, properties of indefinite integrals, indefinite integral of elementary functions, methods of integration: substitution method and the method of integration by parts) (P3H + V3H) 9th Definite integral and improper integral (upper integral sum, the lower integral sum, integrable functions in Riemann's sense, properties of definite integral, Newton-Leibniz formula, a change of variables in a given integral; improper integral of the first kind, improper integral of the second kind) (P3H + V2H) 10th Applications of integral (area between the curves, length of a curve, the volume of a rotational body) (P1h + V1H) 11th Functions of several variables (surface in space, natural area definitions of functions of several variables, limit and continuity of functions of several variables, partial derivatives, geometric interpretation of partial derivatives, partial derivatives of higher order, Schwarz theorem, the derivation of complex function of several variables, derivative of implicit functions, complete (total) differential, Taylor and Maclaurin formulas and series of functions of two variables, extreme values for functions of two variables) (P4H + V3H) 12th series of numbers, series of functions and power series (the criteria for comparing the series with positive terms, D`Alembertov criterion, Cauchy criterion, alternating series, Leibniz criterion, series with positive and negative members, an absolute and conditional convergence series, series of functions, the area of convergence of series of functions, power series, Abel's theorem, radius and interval of convergence of the series, Taylor series, Mac Lauren series, Taylor series of elementary functions) (P4H + V3H) 13th Differential equations (differential equations of the first order, Cauchy problem, the general solution, particular solution, the general integral, particular integral, Separation of a variables, homogeneous equations) (P2h + V2H) 14th Seminar (3h)

2.6. Format of instruction:	☒ lectures ☒ seminars and workshops ☒ exercises	☒ independent assignments ☒ multimedia and the internet ☐ laboratory	2.7. Comments:

	☐ on line in entirety ☒ partial e-learning ☐ field work	☒ work with mentor ☐ (other)	

2.8. Student responsibilities	By continuous monitoring during the semester, the students accumulate points which, in the end, articulate requirements for signature and evaluation through: 1st Presence of lecture (80%) and exercises (80%) 2nd Doing homeworks (80%) 3rd Participation in class during the lectures and exercises 4th Two partional preliminary exams 5th writing seminars

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	1.5	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay	0.5	(other)	
	Tests	(3.0)	Oral exam	1.5	(other)	
	Written exam	1.5	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	A requirement for signature is 80% of class attenance and doing 80% of homeworks and obligatory seminars To pass the exam, it is sufficient to achieve at least fifty per cent of the all examples and theoretical problems through the partial exams. In case that student is not satisfy whit his grade, than he has to do the classical exam (written exam and oral exam)

2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**

	J. Beban-Brkić; Mathematics I (in Croatian), Faculty of Geodesy, Zagreb		
	I. Slapničar: Mathematics 1 (in Croatian); FESB; Split 2002		
	P. Javor; Introduction to Mathematical Analysis (in Croatian), Školska knjiga, Zagreb		
	Slapničar; J. Banić; M. Ninčević: Mathematics 1- Excercises Collection (in Croatian); FESB; Split 2010		
	V. Zadelj-Martić; Non reviwed Intern skript (in Croatian)		
2.12. Optional literature (at the time of submission of study programme proposal)	W. F. Trench; Introduction to Real Analysis; San Antonio, Texas, USA B. Apsen; Riješeni zadaci iz više matematike I, II, B. P. Demidović; Zadaci i riješeni primjeri iz matematičke analize za tehničke fakultete		
2.13. Quality assurance methods that ensure the acquisition of exit competences	Homework, participation in class during the lectures and exercises, writing obligatory seminars, the accession of the partial exam, the accession of the classical exam (if the exam is failed by a partial exams) Seelf-evaluation of teachers and student survey		
2.14. Other (as the proposer wishes to add)	Obligatory internet literature: 1. I. Slapničar; http//lavica. Fesb.hr/mat1/ 2. I. Slapničar; http//lavica. Fesb.hr/mat2/		

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Prof. Mario Brkić	1.6. Year of the study programme	1st year, 1st semester
1.2. Name of the course	Physics	1.7. Credits (ECTS)	5
1.3. Associate teachers	Domagoj Ruždjak	1.8. Type of instruction (number of hours L + S + E + e-learning)	15*2L + 15*2E
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	100
1.5. Status of the course	obligatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	Understand and apply the basic laws of geometrical optics, mechanics, oscillatory motion and waves, as well as electromagnetism.
2.2. Course enrolment requirements and entry competences required for the course	Entry competencies: vector algebra, analytic geometry, methods of solving systems of linear equations, elementary functions, derivatives, indefinite and definite integrals, series of functions.
2.3. Learning outcomes at the level of the programme to which the course contributes	Knowledge and understanding 5. Understand mathematical methods and physical laws applied in geodesy and geoinformatics. Applying knowledge and understanding 6. Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of problems in the field of geodesy and geoinformatics. Making judgments 16. Exercise appropriate judgments on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. Learning and ethical skills 20. Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines,

	and for the development of interest in lifelong learning and further professional education.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	1. Derive and apply the equations of geometrical optics. 2. Describe the motion by vectors of position, velocity and acceleration. 3. Apply Newton's laws of motion. 4. Describe the motion of the gyroscopes. 5. Derive and apply the Kepler's laws. 6. Derive the general expression for the gravitational potential energy and define the potential and equipotential surface. 7. Describe and compare the simple and physical pendulum. 8. Describe the harmonic waves. 9. Describe the electric field, electric potential difference, and electric current; describe the magnetic field of a current loop. 10. Describe the electromagnetic induction.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	1. Physics and measurement. Standards, dimensional analysis, significant digits, order of magnitude, scalars and vectors, unit vectors and vector components, analytical method of addition of vectors, scalar product of vectors, vector product. 2. Geometrical optics. The absorption, reflection and transmission of light rays, the laws of geometrical optics, Huygens' principle, total reflection, reflection, mirror equation, magnification. 3. Optical instruments. Refraction, lens equation, positive and negative lenses, magnification of the lenses, eye, simple magnifier, microscope, telescope. 4. Kinematics 1D. Position and displacement, velocity in 1D, motion with constant velocity, acceleration in 1D, motion with constant acceleration, the area under the graph of v(t) and a(t), free-fall. 5. Kinematics 2D. Position, velocity and acceleration in 2D, uniform circular motion, tangential and radial acceleration; position, velocity and acceleration in 3D. 6. Newton's laws of motion. Newton's first law, inertial reference systems, Newton's second law, Newton's third law, gravitational force and weight, contact forces. Applications of Newton's Laws. Motion in accelerated frames. 7. Work and energy. Work done by constant and varying force, Hooke's law, general expression for the work, kinetic energy and the work, work of conservative forces, potential energy of a system, conservation of mechanical energy, relationship between conservative forces and potential energy, power. The center of mass, motion of a system of particles. 8. Rotational kinematics. Angular position, angular velocity and angular acceleration, rotational motion with constant angular acceleration, angular and linear quantities, rotational kinetic energy, moment of inertia, parallel axis theorem. 9. Rotational dynamics. Torque and angular acceleration, angular momentum, angular momentum of a rotating rigid object, conservation of angular momentum, a variable moment of inertia of the system, motion of gyroscopes; the conditions of static equilibrium, center of gravity.

<table>
<tr><td></td><td colspan="6">10. Newton's law of universal gravitation. Law of gravitation for particles, gravitational force between the bodies, variation of free-fall acceleration at the surface of the Earth, gravitational field, gravitational flux, gravitational potential energy, Kepler's laws.
11. Oscillations and waves. Kinematics of simple harmonic motion, dynamics of simple harmonic motion, simple pendulum, physical pendulum, traveling waves, the wave function, interference of harmonic waves, harmonic wave, constructive and destructive interference, Doppler effect.
12. The electric current. Electric charge, Coulomb's law and electric field, Gauss's law for electric field, electric potential energy, electric potential and potential difference, electric current, Ohm's law, resistance, Joule's law, batteries.
13. The magnetic field. Sources of the magnetic field, magnetic force acting on a current-carrying conductor, torque on a current loop in a uniform magnetic field, magnetic moment, Biot-Savart law, the magnetic field current through a long straight wire, magnetic field on the axis of a circular current loop, Ampère's law, Gauss's law for the magnetic field.
14. Electromagnetic induction. Faraday's law of induction, Lenz's law, generators.</td></tr>
<tr><td>2.6. Format of instruction:</td><td colspan="2">☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="2">☐ independent assignments
☒ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:

The exercises consist in solving selected (approximately 100) problems. In addition, there are numerical exercises in MS Excel.</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="6">Student attendance is required at min. 70% of classes, and 10/13 tests.</td></tr>
<tr><td rowspan="5">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Tests</td><td>2/</td><td>Oral exam</td><td>2</td><td>(other)</td><td></td></tr>
<tr><td>Written exam</td><td>2</td><td>Project</td><td></td><td>(other)</td><td></td></tr>
<tr><td>2.10. Grading and evaluating student work in class and at the final exam</td><td colspan="6">Tests. Each of 13 tests consists of a problem (similar to previous exercises).
Written exam. The written part of the exam consists of 10 problems.
Oral exam. In the oral part of the exam the questions are from the theory.</td></tr>
<tr><td rowspan="2">2.11. Required literature (available in the library and via other media)</td><td colspan="4">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="4">M. Brkić, 2007: Physics, reviewed handbook of the Faculty of Geodesy.</td><td></td><td>e-</td></tr>
</table>

			ucenje.geof.unizg.hr
	M. Brkić, 2007: Physics, manuscript of the Faculty of Geodesy.		e-ucenje.geof.unizg.hr
2.12. Optional literature (at the time of submission of study programme proposal)	Serway R. A. and John W. Jewett, Jr., 2013: Physics for Scientists and Engineers with Modern Physics, Ninth Edition, ISBN-13: 978-1-133-95405-7, ISBN-10: 1-133-95405-7, Brooks/Cole, Boston, USA		
2.13. Quality assurance methods that ensure the acquisition of exit competences	Tests. Exam. Student polls.		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Đuro Barković Nada Vučetić	1.6. Year of the study programme	1
1.2. Name of the course	Basics of Geoinformatics	1.7. Credits (ECTS)	5
1.3. Associate teachers	Martina Triplat Horvat Lili Gracin	1.8. Type of instruction (number of hours L + S + E + e-learning)	60(30L+30E)
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	95
1.5. Status of the course	obligatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	level 2
2. COUSE DESCRIPTION			
2.1. Course objectives	Development of the ability to recognize, identify and understand the spatial and spatio-temporal components of the reality.		
2.2. Course enrolment requirements and entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	Knowledge and understanding Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Applying knowledge and understanding Determine and interpret the size, properties and relations of objects in space on the basis of measured data, spatial databases, plans and maps. Making judgements Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution. Learning and ethical skills Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards.		
2.4. Learning outcomes expected at the level of the course (4 to 10 learning	1. Formulate the basic concepts and definitions about the space, time, space-time and reality. 2. Explain the process of creating a model using the perceived reality, the conceptual data model and specifications		

outcomes)	(perception of reality). 3. Explain the concept of abstract universe and discern and share the reality of the elements (entities). 4. Describe and explain various forms of representations of the basic entities of reality. 5. Describe the different views of spatial phenomena and connect the similarities and differences of space and time. 6. Define the representation scale of geospace and explain its importance. 7. Explain and describe the coordinate systems and the location of objects using an attribute. 8. Distinguish and compare different types of maps. 9. Explain the view of geospace based on location, object and time. 10. Distinguish between absolute and relative spatial relationships and explain the basic idea of topological relations.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Lectures: 1. The content and the organization of the course. 2. The perceived reality. Breaking down the reality into elements, part 1. 3. Breaking down the reality into elements, part 2. Space and time, part 1. 4. Space and time, part 2. Similarities and differences between space and time. 5. Different views of space phenomena, part 1. 6. Different views of space phenomena, part 2. Geospace scale. 7. Location of the object described using an attribute. Review of knowledge and skills. 8. The first test. 9. Metric and nominal determination of geospatial objects. Reference surfaces. Coordinate systems. 10. Coordinate transformations. Map projections. Official map projections. 11. Conceptual models of geospatial data. The view based on location, object and time. 12. Comparison of absolute and relative spatial relationships. 13. Terms and definitions from the field of graph theory and theory of sets that are needed to understand the topology. 14. The topological relationships. Review of knowledge and skills. 15. The second test. Exercises: 1. The organization of exercises and introducing to tasks. 2. Coding of objects in relation to other objects and in relation to themselves. Short field exercises – to encode the own movement using the described methods and to find an object according to instructions. 3. Creating of a model of the given geospatial objects described by spatial, temporal and attribute components. 4. A brief presentation of the model. To refill the presented model with scale values and their domains for each attribute.

	5. Field data collection for the created model. 6. Field data collection for the created model (continuation). 7. Getting acquainted with the elements of spatial data (origin, positional accuracy, attribute accuracy, completeness, logical consistency, semantic accuracy and time information) through various examples in geodesy and geoinformatics. 8. Introduction to systems for position encoding. 9. Technological solutions for orientation and movement in space: map, compass, handheld and navigational GPS, mobile phone devices. Introduction to a handheld GPS receiver. 10. Collection of field data about object location for the created model using a handheld GPS receiver. 11. Analysis of a model of geospatial data. 12. Processing of data collected in the field and production of bases in QuantumGIS or Autodesk Map. 13. Processing of data collected in the field and production of bases in QuantumGIS or Autodesk Map (continuation). 14. Presentation of processed data. 15. Test				
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☐ partial e-learning ☐ field work		☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)		2.7. Comments:
2.8. Student responsibilities	Students are required to attend the class (min. 70%) and actively participate in its work. Mandatory participation in three tests.				
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	0.5	Research		Practical training 1
	Experimental work		Report		(other)
	Essay		Seminar essay		(other)
	Tests	1.5	Oral exam	1	(other)
	Written exam	1	Project		(other)
2.10. Grading and evaluating student work in class and at the final exam	There are three tests during the course. Students who pass all three tests do not need to pass the written part of the final exam. This is valid only for the first two exam terms. The final exam consists of a written and an oral part.				
2.11. Required literature (available in the library and via other media)	**Title**			**Number of copies in the**	**Availability via other media**

		library	
	Lapaine, M. (ed.) (2001), Elementi kvalitete prostornih podataka, editors of the original Guptill, S. C. and J. L. Morrison, translated by Tutić, D. and M. Lapaine, Državna geodetska uprava RH, Zagreb.	1	
	Maguire, D.J., Goodchild, M. F., Rhind, D. W. (1991.), Geographical information systems, Principles and applications, Longman Scientific and Technical, New York.	1	
	Molenaar, M. (1998.), An Introduction to the Theory of Spatial Object Modelling for GIS, Taylor and Francis, London, Bristol.	1	
	Peuquet D. J. (2002.), Representations of Space and Time, The Guilford Press, New York, London.	1	
	Barković, Đ., Vučetić, N. (2014), Handouts of internal Lecture notes in Basics of Geoinformatics.		e-learning
2.12. Optional literature (at the time of submission of study programme proposal)	Hawking, S. W. (2004.), Ilustrirana kratka povijest vremena (preveo Damir Mikuličić), Izvori, Zagreb. Hawking, S. W., Penrose, R. (2002.), O prirodi prostora i vremena (preveo Jadranko Gladić), Izvori, Zagreb. Einstein, A. (1999.), Moj pogled na svijet (preveo Damir Mikuličić), Izvori, Zagreb.		
2.13. Quality assurance methods that ensure the acquisition of exit competences	Taking part at the three tests. Passing the written and oral exam. Self-evaluation of teachers and questioning of participants.		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Đuro Barković	1.6. Year of the study programme	1
1.2. Name of the course	Geodetic Instruments	1.7. Credits (ECTS)	5
1.3. Associate teachers	Goran Jurakić	1.8. Type of instruction (number of hours L + S + E + e-learning)	60 (30L+30E)
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	95
1.5. Status of the course	Compulsory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	level 2

2. COUSE DESCRIPTION	
2.1. Course objectives	Acquiring knowledge about the physical basis of geodetic instruments and practical knowledge about the instrument for measuring angles, height differences, distances and position of the points and knowledge of the methods testing and control of geodetic instruments.
2.2. Course enrolment requirements and entry competences required for the course	Compulsory attendance at 70% of teaching – lectures. Compulsory attendance at 70% of teaching – exercises. Compulsory presence of students at all knowledge tests.
2.3. Learning outcomes at the level of the programme to which the course contributes	Knowledge and understanding Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Applying knowledge and understanding Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of problems in the field of geodesy and geoinformatics. Handle geodetic instruments and appropriate measuring equipment properly, and perform geodetic measurements. Solve practical tasks in surveying, spatial data collection, real estate evaluation and management. Learning and ethical skills Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning	1. Define the terms: measurement, units of measurement, basic geodetic measurement variables. 2. Explain concepts: accuracy, correctness, precision, error and deviation.

outcomes)	3. Knowing the nature and properties of light in the context of the law of reflection (rejection) and refraction (fracture) light and explain the refractive index of light. 4. Differentiate and explain the properties of mirrors, prisms, plane parallel plate, optical wedge, lens, telephoto lens and other optical elements and systems. 5. Introduction to the structure of the eye as part of the optical system. 6. Explain theodolite, level and devices for measuring length - division, purpose, structure, components,operating conditions, testing and rectification of the mistake that affect the measurement. 7. Measure the angles, height difference and length by different methods and measurement procedures. 8. Explain instruments for determining the position of points (coordinates) - division, purpose, structure, parts and errors that affect the determination of coordinates. 9. Apply automate measurements and communication between the geodetic instruments and computers.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	1. Basics of geodetic measurements. Measurements in geodesy. Getting to know of instruments and accessories. Staking out of perpendicular using pent-prisms. (2L + 2E) 2. Measuring instruments and accessories. Light-genesis and character. Basic optical, mechanical and electronic circuits in instruments. Centering and levelling theodolite. Rectification tubular level. (2L + 2E) 3. Geometrical optics. Plane parallel plate. Optical wedge. Prisms. Prisms for reflection. Optical micrometer. Straight and angled mirror. Focusing the crosshair. Focusing. Parallax of the crosshair. Boresight with theodolite. Reading with theodolite: index, scale and optical micrometer. (2L + 2E) 4. Lens. Fundamentals of optical mappings. Systems of lens. Errors mappings. Classification of optical instruments. Increase. Eye. Accommodation. Adaptation. Visual acuity. The correction of the eye. Fieldwork with theodolite. Observation Hz directions and measuring height of instrument. (2L + 2E) 5. Magnifier. Microscope. Binoculars. Classification and characteristics of binoculars. The increase. The luminosity. The screens. Field of view. Resolving power. Crosshair. Conditions of theodolite. Testing double collimation error. Testing of the optical plummet. (2L + 2E) 6. Tubular and circular level. Axis and sensitivity level. Classification theodolites. Optical theodolite. The main parts. Axis. The constructive conditions. Testing of compensator index vertical circle theodolite. Measurement Hz and V angles. Trigonometric measurement of the height difference. (2L + 2E) 7. Errors collimation, tilting and vertical axis of theodolite. Errors eccentricity Hz circle. Error index of the vertical circle. Fieldwork with theodolites. Instrument height. Measurement Hz and V angle on the 3 point with gyrus method. Trigonometric measurement of the height difference. 1st preliminary exam. (2L + 2E) 8. Electronic theodolites. Characteristics. Basic construction. Ways of reading and registration. Dual axis compensator. Other special theodolites, and gyro theodolite. Laser binoculars. Optical plummet. Introduction to levels. Level with

	compensator. Conditions of levels with compensator. Reading lath: centimeter and half-centimeter. (2L + 2E) 9. Instruments for measuring height differences. Methods: trigonometric, geometric and barometric. Classification of levels. Basic parts and functions. Automatic leveling boresight line. Errors levels. Accessories levels. Fieldwork with levels. Determination of the height difference with level between 3 points. Testing of the zero position compensator of level. (2L + 2E) 10. Electronic level. The principle of operation. The coded lath. Testing of level. Rotating laser level. The working principle of barometer. Optical distance meters. Reichenbach distance meter. Auto reduction distance meters with diagrams. Distance meters with a constant base on aim. Calculating the distance and height difference. 2nd preliminary exam. (2L + 2E) 11. Instruments for measuring distances. The mechanical, optical and electronic measurement. Measuring tape. Odometer. Distometer. Optical measurement of distances. Basis lath. Measuring the length with interference of light. Fieldwork with optical distance meters. Measuring the length and height differences on the three points. 3rd practical preliminary exam – centering and leveling theodolite. (2L + 2E) 12. Electronic measuring distances. The principle of operation. Radiation sources. Basic correction and reduction. Testing. Hand-held laser distance meter. The total station. Transferring measurement data to a computer. Repeat 1st preliminary exam. (2L + 2E) 13. Total station. Optical. Electronic. Electronic record. Transferring measurement data to computer. Repeat 2nd preliminary exam. (2L + 2E) 14. Instruments for satellite positioning. GNSS receiver. Sources of errors. Uninterrupted flow of geodetic data. Testing of geodetic instruments. Repetition - field work with levels, theodolites, measurement Hz and V angles. Repeat 3rd practical preliminary exam. (4L + 4E)

2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☒ field work	☒ independent assignments ☒ multimedia and the internet ☒ laboratory ☐ work with mentor ☒ team assignments	2.7. Comments:
2.8. Student responsibilities			

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS*	Class attendance	0.5	Research		Practical training	0.5
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	1.0	Oral exam	2.0	(other)	

value of the course)	Written exam	1.0	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	During the semester are organized three preliminary exams. Students who pass the preliminary exams are exempt from the written part of the exam. Other students can take the written and oral exam.		
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Benčić, D. (1990): Geodetski instrumenti (Geodetic Instruments), Školska knjiga, Zagreb.		
	Benčić, D., Solarić, N. (2008): Mjerni instrumenti i sustavi u geodeziji i geoinformatici (Measuring Instruments and Systems in Geodesy and Geoinformatics), Školska knjiga, Zagreb.		
	Lasić, Z (2007): Geodetski instrumenti (Geodetic Instruments), internal script, Faculty of Geodesy – University of Zagreb, Zagreb.		
2.12. Optional literature (at the time of submission of study programme proposal)	Deumlich, F., Staiger, R. (2002): Intrumentenkunde der Vermessugstehnik, Herbert Wichmann. Fialovszky, L. (1991): Surveying Instruments and their Operational Principles, Akademiai Kiado, Budapest. Kahmen, H. (1997): Vermessungskunde, Walter de Gruyter, Berlin.		
2.13. Quality assurance methods that ensure the acquisition of exit competences	Testing three preliminary exams. Testing a written and oral exam. Self-evaluation of teachers and polling participants.		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Vlado Cetl Almin Đapo Dražen Tutić Robert Župan	1.6. Year of the study programme	1
1.2. Name of the course	Engineering Graphics in Geodesy and Geoinformatics	1.7. Credits (ECTS)	3
1.3. Associate teachers	Ana Kuveždić Divjak Martina Triplat Horvat Luka Babić Mario Mađer Vanja Miljković Baldo Stančić	1.8. Type of instruction (number of hours L + S + E + e-learning)	15L+30E
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	80-90
1.5. Status of the course	Mandatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION			
2.1. Course objectives	The aim of the course is to provide basic theoretical and practical knowledge in the field of computational geometry and graphics with emphasis on application in engineering sciences, especially in Geodesy and Geoinformatics. Through practical exercises the most popular software is used.		
2.2. Course enrolment requirements and entry competences required for the course	No conditions		
2.3. Learning outcomes at the level of the programme to which the course contributes	Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data Prepare geodetic documents needed to establish and maintain cadastral records and land registry, as well as the documents for engineering works Make plans, maps and related presentations using modern methods and technologies on the basis of measured data and other sources		

2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Distinguish between raster and vector graphics, concepts of computer-aided shaping (CAD) and GIS (GIS) and color systems in computer graphics Develop a vector drawing by default template, edit the raster image in the geometric and radiometric sense and create a two-dimensional drawing and surfaces in CAD-in and load data in geographic information systems (GIS) Distinguish file formats for raster and vector graphics, computer aided design (CAD) and geographic information systems (GIS). Geometric and topological transform raster and vector data. Specify the scale drawings and print-to-scale drawing in the paper. Create and analyse surfaces, volumes and profiles in programs for CAD and / or GIS..
2.5. Course content broken down in detail by weekly class schedule (syllabus)	1) A Brief History of Computer Graphics. Overview of the development of computer graphics in geodesy and geoinformatics. 2) Vector and raster graphics. The color systems. 3) The concept, features and applications of computer-aided design and design - CAD. 4) Coordinate systems. The relative and absolute coordinates. Basic geometric elements in vector graphics. 5) Commercial and free software. Application in Geodesy and Geoinformatics. 6) Formats of data storage in CAD. 7) 2D transformation of raster and vector data. Georeferencing. Creation and editing of topology. 8) Dimensioning. 9) Extension capabilities of CAD with user applications. 10) Interoperability of CAD and GIS systems. 11) Introduction of technical standards and regulations for preparation of documentation. 12) The basic elements of 3D modelling. 13) Surfaces and volumes. 14) 3D visualization. 15) Consultations, Repetitions and Preparation for Exam Exercises: Introduction to graphical user interfaces and CAD programs. Practical work in vector and raster graphics programs.

DETAILED PROPOSAL OF THE STUDY PROGRAMME

<table>
<tr><td></td><td colspan="6">Construction and editing of 2D and 3D geometric elements in AutoCAD. Georeferencing of raster. Translation from raster to vector form. The advanced design and editing 2D geometric elements on examples from surveying practice. Creating attribute blocks. Building topology and editing topological relations. Topological analysis. Export data from CAD to the database. Basic elements of 3D modelling. Object drawing. Using styles in 3D CAD modelling. Surfaces. Preparation for print and scales.</td></tr>
<tr><td>2.6. Format of instruction:</td><td colspan="2">☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☒ partial e-learning
☐ field work</td><td colspan="2">☒ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☒ midterm exams (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="6">Compulsory attendance at 70% of teaching - lectures.
Compulsory attendance at 70% of classes - exercises.
Creation and submission of projects task.</td></tr>
<tr><td rowspan="5">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>0,5</td><td>Research</td><td></td><td>Practical training</td><td>0.5</td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Tests</td><td>0,5</td><td>Oral exam</td><td>1,0</td><td>(other)</td><td></td></tr>
<tr><td>Written exam</td><td>0,5</td><td>Project</td><td></td><td>(other)</td><td></td></tr>
<tr><td>2.10. Grading and evaluating student work in class and at the final exam</td><td colspan="6">Accessing three midterm exams to which the student responds to the theoretical issues and practical tasks. Preliminary exams are conducted through a system of e-learning and practical work on computers. Each exam content corresponding to three course units. Students who pass all 3 midterm exams are exempt from final exam.</td></tr>
<tr><td rowspan="6">2.11. Required literature (available in the library and via other media)</td><td colspan="4">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="4">Lectures and presentations on e-learning.</td><td></td><td></td></tr>
<tr><td colspan="4">Lapaine, M., Tutić, D.: Osnovni tečaj AutoCAD-a. Manuscript. Faculty of Geodesy, Zagreb 2001.</td><td></td><td></td></tr>
<tr><td colspan="4">Lučić, M.: AUTOCAD – handbook for technical drawing on computer. Naklada Lučić, Tenja 2005.</td><td></td><td></td></tr>
<tr><td colspan="4"></td><td></td><td></td></tr>
<tr><td colspan="4"></td><td></td><td></td></tr>
</table>

2.12. Optional literature (at the time of submission of study programme proposal)	Internet sources and help systems of graphic programs		
2.13. Quality assurance methods that ensure the acquisition of exit competences	In accordance with the Quality Policy and Quality Manual, University of Zagreb and the quality assurance system of the Faculty. Survey evaluation of subjects and teachers. Self-evaluation of teachers.		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Drago Špoljarić	1.6. Year of the study programme	I.
1.2. Name of the course	Engineering Informatics	1.7. Credits (ECTS)	2
1.3. Associate teachers	Mario Miler Dražen Odobašić	1.8. Type of instruction (number of hours L + S + E + e-learning)	30 (15L-15E)
1.4. Study programme (undergraduate, graduate, integrated)	study of geodesy and geoinformatics, BSc	1.9. Expected enrolment in the course	60
1.5. Status of the course	optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	e-learning 2

2. COUSE DESCRIPTION	
2.1. Course objectives	Adoption of the basic theoretical and practical knowledge in informatics through three basic parts: hardware, software and experts needed to easily learn the task during the study and application of the engineering profession. Through preparation and presentation of modern informatic topics, students are actively involved in expanding and upgrading their IT skills. Through practical tasks students learn the rules of desirable behavior in the Internet community, correct electronic communication and behavior on social networks.
2.2. Course enrolment requirements and entry competences required for the course	no
2.3. Learning outcomes at the level of the programme to which the course contributes	**Knowledge and understanding** Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. **Applying knowledge and understanding** Use information technology in solving geodetic and geoinformation tasks. **Communication skills** Communicate the results obtained by means of geodesy and geoinformation to clients and experts of geodetic and other related professions. **Learning and ethical skills** Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services

	based on the position, and the changes in regulations, norms and standards.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Distinguish, describe and define the physical components of a computer (hardware), software and operating system (software) and user segment and their interconnection. Use modern operating systems, office tools, e-mail and the Internet. Explain the division of computer networks, technology connectivity and protocol for communication over computer networks. The ability to decent communication via the Internet (for example, correctly write an e-mail). Recognize the dangers of the Internet and apply adequate protective measures, and identify the reasons of data protection on the Internet. Describe the role of open and commercial information systems and applications, and to explain their role and communication technologies in geodesy and geoinformatics.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Lectures 1. Content and organization of the subject (1L + 1E). How to subscribe to e-learning, access the course. Rules desirable behavior in the Internet community (Netiquette). Rules on the use of public computers at the Faculty of Geodesy. 2. Concept and content of IT and / or computer science. What is Engineering Informatics? Computer system: hardware, software and experts. 3. The component of a computer system - hardware. 4. Component of a computer system - software. Operating systems. 5. Component of a computer system - experts. 6. Computer Networks, connectivity and communication through the network. 7. Internet. 8. Network protocols (HTTP, HTTPS, FTP, etc.). 9. Dangers on the Internet, viruses, spyware, adware, etc. Protective measures. 10. Dangers on social networks. Protective measures. 11. Internet communication: the official and personal. How to write an electronic letter (e-mail). 12. Internet presentations: the official (institutional) and personal websites / portals. 13. Data and copyright (licencing). 14. Commercial and free (open source) software needed for the technical and scientific tasks in geodesy and geoinformatics. 15. Trends in the development and application of information and communication technologies in geodesy and geoinformatics. Exercises 1. Introducing students to the IT infrastructure at the Faculty: mail and web servers, university websites and e-learning (with

<table>
<tr><td></td><td colspan="3">the participation of B. Jakubec).
2. Introduce students to topics of seminars and project tasks, conditions and terms of manufacturing and presentation. The choice of topics.
3. Collection of online resources for making selected the essay topic.
4. Basic to use the Linux operating system.
5. Installation of Linux operating system (Ubuntu or Fedora, etc.).
6. Introduction to the structure of the Linux file system.
7. Foundations of using the command line.
8. Analysis of the way of handling files on the Linux operating system (owners, users, groups and permissions).
9. Introduction to safety features on Linux and Windows operating system.
10. Using network protocols on the Internet.
11. Panel Discussion: Internet communication (social networks, forums, blog, ...).
12. Panel Discussion: Data on the Internet and rights (license) use of the data.
13. Presentation (presentation) seminars and project tasks - discussion.
14. Presentation (presentation) seminars and project tasks - discussion.
15. Presentation (presentation) seminars and project tasks - discussion.</td></tr>
<tr><td>2.6. Format of instruction:</td><td>☒ lectures
☒ seminars and workshops
☒ exercises
☐ on line in entirety
☒ partial e-learning
☐ field work</td><td>☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td>2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="3">Mandatory attendance at 70% of teaching - lectures
Mandatory attendance at 70% of classes - exercises
Required preparation and tests in two project tasks and presentation of seminar paper.</td></tr>
</table>

<table>
<tr><td rowspan="5">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>0.5</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>0.5</td><td>(other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td>1,0</td><td>(other)</td><td></td></tr>
<tr><td>2.10. Grading and evaluating student work in class and at the final exam</td><td colspan="6">No rating (examination). Continuous monitoring of teaching, preparation and presentation of seminar papers and projects.</td></tr>
</table>

	Title	Number of copies in the library	Availability via other media
2.11. Required literature (available in the library and via other media)	Vučetić, N.: Informatika I		e-learning
	Roić, M.: Informatika II		e-learning
	Rožić, N.: Informatika III		e-learning
	Mnogobrojni Internetski izvori: web stranice i portali		internet
	Hrvatski informatički časopisi: Bug, PC Chip, Vidi, Mreža		
	R. Kučinac, I. Borovec: Osnove računala i Windows XP, Miš, 2002.		
2.12. Optional literature (at the time of submission of study programme proposal)			
2.13. Quality assurance methods that ensure the acquisition of exit competences	Students are required to demonstrate their knowledge creation and presentation of seminar work and project. Self-evaluation of teachers and interviewing participants.		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Rinaldo Paar	1.6. Year of the study programme	1
1.2. Name of the course	Introduction toGeodesy	1.7. Credits (ECTS)	2
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	30 (L-30, E-0)
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	60-80
1.5. Status of the course	elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	The aim ofthe course is toteach students about thesurveyingand Faculty of Geodesy. Preparingstudentsfor studying atthe Faculty of Geodesy, in awayto get acquaintedwith the organizationof the faculty. Students are introduced withthe organization ofsurveyingactivitiesinthe Republic of Croatia. Studentswill masterthe basic conceptsofgeodesy, ie. they mustbefamiliar with the basictheoriesof measurementsanduncertainties that may arise, coordinate systems, geodeticbasisandgeoinformation systems.
2.2. Course enrolment requirements and entry competences required for the course	/
2.3. Learning outcomes at the level of the programme to which the course contributes	**Knowledge and understanding** - Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. - Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. - Demonstrate competences in regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy right, publishing and exchange of spatial data. - Understand mathematical methods and physical laws applied in geodesy and geoinformatics.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	**The studentswill:** 1. Repeat the historical development of geodesy and Faculty of Geodesy. 2. Explain the structure and organization of the Faculty of Geodesy and geodetic activity in the Republic of Croatia. 3. Explain the basic concepts and definitions in geodesy.

	4. Define the units of measurement for length, angles and surfaces. 5. Calculate the earth surface parts (areas). 6. Explain the basic theory of measurements and uncertainties that may occur. 7. Interpret the coordinate systems, geodetic surveys and geodetic basis.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	**Week/Lectures(two hours per week)** 1. L:The history and structure of the Faculty of Geodesy 2. L:Undergraduate and graduate study of Geodesy and Geoinformatics. Academic degrees. 3. L:Organization of surveying activities in the Republic of Croatia; schools, universities, associations, societies, cadastres, land registers, chamber and administration. Papers: Geodetski list, Kartografija i geoinformacije, Ekscentar. 4. L:Tasks of geodesy, basic terms and definitions in geodesy. Classification of geodesy. Historical development of geodesy. 5. L:Units of measurement for length, angles and surfaces.Basic theory of measurement. 6. L:Uncertainties in the measurements, precision and accuracy. 7. Firstpreliminary exam. 8. L:Coordinate systems. Geodetic plans and maps. 9.

DETAILED PROPOSAL OF THE STUDY PROGRAMME

	L:Geodetic basis. 10. L:Satellite positioning. 11. L:Land surveying. 12. L:Area calculations. 13. L:Introduction to geoinformation systems. 14. L:The future of geodesy. 15. Second preliminary exam.

2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☐ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ team work (other)	2.7. Comments:

2.8. Studentresponsibilities	Obligatorypresence inmore than70% of lectures. Accessingthetwopreliminary exams inwhich studentssolvecomputationalandtheoretical tasks.

2.9. Screening student work *(name the proportion of ECTS credits for eachactivity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	1	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	1	Oral exam		(other)	
	Written exam		Project		(other)	

<table>
<tr><td>2.10. Grading and evaluating student work in class and at the final exam</td><td colspan="3">Successfully pass two preliminary examsthat take placeduring the semesterare a condition for obtaining the course signature.</td></tr>
<tr><td rowspan="6">2.11. Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>Macarol S: Practical geodesy, 1985.</td><td>10</td><td></td></tr>
<tr><td>Benčić D, Solarić N: Measuring instruments and systems in geodesy and geoinformatics, 2005.</td><td>10</td><td></td></tr>
<tr><td>Rezo, M.: Plane geodesy, 2013.</td><td>10</td><td></td></tr>
<tr><td>Paar, R. The manuscript from lectures, 2014.</td><td></td><td>Through e-learning systems for the course</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>2.12. Optional literature (at the time of submission of study programme proposal)</td><td colspan="3"></td></tr>
<tr><td>2.13. Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">Via:
1.Preliminary exams –2 exams.
2. Value theteacherby the students through thesurvey- student evaluation.</td></tr>
<tr><td>2.14. Other (as the proposer wishes to add)</td><td colspan="3">Studentsare expected torespectthe principles ofacademic integritywhich are regulated bythe Code of Ethicsof the University(available at: www.unizg.hr).
In classit is expectedthateveryone has the rightto speak your mindas long as itdoes not offendthe other person.</td></tr>
</table>

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Željka Tutek	1.6. Year of the study programme	First
1.2. Name of the course	Mathematics on Computers	1.7. Credits (ECTS)	1
1.3. Associate teachers	-	1.8. Type of instruction (number of hours L + S + E + e-learning)	0L+15E
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	>50
1.5. Status of the course	elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	The objectives of this course are • acquire the skills of independent use of mathematical software system (e.g. free open source Sage or similar) for tasks that require symbolic and/or numerical computation • solving of problems in the computer laboratory to support the teaching of mathematical courses (Analytic geometry and linear algebra and Mathematical Analysis).
2.2. Course enrolment requirements and entry competences required for the course	-
2.3. Learning outcomes at the level of the programme to which the course contributes	At the program level, the course contributes to the following learning outcomes: • To use information technology in solving geodetic and geoinformation tasks. • To make conclusions on the basis of performed computational processing and interpretation of surveying data and obtained results. • To understand the mathematical methods and physical laws applied in geodesy and geoinformatics. • To apply the knowledge in mathematics and physics for the purpose of recognizing, formulating and solving problems in the field of geodesy and geoinformatics.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	• Use of a mathematical software system for solving equations and inequalities. • Use of a mathematical software system for computing with vectors. • Use of a mathematical software system for computing with matrices.

<table>
<tr><td></td><td colspan="4">Use of a mathematical software system for visualizing linear operator in plane and space.
Use of a mathematical software system for determining the eigenvalues and eigenvectors.
Use of a mathematical software system for determining the limits.
Use of a mathematical software system for symbolic and numerical deriving and integrating.
Use of a mathematical software system for testing properties and graphing functions of one two variables.
Using a mathematical programming system for drawing 2D and 3D graphs</td></tr>
<tr><td>2.5. Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="4">Schedule of the exercise on the computer

1.-2. Getting started with the mathematical software system (e.g. Sage).
3. Number representation in computer. Real and complex numbers. Arithmetic operations. Elementary functions.
4-5. Solving equations and inequalities.
6. Calculations with vectors.
7. Determining the limits.
8. Computation with matrices.
9. Symbolic and numerical derivation.
10. Exploring the properties of functions of one and several variables.
11. Drawing 2D and 3D graphs.
12. Symbolic and numerical integration.
13. Visualization of linear operators in the plane and in space.
14. Determination of eigenvalues and eigenvectors.</td></tr>
<tr><td>2.6. Format of instruction:</td><td>☐ lectures
☐ seminars and workshops
☐ exercises
☐ on line in entirety
☒ partial e-learning
☐ field work</td><td>☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="4">Regular exercises attendance (exercises in computer lab), solving homework, and activities through a system of E-learning.
The requirement for signature: 80% of arrivals on laboratory exercises and 80% of completed assignments during the semester.</td></tr>
</table>

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of*						
	Class attendance	50%	Research		Practical training	
	Experimental work		Report		Homework	50%
	Essay		Seminar essay		(other)	

ECTS credits is equal to the ECTS value of the course)	Tests		Oral exam		(other)	
	Written exam		Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	The subject is not assessed.

2.11. Required literature (available in the library and via other media)	Title	Number of copies in the library	Availability via other media
	Sage standard documentation, http://www.sagemath.org/		yes
	A. Casamayou, N. Cohen, G. Connan, T. Dumont, L. Fousse, F. Maltey, M. Meulien, M. Mezzarobba, C. Pernet, N. M. Thiéry, P. Zimmermann : Calcul mathématique avec Sage , 2013. (ISBN: 9781481191043)		yes

2.12. Optional literature (at the time of submission of study programme proposal)	
2.13. Quality assurance methods that ensure the acquisition of exit competences	The acquisition of the exit competences will be checked during the semester through independent (in the computer laboratory and for homework) solving problems by using mathematical software system.
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Dalibor Vračan	1.6. Year of the study programme	First, 1st semester 2nd semester Second, 3rd semester 4th semester
1.2. Name of the course	Physical and health culture	1.7. Credits (ECTS)	0
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	30 (E)
1.4. Study programme (undergraduate, graduate, integrated)	Bachelor Study	1.9. Expected enrolment in the course	90
1.5. Status of the course	obligatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	

2. COUSE DESCRIPTION	
2.1. Course objectives	Transfer of information and knowledge about kinesiology and physiology of sport about influence of corporal activity on total psychophysical and social status of human. Adopting new and improvement of existing motility knowledge's and skill's and specialization of students in kinesiological activities appropriate for daily sport-recreational exercise.
2.2. Course enrolment requirements and entry competences required for the course	No
2.3. Learning outcomes at the level of the programme to which the course contributes	
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	
2.5. Course content broken down in detail by weekly class schedule	1. Sport games – football - technique. Handball - technique. 2. Sport games – football - technique. Handball - technique.

(syllabus)	3. Sport games – football - technique. Handball - technique. 4. Sport games – basketball - technique. 5. Sport games – basketball - technique. 6. Sport games – basketball - technique. 7. Parter gymnastics. 8. Partner gymnastics. 9. Swimming - tehnique. 10. Swimming - tehnique. 11. Swimming - tehnique. 12. Aerobic – motion in space in rythmical cycles. 13. Aerobic – motion in space in rythmical cycles. 14. Stretching – creating small excersising systems in accordance to specific sport. 15. Endurance of motion in nature.

2.6. Format of instruction:	☐ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☐ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:
2.8. Student responsibilities	Presence on 80% (24/30) hours of exercise		

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	1	Research		Practical training	
	Experimental work		Report		independent assignments	
	Essay		Seminar essay		interactive tasks	
	Tests		Oral exam		(other)	
	Written exam		Project		(other)	
2.10. Grading and evaluating student work in class and at the final exam	Course is not assessed					

2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Mišigoj-Duraković M. i sur. (1999.) *Tjelesno vježbanje i zdravlje*, Zagreb: Grafos		Knjižnice grada,

			Kineziološki fakultet.
2.12. Optional literature (at the time of submission of study programme proposal)	Volčanšek, B. (1996.) *Plivanje*, Zagreb: Fakultet za fizičku kulturu Sveučilišta u Zagrebu Trninić, S. (1996.) *Analiza i učenje košarke*, Zagreb: Fakultet za fizičku kulturu Sveučilišta u Zagrebu Janković, V. (1966.) *Odbojka*, Zagreb: Fakultet za fizičku kulturu Sveučilišta u Zagrebu Šnajder, V.; Milanović, D. (1991.) *Atletika hodanja i trčanja*, Zagreb: Fakultet za fizičku kulturu Sveučilišta u Zagrebu, 1991.		
2.13. Quality assurance methods that ensure the acquisition of exit competences	The implementation of a single university Questionnaire for evaluating teachers prescribed by the Senate.		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Nikol Radović	1.6. Year of the study programme	II.semester
1.2. Name of the course	Computer geometry	1.7. Credits (ECTS)	5
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	30(L) + 30(E) + e-learning
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	90
1.5. Status of the course	mandatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	Level 2
2. COUSE DESCRIPTION			
2.1. Course objectives	The goal of course Computational geometry is the renewal and replenishment secondary education of geometry, using the dynamic geometry (Geometer's Sketchpad 5.03HR) as a tool for drawing / design, with particular emphasis on applications in geodesy and geoinformatics.		
2.2. Course enrolment requirements and entry competences required for the course	knowledge of secondary school mathematics/ geometry programs		
2.3. Learning outcomes at the level of the programme to which the course contributes	**Knowledge and understanding** - To know theoretical principals, procedures of computer processing and visualisation of surveying data. - To understand the mathematical methods and physical laws applied in geodesy and geoinformatics. **Application of knowledge and understanding** - To apply the knowledge in mathematics and physics for the purpose of recognizing, formulating and solving problems in the field of geodesy and geoinformatics, - To use information technology in solving geodetic and geoinformation tasks. **Learning and ethical skills** - To plan the continuation of academic education in the field of geodesy and geoinformatics, or related disciplines, and to develop the lifelong learning attitude.		
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- Troubleshoot and draw constructive task of applying the transformation plane / space using dynamic geometry Sketchpad 5:03CRO - To construct geometric figures by animation using the dynamic geometry sketchpad 5:03		

<table>
<tr><td></td><td colspan="3">- To solve constructive tasks by iteration method
- The basics of mathematical (geometric) model and apply them
- Ability to formulate problems of geodesy on geometric (mathematical) language as well as their analysis and resolution
- Demonstrate skills geometric reasoning</td></tr>
<tr><td>2.5. Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="3">- A brief history of geometry / Computer geometry (1 hour)
- Transformation of the plane (translation, symmetry, rotation, slide symmetry). (3 hours)
- Solving constructive tasks by methods of plane transformation s. (4 hours)
- Solving constructive tasks using as the locus of points. (4 hours)
-The composition of plane transformations and symmetry groups and their display using the dynamic geometry (4 hours)
- Basic concepts of fractal geometry and structure fractal iteration method using dynamic geometry (2 hours)
- Visualization of projective planes (2 hours)
- Display plane curves 2 and a higher degree with the program dynamic geometry as tool for for drawing (2 hours)
- Animation as the foundation of computer graphics, construction geometric figure animation (2 hours)
- The use of dynamic geometry (2 hours)
- Non-Euclidean geometry (4 hours)</td></tr>
<tr><td>2.6. Format of instruction:</td><td>☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☒ partial e-learning
☐ field work</td><td>☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☒ homeworks</td><td>2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="3">- Presence in more than 80% lecture and 80% of exercises; homework (five compulsory and two bonuses).
- For homework students receive tasks that must be addressed to one of constructive methods or must apply one or more of the default method, with their implementation (task open-ended).
- Every homework is evaluated.
- (Correct) homework's delivered on time and pass on first colloquium (theoretically) are the condition for signature.
- Accessing three colloquiums to which the student responds to the theoretical issues and solves problems.
- In writing: the written part of the exam students may be released if such material is deposited through two theoretical and constructive three colloquia that take place during the semester.
Oral: theoretical knowledge is tested on regular examination periods</td></tr>
</table>

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	0.5	Research		Practical training	
	Experimental work		Report		homeworks	1
	Essay		Seminar essay		(other)	
	Tests	1.2	Oral exam	1.2	(other)	
	Written exam	1.1	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam

Continuous monitoring of the exercises, homework, and colloquia.
During the semester the five compulsory and two bonus homework, to be evaluated.
All are drawn in the program dynamic geometry sketchpad 5.03CRO and submit such files.
In the semester are three colloquia. 1. Colloquium is theoretically and a condition for signature. 2nd and 3rd Colloquium consist of theoretical and constructive parts (which are delineated in the program dynamic geometry sketchpad 5:03 CRO).
To pass the colloquium should be both theoretically and constructive part of affirmative solve.

1. 1st Colloquium (theoretically) (max. 150 points)
   0-75 points ------------- >insufficient (1)
   76-109 points ---------- > sufficient (2)
   110-129 points -------- > good (3)
   130-140 points -------- > very good (4)
   141-150 points -------- >excellent (5)

   2nd / 3rd COLLOQUIUM
   THEORETICAL (max. 30 points)
   0-15 points ------------ > insufficient (1)
   16-20 points ---------- >sufficient (2)
   21-24 points ----------→ good (3)
   25-27 points ----------- > very good (4)
   28-30 points ---------- > excellent (5)

   CONSTRUCTIVE (max. 230 points)
   0-115 points ---------- --- >insufficient (1)
   116-189 points ------- --→ sufficient (2)
   190-209 points ---------→ good (3)
   210-219 points --- ----- > very good (4)
   220-230 points ---------→ excellent (5)

	All students who have earned a minimum of sufficient (2) per each of the activities, will be exempt from the written exam. All students who have earned a minimum of very good (4) per each of the activities, will be exempt from the exem.		
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	D. Palman, *The triangle and circle*, Element, Zagreb, 1994.		
	D. Palman, *Geometrical constructions*, Element, Zagreb, 1996.		
	D. Palman, *Stereometry*, Element, Zagreb, 2005.		
	D. Palman, *Projective constructions*, Element, Zagreb, 2005.		
	D. Palman, *Planimetry*, Element, Zagreb, 1999.		
	All course materials are available in electronic form for students.		
2.12. Optional literature (at the time of submission of study programme proposal)	V. Gutenmacher, N. B. Vasilyev: *Lines and Curves A Practical Geometry Handbook*, Birkhauser Boston Inc., 2004. B. E. Reynolds, W. E. Fenton: *College Geometry Using The Geometer's Sketchpad*, Key College Publishing, 2006. C. V. Sanders: *Geometric Graphic*, Key Curriculum Press, Emeryville, 2003.		
2.13. Quality assurance methods that ensure the acquisition of exit competences	- A survey on the quality of teaching and learning materials - Class attendance and class participation - Evaluation of the results of the examination (year)		
2.14. Other (as the proposer wishes to add)	The mathematical/ geometric approach to problems by applying dynamic geometry as a tool to draw enable students to select the correct application of basic mathematical/ geometrical skills, discover patterns in forms, templates, and to recognize and communicate with them related ideas. Solving mathematical/ geometry with a focus on geosciences requires creativity and a systematic approach, which plays a major role innovation and scientific and technical and scientific discoveries..		

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Vida Zadelj-Martić	1.6. Year of the study programme	1/II
1.2. Name of the course	Vector Analysis	1.7. Credits (ECTS)	3 ECTS
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	30+15
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	100
1.5. Status of the course	obligatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	1, 10%

2. COUSE DESCRIPTION	
2.1. Course objectives	Understanding the key topics and problems of Vector Analysis. Also it is necessary to develop many skills between abstract entities according to certain rules and apply it into Geodesy
2.2. Course enrolment requirements and entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. Understand mathematical methods and physical laws applied in geodesy and geoinformatics. Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of problems in the field of geodesy and geoinformatics. Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	1) Define and implement the tasks of the term of the vector functions of one scalar variable 2) Define and apply the concepts of tasks: line integral of the first and the second kind and their properties; determine the relationship between line integral of the first and the second kind, and define and apply Green formula 3) Define and apply the concepts of tasks: double and triple integrals and their applications, with the introduction of the Jacobian for cylindrical and spherical coordinates

	4) Define and apply the concepts of tasks: surface integrals and vector surface integrals. Describe the flux of a vector field through a surface 5) Define and apply the concepts of tasks: scalar and vector fields and directional derivatives 6) Telling the Green-Gauss-Ostrogradski theorem and Stokes' theorem and applying to the tasks		
2.5. Course content broken down in detail by weekly class schedule (syllabus)	1) Vector function and space curves; derivatives and integrals of vector functions 2) Line integrals of the first kind and properties(Jordan curve, curve orientation, tangent vector to the curve, length of a curve, line integrals of the first kind, properties, line integral of the first kind using polar coordinates) 3) Application of line integral of the first kind on tasks 4) Line integrals of the second kind and properties 5) Application of line integrals of the second kind on tasks; relationship between line integral of the first and the second kind 6) Double and triple integrals and applications (double integral, replacing the order of integration, volume and surface area using double integrals, change of variables in a double integral, Jacobian, volume by the triple integrals, Jacobian for cylindrical and spherical coordinates) 7) Green's formula 8) Definition of parametric surfaces; Normal vectors and tangent planes; Area of a parametric surface 9) Definition of the surface integral 10) Oriented surfaces; The vector surface integral ; flux of a vector field through a surface 11) The use of surface integrals on various types of tasks 12) Scalar and vector fields (scalar fields, level surface and level curves of a scalar field, gradient of a scalar field, Hamilton's operator, Laplace operator, vector field, the curl of a vector field, divergence of a vector field, solenoidal field) 13) Directional derivative 14) Green-Gauss-Ostrogradski theorem and Stokes' theorem		
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work	☒ independent assignments ☒ multimedia and the internet ☐ laboratory ☒ work with mentor ☐ (other)	2.7. Comments:
2.8. Student responsibilities	By continuous monitoring during the semester, the students accumulate the points which, in the end, articulate requirements for signature and evaluation through: 1st Presence of lecture (80%) and exercises (80%)		

	2nd Doing homeworks (80%) 3rd Participation in class during the lectures and exercises 4th Two partional preliminary exams

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	1.0	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	(2.0)	Oral exam	1.0	(other)	
	Written exam	1.0	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	A requirement for signature is 80% of class attenance and doing 80% of homeworks To pass the exam, it is sufficient to achieve at least fifty per cent of the all examples and theoretical problems through the partial exams. In case that student is not satisfy whit his grade, than he has to do the classical exam (written exam and oral exam)

	Title	**Number of copies in the library**	**Availability via other media**
2.11. Required literature (available in the library and via other media)	I. Slapničar; http//lavica. Fesb.hr/mat2/ I. Slapničar; http//lavica. Fesb.hr/mat3/		
	M. Lapaine; Vektorska analiza, Geodetski fakultet, Zagreb		
	P. Javor; Matematička analiza 2, Element, Zagreb		
	V. Zadelj-Martić; Non reviwed lectures on e-learning (in Croatian)		

2.12. Optional literature (at the time of submission of study programme proposal)	W. F. Trench; Introduction to Real Analysis; San Antonio, Texas, USA B. Apsen; Riješeni zadaci iz više matematike I, II,
2.13. Quality assurance methods that ensure the acquisition of exit competences	Homework, participation in class during the lectures and exercises, the accession of the partial exam, the accession of the classical exam (if the exam is failed by a partial exams). Self-evaluation of teachers and student survey
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Nada Vučetić	1.6. Year of the study programme	1
1.2. Name of the course	Progamming	1.7. Credits (ECTS)	5
1.3. Associate teachers	Lili Gracin	1.8. Type of instruction (number of hours L + S + E + e-learning)	L30+E30
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	90
1.5. Status of the course	obligatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION			
2.1. Course objectives	To adopt the basic concepts of programming and the ability to design simple programs in the programming language Java for solving mathematical, geodetic and geoinformatics problems.		
2.2. Course enrolment requirements and entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	**Applying knowledge and understanding:** Use information technology in solving geodetic and geoinformation tasks. **Making judgements:** Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution. **Communication skills:** Communicate the results obtained by means of geodesy and geoinformation to clients and experts of geodetic and other related professions. **Learning and ethical skills:** Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards.		
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	1. Distinguish and apply different types of data storage in a computer. 2. Describe and apply the procedures of program design. 3. Analyze the given simple mathematical, geodetic and geoinformatics problem and develop an algorithm by using a		

	pseudocode and a flowchart for its solution. 4. Use a programming language for the implementation of the algorithm expressed by using pseudocode and flowchart. 5. Distinguish simple and complex data types in a programming language. 6. Design an application that uses complex data types.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Lectures: 1. The objective and the content of the course. The organization of teaching. 2. Computer architecture. Data records in the computer: number systems, standards and file formats, recording errors. 3. The concept of programming. Definition and basic properties of the algorithm. 4. Fundamentals of object oriented programming. Introduction to Java. 5. The basic elements of the Java programming language: the names, data types, variables, expressions, statements, blocks (compound statements). 6. Built-in mathematical functions in Java. Data input and output using standard devices of a computer. 7. Statements for conditional branching in a program. 8. The first test. 9. Repetition statements. 10. Jump statements. 11. Introduction to classes. 12. Onedimensional and multidimensional arrays. 13. Classes to create and manipulate strings (sequences of characters) 14. Reading data from a file and writing data to a file. 15. The second test. Exercises: 1. The organization of exercises and introducing to tasks. 2. Converting a number from one Base to another. Arithmetic expressions. 3. Creating algorithms (flowcharts and pseudocodes) to solve simple problems. 4. Introduction to Java. Creating the first Java program. 5. Solving the problems (flowchart, pseudocode, code in Java) using the basic elements of the Java programming language. 6. Problem solving (flowchart, pseudocode, code in Java) using Java built-in mathematical functions. 7. Solving the problems (flowchart, pseudocode, code in Java) using statements for conditional branching in the programs. 8. Solving of problems (flowchart, pseudocode, code in Java)) from the test. 9. Problem solving (flowchart, pseudocode, code in Java) using repetition statements.

	10. Solving the problems (flowchart, pseudocode, code in Java) using jump statements. 11. Creating a class with own methods. 12. Solving the problems (flowchart, pseudocode, code in Java) using onedimensional and multidimensional arrays. 13. Problems solving (flowchart, pseudocode, code in Java) using strings. 14. Reading data from a file and writing data to a file. Problems solving. 15. Solving the problems (flowchart, pseudocode, code in Java)) from the test. Exercises follow the lectures. During exercises, the problems from the area that was explained in the lecture are solved, and it is expected that the student is actively involved in solving these problems.

2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☐ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:

2.8. Student responsibilities	Students are required to attend the class (min. 70%), actively participate in its work, do homeworks, as well as to practice self-learning.

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	2	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	1.5	Oral exam	0.5	(other)	
	Written exam	1	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	There are two tests during the course. Each test contains material from lectures and exercises from the beginning of the semester until the day of the test. Both of them consist of theoretical and practical parts. The practical part consists in creating and documenting complete computer programs to fulfil the task The student can pass the exam on the basis of knowledge checking during the semester if he obtained at least 50% of points in each test. The grade in percentage: Grade(%) = 0.5(K1+K2), where K1 and K2 are student's points in percentage from the first and second test. The final course grade: Percentage: Grade:

	Croatian: ECTS: 50% - 61% sufficient (2) (D, E) 62% - 74% good (3) (C) 75% - 85% very good (4) (B) 86% - 100% excellent (5) (A) If the student did not achieve at least 50% of points in each test, he takes the written and oral exam during the regular exam period. In the written exam, student creates complete computer programs to solve simple mathematic and geoinformatics problems. In the oral exam the acquired theoretical knowledge is checked.		
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Chapman, S. J., Java for Engineers and Scientists, Prentice Hall, 2003.	1	
	Vučetić, N., Programming 1 with Java. University of Zagreb, Faculty of Geodesy, Zagreb 2010. (Lecture notes) (in Croatian)		e-learning
	Vučetić, N., Handouts of internal Lecture notes in Programming, 2014.		e-learning
2.12. Optional literature (at the time of submission of study programme proposal)			
2.13. Quality assurance methods that ensure the acquisition of exit competences	The quality will be monitored through success at tests and exams, and via anonymous students surveys.		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Vlado Cetl	1.6. Year of the study programme	1.
1.2. Name of the course	Land Surveying	1.7. Credits (ECTS)	5.0
1.3. Associate teachers	Loris Redovniković Saša Vranić Radan Vujnović	1.8. Type of instruction (number of hours L + S + E + e-learning)	30L+60E
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	80-90
1.5. Status of the course	Mandatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	The objective of the course is to provide teoretical and practical knowledge and skills in land surveying as a fundamental geodetic activity
2.2. Course enrolment requirements and entry competences required for the course	Completed course: Geodetic instruments
2.3. Learning outcomes at the level of the programme to which the course contributes	Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data Handle geodetic instruments and appropriate measuring equipment properly, and perform geodetic measurements Solve practical tasks in surveying, spatial data collection, real estate evaluation and management Establish geodetic networks needed in surveying and stakeout in order to provide the required quality of the works performed in certain space Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Describe and apply the basic principles and methods of land survey Describe the basic geodetic network, their establishment and implementation Describe the procedure of field inspection in order to establish the basic geodetic networks Stabilize, measure and establish the basis for detailed land surveying

	Explain the types of traverses respect to their connection on the basic geodetic networks Explain and distinguish methods of determining the height in land surveying Use appropriate surveying instruments in theland surveying Describe and apply the procedure of calculating the coordinates of geodetic points and a detailed points
2.5. Course content broken down in detail by weekly class schedule (syllabus)	1. Basic concepts and principles of land surveying. Geodetic basis for surveying the land and putting them in place, methods of surveying and measurement quantities. Basics coordinate calculations 2. Coordinate systems of Gauss-Krüger projection meridian zones. Coordinate system HTRS96/TM 3. Basic concepts of triangulation. Basic concepts of GNSS measurements, measurement methods and the principle of fitting in terrestrial systems 4. Geodetic basis in the form of traverses. Traverse. Both sides are connected, connected only by coordinates, closed and blind traverse. Connection to the inaccessible point 5. Field inspection and stabilization of geodetic points 6. Measurement of angles in the traverses and sources of uncertainty in the measurement of angles, a priori estimation of accuracy of measurement and permitted angular deviation 7. Linear measurement in traverses. Measuring the length with the electro-optical distance meters and sources of uncertainty of measurement. Corrections of measured length due to meteorological factors, reducing the surface of the reference ellipsoid and the correction due to deformations of the projection 8. Preliminary exam 9. Calculating coordinates of traverse points by approximate methods. Calculating the coordinates of small points (on the line and vertical) 10. Levelling. The general terms, the principle of determining height differences, a division of leveling 11. General leveling, rules of operation, the stabilization of refernce height points. Sources of uncertainty in leveling. Connection of leveling travers to reference hight point 12. Calculation of leveling traverse. Detailed leveling. Leveling of profile and surfaces 13. Trigonometric and GNSS measurements of height differences. Determination of height differences of close points 14. Land surveying methods. Polar method (Tacheometry). Rules in surveying, selection of points, dependence of scale to surveying details and the use of topographic key. The encoded tacheometry. Surveying using GNSS RTK 15. Preliminary exam Exercises: The establishment of a traverse for the purpose of land surveying. Surveying od detail points and data processing. Measurement of levelling traverse using precise leveling, height determination of detailed points. Trigonometric and GNSS leveling

DETAILED PROPOSAL OF THE STUDY PROGRAMME

2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☒ field work	☒ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:

2.8. Student responsibilities	Regular attendance of more than 70% lectures and 70% exercises. Completition of the project on the exercises

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	1.5	Research		Practical training	0.5
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	1.0	Oral exam	1.0	(other)	
	Written exam	0.5	Project	0.5	(other)	

2.10. Grading and evaluating student work in class and at the final exam	During the semester, two preliminary exams are organized. Preliminary exams consist of practical computing tasks. To pass it student must completely accurate (100%) solve the tasks. Students who pass both exams are exempted from the written exam

	Title	**Number of copies in the library**	**Availability via other media**
2.11. Required literature (available in the library and via other media)	Kahmen, Heribert / Faig, Wolfgang (2012): Surveying. De Gruyter, ISBN: 978-3-11-084571-6	10	
	Rezo, M. (2014): Ravninska geodezija-zbirka zadataka. Geotehnički fakultet, Varaždin	10	
	Cetl, V.: Land Surveying, Internal script		online
	Online course materials on e-learning system		online

2.12. Optional literature (at the time of submission of study programme proposal)	Macarol S. (1978): Praktična geodezija, Tehnička knjiga, Zagreb
2.13. Quality assurance methods that ensure the acquisition of exit competences	In accordance with the Quality Policy and Quality Manual, University of Zagreb and the quality assurance system of the Faculty Survey evaluation of subjects and teachers. Self-evaluation of teachers
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Đuro Barković Mladen Zrinjski	1.6. Year of the study programme	1
1.2. Name of the course	Field Measurement	1.7. Credits (ECTS)	5
1.3. Associate teachers	Radan Vujnović	1.8. Type of instruction (number of hours L + S + E + e-learning)	60 (30L+30E)
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	90
1.5. Status of the course	Compulsory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	level 2
2. COUSE DESCRIPTION			
2.1. Course objectives	Acquire knowledge and skills in the organization of field work, the basis of the theory of measurement and computation in plane geodesy. Reconnaissance of the terrain, performing field measurements and processing of measurement data.		
2.2. Course enrolment requirements and entry competences required for the course	Completed course ''Geodetic Instruments''. Completed course ''Engineering Graphics in Geodesy and Geoinformatics''.		
2.3. Learning outcomes at the level of the programme to which the course contributes	Knowledge and understanding Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. Applying knowledge and understanding Handle geodetic instruments and appropriate measuring equipment properly, and perform geodetic measurements. Solve practical tasks in surveying, spatial data collection, real estate evaluation and management. Making judgements Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. Learning and ethical skills Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards.		

2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	1. Define the terms: planar Cartesian coordinate system, geodetic points, geodetic plans and maps and other geodetic documentation. 2. Understand and describe of geodetic assignments fieldwork, spatial orientation in the field, the detection of existing and setting new points of geodetic networks (reconnaissance of the terrain). 3. Create a work plan geodetic assignment, apply and select the geodetic methods and measurement procedures for measuring and predict and determine the value of the potential impacts on the execution of assignments. 4. Select the most suitable instruments and accessories for field geodetic measurements according to the required measurement uncertainty, which is defined by specific geodetic assignment. 5. Measure the horizontal directions gyrus method, vertical angles in more repetitions and distances of different measurement procedures. 6. Measure the horizontal directions and other measurement quantities with eccentric positions for indirectly determining elements eccentricity and apply centering account. 7. Define the terms of bearing grid, geodetic azimuth and coordinate differences and apply the basics of computing in Cartesian coordinate system. 8. Apply affine transformation of coordinates of points in the plane. 9. Measure geodetic measurement quantities and calculate the coordinates of points: intersecting, resecting and intersection of arcs. 10. Differentiate terrestrial and satellite methods for determining the coordinates of points according to the criteria of measurement uncertainty.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	1. Organization of fieldwork. Project assignment – closing the triangle. (2L + 2E) 2. Geodetic basis. Project assignment – bearing grid and distance. (2L + 2E) 3. Basic theory of measurement. Project assignment – intersecting. (2L + 2E) 4. Methods of determining the coordinates of points. Project assignment – resecting. (4L + 4E) 5. Methods for measuring angles. Field exercises – preparation and submission of project assignment. (2L + 2E) 6. Eccentric measuring angles and centering account. Field exercises – preparation and submission of project assignment. (2L + 2E) 7. Basics of computations in a rectangular coordinate system. Field exercises – preparation and submission of project assignment. (2L + 2E) 8. Transformations of coordinates. Field exercises – preparation and submission of project assignment. (2L + 2E) 9. Intersecting. Field exercises – preparation and submission of project assignment. (2L + 2E) 10. Resecting. Field exercises – preparation and submission of project assignment. (2L + 2E) 11. Intersection of arcs. Field exercises – preparation and submission of project assignment. (2L + 2E)

	12. Trigonometric measurement of the height of close points. Field exercises – preparation and submission of project assignment. (2L + 2E) 13. Basics of trilateration. Field exercises – preparation and submission of project assignment. (2L + 2E) 14. Review of knowledge and skills. (2L + 2E)					
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☒ field work		☒ independent assignments ☒ multimedia and the internet ☒ laboratory ☐ work with mentor ☒ team assignments		2.7. Comments:	
2.8. Student responsibilities	Compulsory attendance at 70% of teaching – lectures. Compulsory attendance at 70% of teaching – exercises. Compulsory submission four projects assignments.					
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	0.5	Research		Practical training	1.0
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	0.5	Oral exam	1.5	(other)	
	Written exam	1.0	Project	0.5	(other)	
2.10. Grading and evaluating student work in class and at the final exam	During the semester is organized one preliminary exam. Students who pass the preliminary exam are exempt from the written part of the exam. Other students can take the written and oral exam.					

2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Barković, Đ., Zrinjski, M. (2014): Terenska mjerenja (Field Measurements), internal script, Faculty of Geodesy – University of Zagreb, Zagreb.		
	Benčić, D. (1990): Geodetski instrumenti (Geodetic Instruments), Školska knjiga, Zagreb.		
	Benčić, D., Solarić, N. (2008): Mjerni instrumenti i sustavi u geodeziji i geoinformatici (Measuring Instruments and Systems in Geodesy and Geoinformatics), Školska knjiga, Zagreb.		

	Macarol, S. (1985): Praktična geodezija (Practical Geodesy), Tehnička knjiga, Zagreb.		
	Rezo, M. (2013): Ravninska geodezija - Zbirka zadataka (Plane Geodesy - Collection of assignments), Faculty of Geotechnical Engineering - University of Zagreb, Varaždin.		
2.12. Optional literature (at the time of submission of study programme proposal)			
2.13. Quality assurance methods that ensure the acquisition of exit competences	Testing one preliminary exam. Testing a written and oral exam. Self-evaluation of teachers and polling participants.		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Miljenko Lapaine	1.6. Year of the study programme	1st year, 2nd semester
1.2. Name of the course	Basics of Statistics	1.7. Credits (ECTS)	4
1.3. Associate teachers	Nikol Radović Martina Triplat Horvat Ana Kuveždić Divjak Marina Viličić	1.8. Type of instruction (number of hours L + S + E + e-learning)	45 (30L + 15E)
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	100
1.5. Status of the course	Mandatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION			
2.1. Course objectives	The objectives of this course are: • acquire the skills of collecting, classification and organization of data, their analysis and graphical presentation using appropriate computer programs (Excel, Statistica,..) as a tool in solving various statistical tasks that appear in geodesy and geoinformatics • help students to overcome more easily the other courses that follow, particularly analysis and processing of geodetic measurements		
2.2. Course enrolment requirements and entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	**Knowledge and understanding** • Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. • Understand mathematical methods and physical laws applied in geodesy and geoinformatics. **Applying knowledge and understanding** • Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of problems in the field of geodesy and geoinformatics. • Use information technology in solving geodetic and geoinformation tasks. **Making judgements**		

<table>
<tr><td></td><td colspan="4">• Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution.</td></tr>
<tr><td>2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="4">• Be able to collect data and their presentation in the form of tables or graphs
• Define mean and dispersion measures
• Define basic terms in the probability theory
• Define discrete and continuous random variables and their distributions
• Define and apply statistical tests
• Define regresion analysis, covariance and correlation
• Be able to apply methods of interpolation in geodesy and geoinformatics
• Be able to apply methods of appoximation in geodesy and geoinformatics</td></tr>
<tr><td>2.5. Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="4">1. Collecting and analysing data and their presentation in the form of tables and graphs (2 hours)
2. Measures of central value and dispersion (2 hours)
3. Basics of the probability theory (4 hours)
4. Discrete random variables and their distributions (2 hours)
5. Continuous random variables and their distributions (2 hours)
6. Statistical tests (6 hours)
7. Regresion analysis, covariance and correlation (6 hours)
8. Interpolation and approximation in geodesy and geoinformatics (6 hours)</td></tr>
<tr><td>2.6. Format of instruction:</td><td colspan="2">☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td>☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☒ consultations
☒ evaluations of knowledge</td><td>2.7. Comments:

Exercises follow lectures in their content.</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="4">Regular attendance to lectures and exercises, the possibility of taking part in preliminary exams, the possibility of consulting the demonstrator and teachers, written and oral exams, activity through the system of E-learning.
Attending lectures and exercises in the amount of 70% and active participation are conditions for signature.
Above 30% of absences - loses the right to the signature, and the signature is a prerequisite for the exam registration.</td></tr>
</table>

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS*	Class attendance	1.8	Research		Practical training	
	Experimental work		Report		Learning and preparation for preliminary and final exams (other)	2.2

value of the course)	Essay		Seminar essay		(other)	
	Tests		Oral exam		(other)	
	Written exam		Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	During the semester, the two preliminary exams (tests) exist through which students can be exempted from the written part of the exam. In order to be exempted from the written part of the exam student should acquire a minimum of 50% marks at both preliminary exams. Student achieves a rating on every preliminary exam and the mean of these two ratings is equivalent to the grade of the written exam. Actual rating from continuous assessment applies to one of the first two examination periods in which students attend only the oral exam. If they do not pass the exam, the next time they should take part in the written part. Written exam consists of six tasks. It is necessary to solve three tasks, or 50%, to pass the written part of the exam.

	Title	Number of copies in the library	Availability via other media
2.11. Required literature (available in the library and via other media)	Radović, N.: Predavanja iz Osnova statistike, Geodetski fakultet Sveučilišta u Zagrebu, 2010-2014		e-learning
	Lapaine, M.: Predavanja iz Osnova statistike, Geodetski fakultet Sveučilišta u Zagrebu, 2010-2014		e-learning
	Vrdoljak, B.: Vjerojatnost i statistika, Građevinsko-arhitektonski fakultet Sveučilišta u Splitu, 2007		

2.12. Optional literature (at the time of submission of study programme proposal)	Mann, Prem S.: *Introductory Statistics*, John Wiley & Sons, New York, 2000 Brandt, S.: *Datenanalyse – Mit statistischen Merhoden und Computerprogrammen*, Bibliographisches Institut, Manheim, 4. izdanje, 1999 Devore, L. J.: *Probability and Statistics for Engineering and the Sciences*, Duxbury Press, 2007 Smirnov, N. V., Belugin, D. A.: Teorija verojatnostej i matematičeskaja statistika v priloženii k geodezii, Nedra, Moskva, 1969 Frančula, N., Lapaine, M.: *Geodetsko - geoinformatički rječnik*, Državna geodetska uprava, Zagreb, 2008 Lapaine, M.: *Određivanje granica razreda metodama aritmetičkog i geometrijskog niza*, Geodetski list 1999, 3, 197-208 Vučetić, N., Petrović, S., Lapaine, M., Frančula, N.: *Pojednostavljenje linija na temelju koeficijenta linearne korelacije*, u: Zbornik Geodetskog fakulteta Sveučilišta u Zagrebu povodom 40. obljetnice samostalnog djelovanja 1962.-2002. (urednik T. Bašić), Geodetski fakultet, Zagreb, 51 - 60 Triplat Horvat, M., Lapaine, M., Tutić, D.: *Application of Bošković's Geometric Adjustment Method on Five Meridian Degrees*,

	KoG, 2011, 15, 67–74. Triplat Horvat, M., Lapaine, M.: *Comparison of Bošković-Laplace's Method with other Methods of Adjustment*, in: Geiger János, Pál-Molnár Elemér, Malvić Tomislav (Eds.): Theories and Applications in Geomathematics, ISBN 978-963-306-235-7, Geolitera, Sopron, 2013, 87–101 Lapaine, M.: *Matematika i njezine primjene*, Poučak, 2002, 11, 13 - 41
2.13. Quality assurance methods that ensure the acquisition of exit competences	Two preliminary exams, written and oral exam. Student evaluation.
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Biserka Fučkan Držić	1.6. Year of the study programme	1.
1.2. Name of the course	Basics of English for Special Purposes	1.7. Credits (ECTS)	3
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	L15 + S 15 + e-learning
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	70
1.5. Status of the course	Optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	Development of communication skills in professional context using specific professional English language
2.2. Course enrolment requirements and entry competences required for the course	Knowledge of English acquired in primary and secondary education
2.3. Learning outcomes at the level of the programme to which the course contributes	Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Demonstrate competences in regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy right, publishing and exchange of spatial data. Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards. Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	use professional literature in English Communicate in professional environment -Write written works in English

<table>
<tr><td></td><td colspan="3">-Describe activities in English

- Getting familiar with basic professional terminology in English</td></tr>
<tr><td>2.5. Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="3">Selected texts intended for achieving the goals in learning English for special purposes in the following areas:

- Definition of geodesy

- Surveying profession – services of geodesists

- History of Geodesy

- Mathematics and Geometry in Geodesy

- Geodetic instruments

- Accuracy and Precision

- Errors in surveying

- Cartography

- Photogrammetry

- GPS</td></tr>
<tr><td>2.6. Format of instruction:</td><td>☒ lectures
☒ seminars and workshops
☐ exercises
☐ on line in entirety
☒ blended e-learning
☐ field work</td><td>☒ independent assignments
☒ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td>2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="3">Presence at lectures and seminars</td></tr>
</table>

DETAILED PROPOSAL OF THE STUDY PROGRAMME

	Seminar tasks – group and individual work, presentations, writing essays, smaller reports Homeworks Preparation of the dictionary of professional terms – on line					
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance		Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests 1	1	Oral exam	1	(other)	
	Written exam 1	1	Project		(other)	
2.10. Grading and evaluating student work in class and at the final exam	Students can take two mid-term exams. The students who pass both mid-term exams are exempt from taking the final examination. The final examination is taken by the students who have not been grade positively on the basis of the points collected in the mid-term exams. The final examination consists of written and oral part.					
2.11. Required literature (available in the library and via other media)	**Title**				**Number of copies in the library**	**Availability via other media**
	Fučkan Držić, B. : Technical Engslih in Surveying and Geodesy, Faculty of Geodesy, Zagreb 2001					
2.12. Optional literature (at the time of submission of study programme proposal)	Selected by a teacher					
2.13. Quality assurance methods that ensure the acquisition of exit competences	Student survey					
2.14. Other (as the proposer wishes to add)						

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Biserka Fučkan Držić	1.6. Year of the study programme	1.
1.2. Name of the course	Basics of German for Special Purposes	1.7. Credits (ECTS)	3
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	L15 + S 15 + e-learning
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	70
1.5. Status of the course	Optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	Development of communication skills in professional context using specific professional German language
2.2. Course enrolment requirements and entry competences required for the course	Knowledge of German acquired in primary and secondary education
2.3. Learning outcomes at the level of the programme to which the course contributes	Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Demonstrate competences in regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy right, publishing and exchange of spatial data. Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards. Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	use professional literature in German Communicate in professional environment -Write written works in German

	-Describe activities in German - Getting familiar with basic professional terminology in German		
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Selected texts intended for achieving the goals in learning German for special purposes in the following areas: - Definition of geodesy - Surveying profession – services of geodesists - History of Geodesy - Mathematics and Geometry in Geodesy - Geodetic instruments - Accuracy and Precision - Errors in surveying - Cartography - Photogrammetry - GPS		
2.6. Format of instruction:	☒ lectures ☒ seminars and workshops ☐ exercises ☐ on line in entirety ☒ blended e-learning ☐ field work	☒ independent assignments ☒ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:
2.8. Student responsibilities	Presence at lectures and seminars		

DETAILED PROPOSAL OF THE STUDY PROGRAMME

<table>
<tr><td></td><td colspan="6">Seminar tasks – group and individual work, presentations, writing essays, smaller reports

Homeworks

Preparation of the dictionary of professional terms – on line</td></tr>
<tr><td rowspan="5">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td></td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Tests</td><td>1</td><td>Oral exam</td><td>1</td><td>(other)</td><td></td></tr>
<tr><td>Written exam</td><td>1</td><td>Project</td><td></td><td>(other)</td><td></td></tr>
<tr><td>2.10. Grading and evaluating student work in class and at the final exam</td><td colspan="6">Students can take two mid-term exams. The students who pass both mid-term exams are exempt from taking the final examination.

The final examination is taken by the students who have not been grade positively on the basis of the points collected in the mid-term exams. The final examination consists of written and oral part.</td></tr>
<tr><td rowspan="3">2.11. Required literature (available in the library and via other media)</td><td colspan="4">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="4">Teaching material selected and adapted by a teacher</td><td></td><td></td></tr>
<tr><td colspan="4"></td><td></td><td></td></tr>
<tr><td>2.12. Optional literature (at the time of submission of study programme proposal)</td><td colspan="6">Selected by a teacher</td></tr>
<tr><td>2.13. Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="6">Student survey</td></tr>
<tr><td>2.14. Other (as the proposer wishes to add)</td><td colspan="6"></td></tr>
</table>

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Nikol Radović	1.6. Year of the study programme	II.semester
1.2. Name of the course	Spherical trigonometry	1.7. Credits (ECTS)	3
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	15 L + 8S + 7E + e -learning
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	>10
1.5. Status of the course	optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	Level 2

2. COUSE DESCRIPTION	
2.1. Course objectives	The goal of course Spherical trigonometry is the renewal and replenishment secondary knowledge of trigonometry plane on the theoretical and practical knowledge of trigonometry spheres with particular emphasis on applications in geodesy and geoinformatics
2.2. Course enrolment requirements and entry competences required for the course	knowledge of secondary school mathematics (trigonometry) programs
2.3. Learning outcomes at the level of the programme to which the course contributes	**Knowledge and understanding** - To know theoretical principals, procedures of computer processing and visualisation of surveying data. - To understand the mathematical methods and physical laws applied in geodesy and geoinformatics. **Application of knowledge and understanding** - To apply the knowledge in mathematics and physics for the purpose of recognizing, formulating and solving problems in the field of geodesy and geoinformatics **Learning and ethical skills** - To plan the continuation of academic education in the field of geodesy and geoinformatics, or related disciplines, and to develop the lifelong learning attitude.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- Define and distinguish spherical triangles - Solve the spherical triangle using the cosine rule for pages / corners and - Solve rectangular and quadrant spherical triangle - Apply Legend theorem for solving spherical triangles

2.5. Course content broken down in detail by weekly class schedule (syllabus)	1. Sphere (sphere), main circle. spherical distance 2. Spherical Triangle 3. Spherical triangle inequality. Spherical excesses 4. Gender. Spherical polar triangle. 5. The basic relationships between the spherical triangle. 6. Cosine rule (for pages, angles) spherical triangle. 7. Sine theorem. 8. 1 and 2 theorem of cotangent 9. Napier's rule 10. Troubleshooting spherical triangle with applications in geodesy and geoinformatics 11. Rectangular spherical triangle. Euler's theorem, 12. Resolving rectangular spherical triangle. 13. The difference between flat and spherical trigonometry. 14. Geographic (astronomical) coordinates. Spherical distance between two points on the earth (sphere) 15. Application of spherical trigonometry in geosciences				
2.6. Format of instruction:	☒ lectures ☒ seminars and workshops ☐ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work		☒ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☒ homeworks		2.7. Comments:
2.8. Student responsibilities	- Presence in more than 80% lecture and 80% of exercises and seminars - For signature all (correct) tasks must be delivered on time and present one seminar topic. - For the seminar, students are divided into groups, receive a topic you have to be presented in front of other students and write spends his mate (max. 2 pages A4 format) topics that are presented.				
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	0.3	Research		Practical training	
	Experimental work		Report		homework	0.4
	Essay		Seminar essay	1	(other)	
	Tests	0.7	Oral exam	0.3	(other)	
	Written exam	0.3	Project		(other)	
2.10. Grading and evaluating student work in class and at the final exam	There are 2 colloquiums in the semester. Each colloquium consists of theoretically and calculation part.				

	To pass the colloquium, students have to affirmative solve both parts (theoretically and computationally). 1. and 2. Colloquiums THEORETICAL (max. 30 points) 0-14 points ------------→ inadequate (1) 15-20 points ----------→sufficient (2) 21-23 points ----------→ good (3) 24-27 points -------- -→very good (4) 28-30 points ---------→excellent (5) COMPUTATION (5th tasks) 2 correctly solved task ---------- sufficient (2) 3 correctly solved task ---------- good (3) 4 correctly solved task ----------very good (4) 5 correctly solved tasks -------- excellent (5) All students who have earned a minimum of sufficient (2) per each of the activities, will be exempt from the written exam. All students who have earned a minimum of very good (4) per each of the activities, will be exempt from the exem.		
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Z. Hanžek. *Trigonometry in plane*, Sveučilišna naklada Liber, Zagreb, 1980.		
	Z. Hanžek. *Spherical trigonometry*. Sveučilišna naklada Liber, Zagreb, 1983.		
	B. Pavković, D. Veljan. *Elementary mathematics* II, Školska knjiga, Zagreb, 1995.		
	All course materials are available in electronic form for students.		
2.12. Optional literature (at the time of submission of study programme proposal)	J. Casey. *A Treatise on Spherical trigonometry and Its Applications to Geodesy and Astronomy*, Merchant Books, 2007.		
2.13. Quality assurance methods that ensure the acquisition of exit competences	- A survey on the quality of teaching and learning materials - Class attendance and class participation - Evaluation of the results of the examination (year)		
2.14. Other (as the proposer wishes to add)	Surveyors carry out calculations on the Earth, and the matter Spherical trigonometry is a tool of these calculations.		

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Željka Tutek	1.6. Year of the study programme	First
1.2. Name of the course	Mathematical Laboratory for Engineers	1.7. Credits (ECTS)	1
1.3. Associate teachers	-	1.8. Type of instruction (number of hours L + S + E + e-learning)	0L+15E
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	>30
1.5. Status of the course	elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	The objectives of this course are • acquire the skills of independent use of mathematical software system (e.g. free open source Sage or similar) for tasks that require symbolic and/or numerical computation • solving of problems in the computer laboratory to support the teaching of mathematical courses (Vector Analysis and Differential Geometry).
2.2. Course enrolment requirements and entry competences required for the course	-
2.3. Learning outcomes at the level of the programme to which the course contributes	At the program level, the course contributes to the following learning outcomes: • To use information technology in solving geodetic and geoinformation tasks. • To make conclusions on the basis of performed computational processing and interpretation of surveying data and obtained results. • To understand the mathematical methods and physical laws applied in geodesy and geoinformatics. • To apply the knowledge in mathematics and physics for the purpose of recognizing, formulating and solving problems in the field of geodesy and geoinformatics.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	• Use of a mathematical software system for calculating partial derivatives, Jacobi and Hesse matrix. • Use of a mathematical software system for plotting vector functions. • Use of a mathematical software system for calculating the gradient, divergence and directed derivatives. • Use of a mathematical software system for the computation of multiple integrals.

	• Use of a mathematical software system for calculating the curve integral. • Use of a mathematical software system for drawing graphs of parametric curves and surfaces. • Use of a mathematical software system for drawing functions default polar, cylindrical and spherical coordinates.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Schedule of the exercise on the computer 1.-2. Elements of working with a mathematical software system (e.g. Sage). 3. Calculation of partial derivatives, Jacobi and Hesse matrix. 4. Drawing the graph of vector functions. 5. Calculations of the gradient, divergence and directed derivatives. 6. Computation of multiple integrals. 7. Computation of line integrals. 8.-9. Drawing the graphs of parametric curve in space. 10.-11. Drawing the graphs of parametric surfaces. 12. Drawing the functions given in polar coordinates. 13. -14. Drawing the functions given in cylindrical and spherical coordinates.

2.6. Format of instruction:	☐ lectures ☐ seminars and workshops ☐ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☒ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:

2.8. Student responsibilities	Regular exercises attendance (exercises in computer lab), solving homework, and activities through a system of E-learning. The requirement for signature: 80% of arrivals on laboratory exercises and 80% of completed assignments during the semester.

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	50%	Research		Practical training	
	Experimental work		Report		Homework	50%
	Essay		Seminar essay		(other)	
	Tests		Oral exam		(other)	
	Written exam		Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	The subject is not assessed.

2.11. Required literature (available in	**Title**	**Number of**	**Availability via**

the library and via other media)		**copies in the library**	**other media**
	Sage standard documentation, http://www.sagemath.org/		yes
	A. Casamayou, N. Cohen, G. Connan, T. Dumont, L. Fousse, F. Maltey, M. Meulien, M. Mezzarobba, C. Pernet, N. M. Thiéry, P. Zimmermann : Calcul mathématique avec Sage , 2013. (ISBN: 9781481191043)		yes
2.12. Optional literature (at the time of submission of study programme proposal)			
2.13. Quality assurance methods that ensure the acquisition of exit competences	The acquisition of the exit competences will be checked during the semester through independent (in the computer laboratory and for homework) solving problems by using mathematical software system.		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Nevio Rožić	1.6. Year of the study programme	2
1.2. Name of the course	Analysis and processing of geodetic measurements	1.7. Credits (ECTS)	5
1.3. Associate teachers	Ivan Razumović, Mariana Andrić	1.8. Type of instruction (number of hours L + S + E + e-learning)	75 (30 L + 45 S + 0 E + 0 e-learning)
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	90-110
1.5. Status of the course	obligatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	e-learning level 1
2. COUSE DESCRIPTION			
2.1. Course objectives	Adoption of theoretical knowledge and empirical skills in analysis and processing of geodetic measurements. Active empirical application of knowledge from analysis and processing of geodetic measurements in solving surveying tasks based on geodetic measurements data.		
2.2. Course enrolment requirements and entry competences required for the course	Passed the course "Analytical geometry and linear algebra" Passed the course "Mathematical Analysis" Passed the course "Vector Analysis" Passed the course "Land Surveying" Conducted course "Field measurements" Conducted course "Basics of Statistics"		
2.3. Learning outcomes at the level of the programme to which the course contributes	<u>Knowledge and understanding</u> Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. <u>Applying knowledge and understanding</u> Use information technology in solving geodetic and geoinformation tasks. <u>Making judgements</u> Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution.		

	<u>Communication skills</u> Communicate the results obtained by means of geodesy and geoinformation to clients and experts of geodetic and other related professions <u>Learning and ethical skills</u> Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Explain the basic principles, concepts, methods and procedures for analysis and processing of mutually independent geodetic measurements. Use appropriate technical terminology related to the analysis and processing of geodetic measurements. Understand the laws of theory of errors, mathematical statistics and probability theory in the analysis and processing of geodetic measurement errors. Apply different criteria to assess the quality of geodetic measurements (precision, accuracy, reliability) and the criteria for evaluating the accuracy of mutually independent geodetic measurements. Apply the laws of variances propagation, weights propagation and cofactors propagation in the case of one or more functions of geodetic measurements. Apply adjustment of direct measurements in the three characteristic cases: classical direct measurements, multipe measured vectors and doube measurements. Apply adjustment of indirect measurements in the forms of regular and singular adjustment. Apply adjustment of conditional measurement. Develop standardized geodetic elaborates depicting the results of analysis and processing of geodetic measurements. Plan processing of geodetic measurements from the viewpoint of the volume and types of measurements, the use of appropriate mathematical model of measurement, the application of appropriate technological tools for the realization of processing and to optimize performance.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	<u>Lectures (15 weeks with two lecture hours per week)</u> 1. Overview of the teaching process methodology and implementation, an overview of the course theoretical content, an overview to the teaching performance and evaluation standards. Operational details necessary for the teaching. 2. General introduction to the analysis and processing of geodetic measurements. Classification of geodetic and surveying measurements. Measuring processes. Matrix algebra and matrix algebra application for the analysis and processing of geodetic measurements. 3. Theory of measurement errors. Relationship between theory of errors and probability theory and mathematical statistics. The quality of measurements and laws of individual and collective behavior of measurement errors. 4. Laws of measurement errors propagation. The law of variances propagation, the law of weights propagation and the law of

	cofactors propagation in case of one or more direct measurement functions. 5. Methods for measurements mathematical processing (adjustments) and classification of functional and stochastic models of geodetic measurements. Classical direct measurements and adjustment of classical direct measurement. 6. Direct measurements in the form of multiple measured vectors and double measurements. 7. Indirect measurement and regular adjustment of indirect measurements. Setting the functional and stochastic models, adjustment algorithm and its application to solving of standardized geodetic problems. 8 Determination of indirect measurements accuracy criteria, including accuracy criteria of their derived functions. Control mechanisms in the adjustment algorithm. 9. Singular adjustment of indirect measurements. Setting the functional and stochastic models and adjustment algorithm. The properties of functional model, datum and configuration defect. Application of the pseudoinverse. 10. Application of the indirect measurements in different surveying tasks, focusing on explicit empirical realization of the theoretical principles of formulating appropriate functional and stochastic models. 11. Conditional measurement and adjustment of conditional measurement. Setting the functional and stochastic models of conditional measurement, adjustment algorithm and its application to solving standardized geodetic problems. 12. Conditional measurement accuracy criteria, including accuracy criteria of their derived functions. Control mechanisms in the adjustment algorithm. 13. Application of conditional measurement adjustmet in surveying tasks, focusing on explicit empirical implementation of the theoretical principles of formulating appropriate functional and stochastic models. 14. Summary of the course theoretical content and preparation for final exam. 15. Review and analysis of the results of the teaching process. <u>Exercises (15 weeks, 3 excercise hours per week)</u> 1. Overview of the teaching process methodology and implementation, an overview of the course exercises content, an overview to the teaching performance, evaluation standards and operational details necessary for the exercises. 2. Empirical exercise no. 1: Application of matrix algebra operations in measurement adjustment algorithms. 3. Empirical exercise no. 2: Application of Cholesky method in order to invert the symmetric regular matrix, as an integral part of the normal equations solving method. 4. Project no. 1: Application of variances propagation, weights propagation and cofactors propagation law in the event of one or more functions of geodetic measurements. 5. Project no. 2: Adjustment of classical direct measurements, multiple measured vectors and double measurements. 6. Colloquium no. 1: The empirical application of the law of variances propagation, weights propagation, cofactors propagation and adjustments of direct measurements. 7. Project no. 3: Regular adjustment of indirect measurements - trilateration network.

	8. Project no. 4: Regular adjustment of indirect measurements - triangulation network. 9. Project no. 5: Singular adjustment of indirect measurements - levelling network. 10. Colloquium no. 2: Empirical application of regular and singular adjustment of indirect measurements. 11. Project no. 6: Adjustment of conditional measurements - triangulation network. 12. Project no. 7: Adjustment of conditional measurement - trilateration network. 13. Colloquium no. 3 Empirical application of adjustment of conditional measurement. 14. Summary of the course empirical content and preparation for examinations. 15. Review and analysis of the results of the exercises teaching process.

2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☐ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments: Realization of teaching process presupposes continuous interaction of students with the course website, especially in the process of the project tasks solving.

2.8. Student responsibilities	Mandatory attendance at 70% at all lectures. Mandatory attendance at 70% at all exercises. Mandatory creation and delivery of two empirical exercises. Mandatory creation and delivery of seven projects.

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	1	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	1	Oral exam	1	(other)	
	Written exam	1	Project	1	(other)	

2.10. Grading and evaluating student work in class and at the final exam	<u>Colloquia</u> During the semester three colloquia are scheduled. The empirical knowledge and skills of analysis and processing of geodetic measurement are checked. Colloquium lasts 120 minutes. Each colloquium contains six empirical questions. Evaluation criteria: one question = one point, without penalty. The minimum number of points for a positive outcome of the colloquium is three and the maximum number of points is the sixth. All passed colloquia substitute a empirical component of final exam. <u>Final exam (contains empirical component and theorethical component)</u> Empirical component: Two empirical questions. The exam lasts 120 minutes. Criteria of evaluation: the first question = one point, second question = five points, without penalty. The minimum number of points for a positive outcome of the exam is 3,

	the maximum number of points is 6. Written exam is eliminatory. The empirical component of final exam is not mandatory in the case of all positive colloquia. The mean scores for all of the Colloquia is adopted as the appropriate number of points. Theoretical component: Six theoretical questions. The exam lasts 30 minutes. Evaluation criteria: one question = one point, without penalty. The minimum number of points for a positive outcome of the exam is 3, the maximum number of points is sixth. The final grade is determined by the total number of points: 0, 1, 2, 3, 4, 5 points - poor, 6 points - enough, 7 and 8 points - good, 9 and 10 points - very good, 11 and 12 points - excellent.		
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Feil, L. : Theory of errors and adjustments – first part. Manualia Universitatis Studiorum Zagrabiensis, Faculty of Geodesy University of Zagreb, ISBN 86-81465-01-5, Zagreb, 1989. (on Croatian)	1	
	Feil, L. : Theory of errors and adjustments – second part. Manualia Universitatis Studiorum Zagrabiensis, Faculty of Geodesy University of Zagreb, ISBN 86-81465-02-3, Zagreb, 1990. (on Croatian)	1	
	Rožić, N. : Processing of geodetic measurements. Manualia Universitatis Studiorum Zagrabiensis, Faculty of Geodesy University of Zagreb, ISBN 978-953-6082-10-0, Zagreb, 2007. (on Croatian)	1	
	Rožić, N. : Processing of geodetic measurements. Faculty of Geodesy University of Zagreb, lectures in form of PPT presentations, Zagreb, 2007. (on Croatian)		yes
2.12. Optional literature (at the time of submission of study programme proposal)	Rožić, N.: Course internet site, www2.geof.unizg.hr/~nrozic/aogm/. Klak, S. : Theory of errors and adjustments. II revised and updated edition., Faculty of Geodesy University of Zagreb, Sveučilišna naklada Liber, Zagreb, 1986. (on Croatian) Rožić, N. : Repetitoria and solved problems in theory of errors and adjustments. Manualia Universitatis Studiorum Zagrabiensis, Faculty of Geodesy University of Zagreb, ISBN 953-6082-00-4, Zagreb, 1993. (on Croatian)		
2.13. Quality assurance methods that ensure the acquisition of exit competences	Recording of presence in the classroom during the teaching process. Check and recording the validity of making and delivery of all empirical exercises and projects. Test the knowledge and skills on the three colloquia during the teaching process. Testing of knowledge on the final exam, which includes a separate components of theoretical knowledge and empirical skills. Self-evaluation and students questioner.		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Damir Medak	1.6. Year of the study programme	II.
1.2. Name of the course	Databases	1.7. Credits (ECTS)	5
1.3. Associate teachers	Mario Miler Dražen Odobašić Ela Vela-Bagić	1.8. Type of instruction (number of hours L + S + E + e-learning)	60 (30P-30V)
1.4. Study programme (undergraduate, graduate, integrated)	Study of geodesy and geoinformatics, BSc	1.9. Expected enrolment in the course	80
1.5. Status of the course	mandatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	1, 20%

2. COUSE DESCRIPTION	
2.1. Course objectives	Students will acquire theoretical background and practical usage of contemporary databases in context of geodesy and geoinformatics.
2.2. Course enrolment requirements and entry competences required for the course	Accomplished the course „Programming“.
2.3. Learning outcomes at the level of the programme to which the course contributes	Maintain topographic, cartographic, maritime and navigation, and land information systems, integrate and visualise spatial information. Use information technology in solving geodetic and geoinformation tasks. Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution. Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning	define basic database concepts, differentiate relational. object, object-relational and deductive database models,

outcomes)	apply entity-relationship model on a concrete problem in fields of geodesy and geoinformatics, crate a database relational schema using the normal forms, explain database indexing, solve practical problems using SQL commands and functions.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Introduction, Course goals. Definitions of basic concepts. Motivation for Databases. Database Management System (DBMS). Three levels of abstraction. Entity Relationship Schema. Logical data models. Acces methods. Linear and binary searching. Data indexing. Entities and attributes. Primary and foreign keys. Relational model. Normal forms. Relational algebra. SQL-92: Data Definition Language, Data Manipulation Language. Multitable queries. Aggregation and grouping operations. Transactions. ACID conditions. Object databases. Encapsulation. Reusability. Inheritance. Polymorphism Extensions to relational model. Spatial extensions. OGC standards. Geometric data types and operations. Knowledge databases. Facts and rules. Prolog. NoSQL.

2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work	☒ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:
2.8. Student responsibilities			

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of*	Class attendance		Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	

ECTS credits is equal to the ECTS value of the course)	Tests	2	Oral exam	1	(other)	
	Written exam	1	Project	1	(other)	
2.10. Grading and evaluating student work in class and at the final exam						

2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Neil Matthew, Richard Stones (2005): Beginning Databases with PostgresSQL, Apress.	1	
	Richard Blum (2007): PostgreSQL 8 for Windows. Mc Graw Hill	1	
	K.Douglas, S.Douglas (2003): PostgreSQL, Second edition. Developers Library	1	

2.12. Optional literature (at the time of submission of study programme proposal)	
2.13. Quality assurance methods that ensure the acquisition of exit competences	
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Jelka Beban Brkić	1.6. Year of the study programme	Second, 3rd semester
1.2. Name of the course	Differential Geometry	1.7. Credits (ECTS)	5
1.3. Associate teachers	Senior Lecturer Željka Tutek, MSc	1.8. Type of instruction (number of hours L + S + E + e-learning)	30 (L) + 30 (E)
1.4. Study programme (undergraduate, graduate, integrated)	Bachelor Study	1.9. Expected enrolment in the course	90
1.5. Status of the course	compulsory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	e-learning level: 2
2. COUSE DESCRIPTION			
2.1. Course objectives	To recognize the mathematical and numerical skills acquired within the theory of curves and surfaces in the field of study. To use the mathematical and numerical skills acquired within the theory of curves and surfaces for solving problems in the field of study.		
2.2. Course enrolment requirements and entry competences required for the course	Passed exams: Analytic geometry and linear algebra, Mathematical Analysis Course completed: Vector analysis Competencies required: vector algebra, analytic geometry, elementary functions, derivatives, partial derivatives, indefinite and definite integrals, differential equations of the first order, double integrals, vector analysis		
2.3. Learning outcomes at the level of the programme to which the course contributes	• Understand mathematical methods and physical laws applied in geodesy and geoinformatics. • Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of problems in the field of geodesy and geoinformatics. • Use information technology in solving geodetic and geoinformation tasks • Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. • Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.		

2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	• identify various forms of curve equations, calculate arc length, curvature and determine the associated vector fields; Identify and differentiate between types of second order surfaces; • analyze the second order surfaces with emphasis on the sphere and the ellipsoid of revolution: determine the parameter curves, the tangent plane and the normal vector to the surface; • determine the first fundamental form of the surface and use it to calculate arc length, surface area and angle between two curves on a surface; • determine the second fundamental form of the surface and use it for classifying points on the surface, calculating the normal, principal, Gaussian and mean curvature of the surface; • detect some special curves on surfaces (lines of curvature, asymptotic lines); • define the concept of the geodesic curvature along a curve on a surfaces and the term geodesic; calculate the geodesic curvature of parameter curves in order to identify whether it is a matter of geodesic coordinates; • pronounce the Theorema Egregium of Gauss; • distinguish and name types of mappings of surfaces according to the mapping invariants; • use a variety of tools for visualizing and solving problems related to the theory of curves and surfaces.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Basic concepts of vector algebra and vector analysis. 1h Representations of curves. 1h Arc length and re-parameterisation of a curve. 2h Moving trihedron. Curvature and torsion. Frenet-Serret formulas. 2h Concept of a surface: definition, parametric representation, coordinate patches, parameter curves. 2h Concept of a surface: the tangent plane and the normal vector to the surface. 2h Review of previous work. 1h 1st preliminary exam 1h First fundamental form and its applications (arc length, surface area and angle between two curves on a surface). 2h Second fundamental form and its applications (normal curvature, types of points on the surface). 2h Asymptotic and principal directions and lines. Principal, Gaussian and mean curvature of the surface. 2h Euler’s theorem and Dupin’s indicatrix. 1h Gauss-Weingarten equations and Christoffel symbols. The fundamental theorem of surfaces. 2h Review of previous work. 1h 2nd preliminary exam 1h Geodesics (geodesic curvature, geodesic coordinates, arcs of minimum length) 3h Mappings of surfaces (Stereographic projection, Mercator projection) 2h Review of previous work. 1h

	The final exam. 1h		
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work	☒ independent assignments ☒ multimedia and the internet ☒ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:
2.8. Student responsibilities	Regular school attendance. Monitoring of e-learning. Writing tasks. Consultations (teacher / student assistant)		

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	Requirement for the signature	Research		Practical training	
	Experimental work		Report		independent assignments	15%
	Essay		Seminar essay		interactive tasks	5%
	Tests	80%	Oral exam	optional	(other)	
	Written exam	100%	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	50-61 credits	sufficient (2)
	62-74 credits	good (3)
	75-87 credits	very good (4)
	88-100 credits	excellent (5)

	Title	**Number of copies in the library**	**Availability via other media**
2.11. Required literature (available in the library and via other media)	Beban Brkic, J.: *Differential Geometry*, Textbook for students (on the web), Faculty of Geodesy, Zagreb 2012		http://e-ucenje.geof.unizg.hr/
	Žarinac-Frančula, B., *Differential Geometry*, *Workbook and Repetitorium*, Školska knjiga, Zagreb, 1990 (multiple editions)	some ten	
	Elezović, N.: *Linear Algebra*, Element, Zagreb, 1995 (multiple editions)		

2.12. Optional literature (at the time of submission of study programme proposal)	Gray, A., *Modern Differential Geometry of Curver and Surfaces With Mathematica*, CRS Press, Boston, London, 1998. Seymour, Lipschutz, *Differential Geometry*, Schaum's Outline Series, McGraw-Hill Book company, New York 1969. IT-project: www.grad.hr/itproject_math/Links/webmath/index.html On-line mathematical encyclopedia: MathWorldWolfram		
2.13. Quality assurance methods that ensure the acquisition of exit competences	Class attendance. In revising during lectures. Solving tasks during exercises. Activity on the system for e-learning. Individual assignment. Interactive tasks. Consultations attendance. Preliminary exams. Exams. The implementation of a single university Questionnaire for evaluating teachers prescribed by the Senate.		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Vlado Cetl	1.6. Year of the study programme	2.
1.2. Name of the course	Geodetic Plans	1.7. Credits (ECTS)	5.0
1.3. Associate teachers	Loris Redovniković Iva Ališić	1.8. Type of instruction (number of hours L + S + E + e-learning)	30L+30E
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	80-90
1.5. Status of the course	Mandatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION			
2.1. Course objectives	The objective of the course is to provide teoretical and practical knowledge and skills in geodetic plans, cadastral maps, topographical maps and digital geodtic plans		
2.2. Course enrolment requirements and entry competences required for the course	Completed course: Land Surveying Passed course: Engineering Graphics in Geodesy and Geoinfromatics		
2.3. Learning outcomes at the level of the programme to which the course contributes	Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data Prepare geodetic documents needed to establish and maintain cadastral records and land registry, as well as the documents for engineering works Make plans, maps and related presentations using modern methods and technologies on the basis of measured data and other sources Determine and interpret the size, properties and relations of objects in space on the basis of measured data, spatial databases, plans and maps Prepare official public documents, reports, graphic and cartographic presentations using the surveying results related to objects in space		
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Distinguish analogue plans with regard to scale, projection and their quality Explain the causes of the different cadastral maps in the Republic of Croatia and the consequences of that Craete a cadastral map and calculate the area of cadastral parcels by different methods Clarify what affects the accuracy of the surfaces on the (analog) cadastral maps Describe how relief is represented on geodtic plans and what influence the accuracy of it		

	Create and interpret height (altitude) representation of terrain Distinguish digital cadastral maps made by different methods Explain the rules of presentation of geodetic plans available through web services (portrayals)
2.5. Course content broken down in detail by weekly class schedule (syllabus)	1. Geodetic plans and their division. The main elements of the geodetic plan. Selection of scale. 2. Creation of geodetic plans 3. Projection and divison on sheets. Content and margin of plan. 4. Standrads and quality of plan. 5. Cadastral maps 6. Methods for area calculations. 7. Topographic maps 8. Preliminary exam 9. Relief and representation on plans. Interpolation of contour lines. Characteristics of contour lines. Equidistance of contour lines 10. Geometric accuracy of geodetic plans. Accuracy of measurements on geodetic plan 11. Digital geodetic plans 12. Characteristics of digital geodetic plans and representation (portrayal) 13. Geodetic plans via web services 14. Applications of geodetic plans 15. Preliminary exam During exercises, students are working on concrete projects, whichis a prerequisite for a preliminary exam

2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:
2.8. Student responsibilities	Regular attendance of more than 70% lectures and 70% exercises. Completition of the project on the exercises		

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS*	Class attendance	1.5	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	1.0	Oral exam	1.0	(other)	

value of the course)	Written exam	1.0	Project	0.5	(other)	

2.10. Grading and evaluating student work in class and at the final exam	During the semester, two preliminary exams are organized. Preliminary exams consist of practical computing tasks and theoretical questions. Students who pass both exams are exempted from the exam

	Title	Number of copies in the library	Availability via other media
2.11. Required literature (available in the library and via other media)	Živković, I. (1983): Topografski planovi, Naučna knjiga, Beograd	10	
	Ivković, M.: Geodetic Plans, Internal script		online
	Online course materials on e-learning system		online

2.12. Optional literature (at the time of submission of study programme proposal)	Christine Andrae, Christian Graul, Martin Over, Alexander Zipf: Web Portrayal Services. Wichmann 2011 Standards and specifications
2.13. Quality assurance methods that ensure the acquisition of exit competences	In accordance with the Quality Policy and Quality Manual, University of Zagreb and the quality assurance system of the Faculty Survey evaluation of subjects and teachers. Self-evaluation of teachers
2.14. Other (as the proposer wishes to add)	

University of Zagreb

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Mraović, Branka	1.6. Year of the study programme	II.
1.2. Name of the course	Information Society	1.7. Credits (ECTS)	3
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	30 (15 L + 15 S)
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate, third semester	1.9. Expected enrolment in the course	90
1.5. Status of the course	obligatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	level 2 of e-learning
2. COUSE DESCRIPTION			
2.1. Course objectives	The course aims to help students of technical science to understand fundamentals of Information and Informational Society by learning from practical examples. The course aims to connect students and their future employers immediately – through the process of teaching.		
2.2. Course enrolment requirements and entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Demonstrate competences in real estate registers and interests in real estates, understand land development measures and methods of land evaluation. Demonstrate competences in regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy right, publishing and exchange of spatial data. Use information technology in solving geodetic and geoinformation tasks. Communicate the results obtained by means of geodesy and geoinformation to clients and experts of geodetic and other related professions. Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards.		

	Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Demonstrate competence in making contact with the employers in the field of geodesy and geoinformatics, identify the principal stakeholders in the geodetic sector, and describe the ways of their organising and communication practices including the levels of hierarchy and authority. Understand how, at what speed and in what ways the stakeholders in geodetic companies and institutions adjust their practices to the global trends that profession seems to be faced with and to the requirements of modern corporate governance, and identify the factors influencing the career paths of the young engineers. Make presentation about critical stakeholders in geodesy and geoinformatics – companies, institutions in Croatia, international organisations and media, and write a critical essay about the topics. Understand a concept of the learning organisation in geodesy and geoinformatics. Analyse and interpret the phases of introduction and implementation of information and communication technology in the geodetic companies and institutions, and compare the trends in the Croatian geodesy to the world trends, make critical evaluation of each phase. Understand the requirement posed by the EU Directives in reference to the transparency of financial reporting as well as the process of accommodation of geodetic companies and institutions to international legal and business standards. Understand the importance of accountable handling with business information in accordance with international ethical standards and ethical standards of the European Union.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	**Course Content – Lectures (by weekly class schedule – 15 hours)** 0. <u>Course Organisation</u> - Basic instructions and guidelines about teaching, e-learning, course content, student responsibilities and rights, grading and evaluating student work in class and the final exam. 1. <u>Epistemology of Information Systems</u> – Information society and network society. Information – semantics and etimology of the word. The purpose of designing information systems. The advantages of network design. 2. <u>Epistemology of Information Systems</u> - A conceptual model of open system solutions. Knowledge construction: datum,

	information, knowledge, agency. Virtual organisation. 3. Epistemology of Information Systems – „A digital nervous system“, „web workstyle“, „web life style“. 4. Epistemology of Information Systems – The networking logic of the information era. Knowledge creating company. The new system of wealth production. 5. Computers and the human mind - Emotional management. Managing mental models: 1. Mobilization/Allocation, 2. Simulation, 3. Communication, 4. Identification. Towards new mental models in cyber space. The modes of learning in virtual communities. An electronically produced text. 6. Computers and the Human Mind - Methodology of use of language in virtual on-line communities. A concept of speech as dialogue. The relevance of Bakhtin's speech theory for cyber space discourse. 7. Computers and the Human Mind - Towards a new theory of subjectivity in the digital era. R. Penrose: A search for the missing science of consciousness: Genuine intelligence and genuine understanding. 8. Data Mining – A key for pro-aktive, knowledge driven decisions. The basic characteristics of data mining tools. The innovativeness of data mining techniques. The role of data mining tools in post-Enron era. 9. Data Mining – Ethical issues related to knowledge construction in the technical environment. Techno-optimists and techno-pessimists. The future of the data mining techniques. 10. The Global Processes – The basic characteristics of the phenomenon of globalization. The networking logic of globality. The role of international organizations. 11. The Global Processes – The new monetarism. Money manager capitalism. The processes od deindustrialization. 12. The Global Corporations – Corporations in the age of globality. Types of multinational corporations: Ethnocentric multinational corporations. Polycentric multinational corporations. Geocentric multinational corporations. 13. The Global Corporations – Strategies of International Business. What should go right in MNC - host country relationships? What often goes wrong in MNCs – host countries relationships? Means and purposes of the corporate network. **Course Content – Seminars and student practical work in the field (by weekly class schedule – 15 hours)** During their seminar work students keep analysing the stakeholders in the geodesy and geoinformatics – companies, institutions in Croatia, international organisations and media. In every moment, it is important to know: Where are you? Who you are doing business with? The work aims: 1. To learn something useful from practical examples. 2. To hear an interesting geodetic story and use it to compile teaching material. 3. To learn how to follow competitors. 4. The project promotes the values of work and personal engagements towards success.

A CONCEPT OF STUDENT'S HOMEWORK

The profile of a stakeholder should contain:

1. General data about stakeholder and the history.
2. Technical image of the company.
3. Analysis of standardized financial reports of the company.
4. Form of business organisation – organisational design and how it has been changed in certain period.
5. Interview with stakeholders.

The profile consists of two parts :

1. Presentation.
2. Essay – comments and analysis of collected data.

This part of our teaching activity is related to the process of making our students acquainted with the demands of the European Union related to the transparency of business performed by legal and natural persons, as well as with the efforts made in geodesy in the processes of harmonizing the Croatian business and legal environment with those in the European Union, and with the international standards of financial business.

The function of the essay is to turn the data – images, numerical and textual data into a story with figures, plot and action. The students should answer to basic questions:

1. What the companies in geodesy are dealing with?
2. What is the factor of success in geodesy?

The individual approach and creativity are highly valued in writing an essay

Work phases

1. PHASE: Students have selected the stakeholders being the subject of their project research on their own. First, they had to suggest a few stakeholders (up to 5) out of each category – company, institution, international organisation and medium, regardless of the fact whether they already knew something about them or found out the information by searching web pages.

2. PHASE : Students were divided into working teams allowed to group themselves on their own. In this way, there were 41 working teams formed out of 83 students.

3. PHASE: The stakeholders were finally selected. Each students team could process one stakeholder, so that 41 teams finally

	made 42 profiles. One team worked comparatively on researching two stakeholders (two geodetic companies). **4. PHASE:** Students had to study by means of web pages the way in which a stakeholder was presented and then periodically report about it at seminar sessions. **5. PHASE:** Students had to make a questionnaire for the observed stakeholder. They were allowed to ask the questions first that they found most interesting. The questions from students' questionnaires were continuously discussed at seminar sessions. Based on suggestions given by the colleagues from other teams, some questions were modified, and some supplemented. **6. PHASE:** Students had to analyse the financial reports of the observed stakeholders on the web pages of FINA. Those students who had international organisations as the objects of their research, contacted directly their stakeholders. The students who selected the institution in Croatia as their stakeholder collected the data in practical work guided their teacher. **7. PHASE:** The analysis of the financial business of stakeholders. After the students had collected the data, they were able to analyse the company's balance sheet alone at the seminar sessions, as well as the financial activities of the stakeholders in the budget of the City of Zagreb, the stakeholders in the state budget, and the financing of international organisations. **8. PHASE:** Students contacted directly the stakeholders and arranged a meeting at the physical location of the stakeholder, when it was possible. The students contacted the stakeholders at distant locations by phone or e-mail. In this work phase, the interviews with stakeholders were done. **9. PHASE:** The teams presented their analyses of collected data in front of their colleagues. **10. PHASE:** Two assignments were created in the e-learning environment of the course. ➢ **First assignment**: The students needed to visit the web page of FINA register of public reports, study the balance sheets of the most successful entrepreneurs in 2012 and compare them with the balances of the business subject whose business they monitored within the scope of the task Stakeholder's profile in geodesy ➢ **Second assignment**: During the seminar session, there was a discussion *pro et contra* opened about the public report on financial results of the company. The basic questions were focused on the usage of financial reports, why the financial reports should be read and whether the financial reports should be public. **11. PHASE:** The working teams handed their presentations and essays to their teacher in digital and analogous forms. Their work resulted in the creation of 41 teaching materials about 42 stakeholders in geodesy.

2.6. Format of instruction:	☒ lectures ☒ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☒ work with mentor ☐ (other)	2.7. Comments:
2.8. Student responsibilities	Create a stakeholder's profile in geodetic sector by student's own choice – company, institution, international organisation, media. Obligatory class attendance of 70% lectures. Obligatory class attendance of 70% seminars. Obligatory two Moodle E-tests.		

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	0.5	Research		Practical training	
	Experimental work		Report		(other)	
	Essay	0.5	Seminar essay	0.5	(other)	
	Tests	0.5	Oral exam	0.5	(other)	
	Written exam	0.5	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	Written and oral exam, and two E-tests. **Prerequisities for teacher's signature and partial immunity of the final exam** *Prerequisities for teacher's signature* - minimum class attendance of 70% - To make a stakeholder's profile in geodetic sector – seminar presentation and essay - Two Moodle E-tests. **Immunity of written exam** -Student must pass both Moodle E-tests (2 to 5 rating) -Presentation -Essay -Regular class attendance – lectures and seminars **Immunity of oral exam**

	- Student must pass both E-tests (4 to 5 rating) -Presentation – rating 4 to 5 -Essay -Regular class attendance – lectures and seminars

	Title	Number of copies in the library	Availability via other media
2.11. Required literature (available in the library and via other media)	Mraović, B.,(2010.) Globalni novac, Politička uvjetovanost financijske informacije, SKD Prosvjeta, Zagreb. Mraović, B., (1995.) Pobjednici i gubitnici, Organizacijske implikacije tehnološkoga razvoja, Zagreb: Nakladni Zavod Globus - 383 pages	Available in the libraries of the city of Zagreb and other Croatian libraries	
	Mraović, B., Uvod u informacijsko društvo, E-Lectures and Seminars, Moodle, Faculty of Geodesy	Moodle	

2.12. Optional literature (at the time of submission of study programme proposal)	Castells, M. (2000.) *Informacijsko doba: ekonomija, društvo i kultura, Sv. I: Uspon mrežnog društva*, Zagreb: Golden marketing. Castells, M. (2000.) *Informacijsko doba: ekonomija, društvo i kultura, Sv. 2: Moć identiteta*, Zagreb: Golden marketing. Castells, M. (2000.) *Informacijsko doba: ekonomija, društvo i kultura, Sv. 3: Kraj tisućljeća*, Zagreb: Golden marketing. Mraović, B. (1996.) *Pobjednici i gubitnici, Organizacijske implikacije tehnološkoga razvoja,* Zagreb: Globus. Mesarić, M. (2004.) *Civilizacija, danas i sutra, Obrisi alternativnih svjetonazora. I., II.,* Zagreb: ITP Škorpion. Kalanj, R. (2004.) *Globalizacija i postmodernitet*, Zagreb: Politička kultura. Radovan, M. (1989,) *Projektiranje informacijskih sistema*, Zagreb: Informator. Panian, Ž. (2001.) *Kontrola i revizija informacijskih sustava*, Zagreb: Sinergija. Weihrich, H., Koontz, H. (1994.) *Menadžment*, Poglavlje 21 "Tehnike kontrole i informacijske tehnologije" Deseto izdanje, Zagreb: MATE. Žugić, Z. (1988.) *Informacijsko društvo, Nova paradigma*, Beograd: Kairos. Prelog, N. (1992.) *Pogled kroz ekran, Vodič u informacijsko društvo,* Zagreb: DRIP, Biblioteka Informacijsko društvo. Dragičević, A. (1994.) *Politička ekonomija informacijskog društva*, Varaždin: Biblioteka udžbenici. Sassen, S. (2003.) *Protugeografije globalizacije, Teorijski i empirijski elementi u izučavanju globalizacije*, Zagreb: Multimedija. Alexander, C. J., Pal, L. A. (2001.) *Kulture interneta, Virtualni prostori, stvarne povijesti i živuća tijela*, Zagreb: Naklada Jesenski i Turk. Levinson, P. (2001.) *Digitalni McLuhan, Vodič za novo doba*, Zagreb: Izvori. 2 Castells, M. (2003.) *Internet Galaksija, Razmišljanja o internetu, poslovanju i društvu*, Zagreb: Naklada Jesenski i Turk.

	Sušanj, Z. (2005.) *Organizacijska klima i kultura*, Jastrebarsko: Slap. Buble, M. (2006.) *Metodika projektiranja organizacije*, Zagreb: Sinergija. Jušić, B. (1991.) *Prilagodljiva organizacija*, Zagreb: Ekonomski institut Zagreb. Jurina, M. (1994.) *Rukovođenje i organizacijsko ponašanje*, Zagreb: Ministarstvo unutarnjih poslova Republike Hrvatske. Sikavica, P., Novak, M. (1999.) *Poslovna organizacija*, Zagreb: Informator.
2.13. Quality assurance methods that ensure the acquisition of exit competences	- continuous monitoring of student knowledge **Rating** Continuous via project tasks: *Written* - Writing essays based on prescribed literature - Writing essyas based on itelligent search of websites - Writing critical essays - Making seminar presentations - Written exam *Oral* - Public presentation of seminar work in lecturing room - Oral exam *Electronic media* Analysing websites The final exam is written and oral.
2.14. Other (as the proposer wishes to add)	Student is expected to accept and respect the principles of academic honesty and integrity prescribed and regulated by the Ethical codex of the University of Zagreb (document available at: www.unizg.hr). In a lecturing room student is allowed to express his/her opinion in a tolerant and open minded way.

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Tatjana Josipović	1.6. Year of the study programme	2
1.2. Name of the course	Foundations of Land Registration Law	1.7. Credits (ECTS)	2
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	30L+5e-learning
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	85
1.5. Status of the course	obligational	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	Learn the basics of the legal system. Gaining knowledge of the basics of real rights. Acquisition of theoretical and practical knowledge on the concept, functions and composition of the land registry with an independent ability to search land registry. Knowing types of entries and terms for land registration entries. Knowledge of the procedural rules.
2.2. Course enrolment requirements and entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	Knowledge and understanding: Demonstrate competences in real estate registers and interests in real estates, understand land development measures and methods of land evaluation. Demonstrate competences in regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy right, publishing and exchange of spatial data.Learning skills and ethics Learning and ethical skills Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	After successfully mastering the course students will be able to: - Explain the basics of the Croatian legal system, especially the position of the rights on land under civil law, - Define and explain the concept of ownership and limited real rights (easements, real burdens, right to build and lien), - Define and explain the concept of land registry and cadastre as well as their connection,

	- Explain the composition of the land register, - Enumerate and explain the types of land registration entries, - Explain the basics of the land law proceedings, - Enumerate and define specific land registration procedures, - Define and explain the basics of the establishment, amendment, renewal and conversion of the land books.					
2.5. Course content broken down in detail by weekly class schedule (syllabus)	29.09.2014.- Organization of teaching and points of tests, the publication of results, the principle of colloquia.) Introductory lecture. The concept of real and land rights; legal sources and position in the legal system. 06.10.2014.- Objects. Term and types of real rights. Ownership. 13.10.2014.-Limited real rights 20.10.2014.-Limited real rights-sequel. 27.10.2014.-Term characteristics of the land register. Functions of land registry. 03.11.2014.-Ratio Cadastre and Land; maintenance approvals cadastre and land registry. 10.11.2014.-Establishment, renewal, conversion of the land books; subtraction and addition. 17.11.2014.-Composition of the land register. Composition EDP Land Registry. 24.11.2014.-Land registry entries (the subject, the general assumption) .The main entry. 01.12.2014.-Pre-registration. 08.12.2014.-Recordation. 15.12.2014.-Land procedure (first part). 12.01.2015.-Land procedure (second part). 19.01.2015.- Land procedure (third part). + 3 colloquia outside the timetable + Parallel conduct classes through the system for e-learning					
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☐ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work		☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)		2.7. Comments:	
2.8. Student responsibilities						
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of*	Class attendance		Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	

ECTS credits is equal to the ECTS value of the course)	Tests	2	Oral exam		(other)	
	Written exam	2	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam			
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Josipović, T.: Zemljišnoknjižno pravo, Informator, Zagreb, 2001		
	Gavella, N. i dr, Stvarno pravo 1, Narodne Novine Zagreb, 2007.		
	Klarić, P., Vedriš, M.: Građansko pravo, 14. izdanje; Narodne Novine 2014.		
	Relevant regulations: Property Act (NN NN 91/96, 68/98, 137/99, 22/00, 73/00, 129/00, 114/01, 79/06, 141/06, 146/08, 38/09, 153/09, 143/12), Land Registration Act (NN 91/96, 68/98, 137/99, 114/01, 100/04, 107/07, 152/08, 126/10, 55/13, 60/13)		
	Other materials made for students available on e-learning moodle platform.		
2.12. Optional literature (at the time of submission of study programme proposal)			
2.13. Quality assurance methods that ensure the acquisition of exit competences	Regular monitoring of students' knowledge by means of tests (3).		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Biserka Fučkan Držić	1.6. Year of the study programme	2.
1.2. Name of the course	English in Geodesy	1.7. Credits (ECTS)	3
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	L15 + S15 + e-learning
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	50
1.5. Status of the course	Optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION			
2.1. Course objectives	Expanding professional vocabulary Developing the skills in discussing professional topics Translation techniques Writing shorter works about professional topics Independent presentation in English related to professional problems Learning about the differences between the professional and standard English language		
2.2. Course enrolment requirements and entry competences required for the course	Passed examination in Basics of English for Special Purposes		
2.3. Learning outcomes at the level of the programme to which the course contributes	Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Demonstrate competences in regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy right, publishing and exchange of spatial data. Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards. Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.		

2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Develop intercultural and communication skills -Develop strategies for the participation in conversations within the professional frame using acquired professional vocabulary in English -Develop skill of understanding, speaking and writing in English for special purposes -Develop productive application of language for special purposes -Develop and improve the skills of interpreting English speaking and written contents -Develop strategies of independent learning
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Selected texts intended for achieving the goals in learning English for special purposes in the following areas: - Land registry - Cadastre -Difference between land registry in Croatia and in English speaking countries - Topographic survey - Construction survey - Employment of surveyors - Writing job applications

2.6. Format of instruction:	☒ lectures YES ☐ seminars and workshops ☐ exercises ☐ on line in entirety	☐ independent assignments YES ☐ multimedia and the internet YES ☐ laboratory ☐ work with mentor	2.7. Comments:

<table>
<tr><td></td><td colspan="2">☐ blended e-learning YES
☐ field work</td><td colspan="2">☐ (other)</td><td colspan="2"></td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="6">Regular class attendance

Interactive participation in teaching and learning process
Writing homeworks</td></tr>
<tr><td rowspan="5">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td></td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Tests</td><td>1</td><td>Oral exam</td><td>1</td><td>(other)</td><td></td></tr>
<tr><td>Written exam</td><td>1</td><td>Project</td><td></td><td>(other)</td><td></td></tr>
<tr><td>2.10. Grading and evaluating student work in class and at the final exam</td><td colspan="6">Students can take two mid-term exams. The students who pass both mid-term exams are exempt from taking the final examination.

The final examination is taken by the students who have not been grade positively on the basis of the points collected in the mid-term exams. The final examination consists of written and oral part.</td></tr>
<tr><td rowspan="2">2.11. Required literature (available in the library and via other media)</td><td colspan="4">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="4">Fučkan Držić, B. : Technical Engslih in Surveying and Geodesy, Faculty of Geodesy, Zagreb 2001</td><td></td><td></td></tr>
<tr><td>2.12. Optional literature (at the time of submission of study programme proposal)</td><td colspan="6"></td></tr>
<tr><td>2.13. Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="6">Student survey</td></tr>
<tr><td>2.14. Other (as the proposer wishes to add)</td><td colspan="6"></td></tr>
</table>

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Biserka Fučkan Držić	1.6. Year of the study programme	2.
1.2. Name of the course	German in Geodesy	1.7. Credits (ECTS)	3
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	L15 + S15 + e-learning
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	10
1.5. Status of the course	Optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION			
2.1. Course objectives	Expanding professional vocabulary Developing the skills in discussing professional topics Translation techniques Writing shorter works about professional topics Independent presentation in German related to professional problems Learning about the differences between the professional and standard German language		
2.2. Course enrolment requirements and entry competences required for the course	Passed examination in Basics of German for Special Purposes		
2.3. Learning outcomes at the level of the programme to which the course contributes	Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Demonstrate competences in regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy right, publishing and exchange of spatial data. Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards. Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.		

2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Develop intercultural and communication skills -Develop strategies for the participation in conversations within the professional frame using acquired professional vocabulary in German -Develop skill of understanding, speaking and writing in German for special purposes -Develop productive application of language for special purposes -Develop and improve the skills of interpreting German speaking and written contents -Develop strategies of independent learning		
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Selected texts intended for achieving the goals in learning German for special purposes in the following areas: - Land registry - Cadastre -Difference between land registry in Croatia and in German speaking countries - Topographic survey - Construction survey - Employment of surveyors - Writing job applications		
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☐ exercises ☐ on line in entirety	☒ independent assignments ☒ multimedia and the internet ☐ laboratory ☐ work with mentor	2.7. Comments:

	☒ blended e-learning ☐ field work		☐ (other)			
2.8. Student responsibilities	Regular class attendance Interactive participation in teaching and learning process Writing homeworks					
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance		Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	1	Oral exam	1	(other)	
	Written exam	1	Project		(other)	
2.10. Grading and evaluating student work in class and at the final exam	Students can take two mid-term exams. The students who pass both mid-term exams are exempt from taking the final examination. The final examination is taken by the students who have not been grade positively on the basis of the points collected in the mid-term exams. The final examination consists of written and oral part.					
2.11. Required literature (available in the library and via other media)	**Title**				**Number of copies in the library**	**Availability via other media**
	Selected by a teacher (tailored courses)					
2.12. Optional literature (at the time of submission of study programme proposal)						
2.13. Quality assurance methods that ensure the acquisition of exit competences	Student survey					
2.14. Other (as the proposer wishes to add)						

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Mraović, Branka	1.6. Year of the study programme	II.
1.2. Name of the course	Business Communication	1.7. Credits (ECTS)	3
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	30 (15 L + 15 S)
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate, third semester	1.9. Expected enrolment in the course	90
1.5. Status of the course	optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	level 2 of e-learning

2. COUSE DESCRIPTION	
2.1. Course objectives	The course aims to improve our students' communication skills both in relation to their colleagues and the members of the general public. The students are given an opportunity to learn the basic principles and practice of communication at work in geodetic company and institution. The course is also aimed at future engineers who want to make sense of communication in their everyday working lives i.e. to help in running a small business, to improve their efficiency at work, or to make the administrative side of their job easier and clearer.
2.2. Course enrolment requirements and entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Demonstrate competences in real estate registers and interests in real estates, understand land development measures and methods of land evaluation. Demonstrate competences in regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy right, publishing and exchange of spatial data.

	Use information technology in solving geodetic and geoinformation tasks. Communicate the results obtained by means of geodesy and geoinformation to clients and experts of geodetic and other related professions. Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards. Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Demonstrate the importance of effective communication and of selecting the appropriate medium to achieve the desired result in geodesy and geoinformatics. Outline the effects of information technology on communication. Understand the importance of company reputation. Understand the importance of communication in business and engineering careers. List the factors which help the business person to decide which kind of communication to use. Explain the function of intelligent search of websites. Explain effective use of information and communication technology in the process of communication within the work place. Identify the main kinds of communication and the areas of their application in geodesy and geoinformatics. Analyse the communication models. Describe principles and practice of successful communication in geodetic company and institution.

	Explain the communication cycle in geodetic company and institution. Understand organisation and the conduct of meetings in geodetic company and institution. Understand barriers to communication. Understand communication within the work place. Understand the importance of good public relations. Demonstrate competence in making an effective oral presentation. Demonstrate competence in making visual and written communication. Understand strategies and tactics in the negotiating process. Understand cultural differences in business communication. Demonstrate competence in making contact with the employers, clients and colleagues and the proper use of communication in business both in Croatia and abroad. Demonstrate competence in making written and oral interview with the stakeholders in geodesy and geoinformatics at their work places.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	**Course Content – Lectures (by weekly class schedule – 15 hours)** 0. <u>Course Organisation</u> - Basic instructions and guidelines about teaching, e-learning, course content, student responsibilities and rights, grading and evaluating student work in class and the final exam. 1. <u>The process of communication</u> – Kinds of communication. Social communication. Network communication. Working with

	people. Business communication. The importance of business communication for a company. 2. Principles and practice of business communication in geodetic companies - Content analyses of documentation which illustrate the ways and models of communication in geodetic sector – examples collected by students: Cadastre, Land registry, State Geodetic Administration. 3. Communication in public relations – The communication channel. Kinds of communication: written, oral and visual. Choosing the medium. Handling the awkward customer. 4. Communication and Information Technology – Network communication – advantages and disadvantages. Tools and techniques of marketing. Advertising. 5. Electronic data and confidentiality - Data storage and retrieval. Electronic conferencing. 6. Communication within the work place - The communication cycle. Phases of the communication cycle. Forms of written communication. Forms of oral communication. 7. Types of meetings - The role and rules of a committee. Organization and conduct of meetings. Report writing. Short or routine reports. Longer or special reports. 8. The communication cycle in small company – Horizontal and vertical communication. Writing business letters. Analysis of the websites of geodetic companies. Analysis of CEOs letters to the shareholders. The language of corporate leaders. 9. The communication cycle in large company – Groups and networks. Networks within larger communication structures. Use of network system in conjunction with the conventional company structure. Making questionnaire for the future purpose of fieldwork. Case studies about stakeholders in geodetic sector. 10. Barriers to communication – Poorly defined aim or information. Barriers caused by the sender or the receiver. Use of the wrong medium. Communicating at the wrong time. Organisational barriers. Barriers caused by external factors. 11. Analyses of external and internal communication in geodetic companies and institutions – Financial reporting. Business

	letters: content and layout. Examples: enquiry, complaint, apology. Circular letters. Standard letters. Internal letters. 12. Analysis of data representing geodetic sector – Graphic, written, visual and oral communication. The construction of business information in geodesy and geoinformatics. 13. Forms and questionnaires – Designing a form. Completing a form. Using forms. Forms in public procurement competition. 14. Graphic communication – Use of statistic data. Using graphics, tables, charts and symbols. 15. Website communication – Intranet. Use of language in cyber space. Changes in language. Reader, purpose and style. **Course Content – Seminars and student practical work in the field (by weekly class schedule – 15 hours)** During their seminar work students keep analysing the stakeholders in the geodesy and geoinformatics – companies, institutions in Croatia, international organisations and media. In every moment, it is important to know: Where are you? Who you are doing business with? The work aims: 5. To learn something useful from practical examples. 6. To hear an interesting geodetic story and use it to compile teaching material. 7. To learn how to follow competitors. 8. The project promotes the values of work and personal engagements towards success. **A CONCEPT OF STUDENT'S HOMEWORK** The profile of a stakeholder should contain: 6. General data about stakeholder and the history. 7. Technical image of the company. 8. Analysis of standardized financial reports of the company. 9. Form of business organisation – organisational design and how it has been changed in certain period.

10. Interview with stakeholders.

The profile consists of two parts :

3. Presentation.
4. Essay – comments and analysis of collected data.

This part of our teaching activity is related to the process of making our students acquainted with the demands of the European Union related to the transparency of business performed by legal and natural persons, as well as with the efforts made in geodesy in the processes of harmonizing the Croatian business and legal environment with those in the European Union, and with the international standards of financial business.

The function of the essay is to turn the data – images, numerical and textual data into a story with figures, plot and action. The students should answer to basic questions:

3. What the companies in geodesy are dealing with?
4. What is the factor of success in geodesy?

The individual approach and creativity are highly valued in writing an essay

Work phases

1. PHASE: Students have selected the stakeholders being the subject of their project research on their own. First, they had to suggest a few stakeholders (up to 5) out of each category – company, institution, international organisation and medium, regardless of the fact whether they already knew something about them or found out the information by searching web pages.

2. PHASE : Students were divided into working teams allowed to group themselves on their own. In this way, there were 41 working teams formed out of 83 students.

3. PHASE: The stakeholders were finally selected. Each students team could process one stakeholder, so that 41 teams finally made 42 profiles. One team worked comparatively on researching two stakeholders (two geodetic companies).

4. PHASE: Students had to study by means of web pages the way in which a stakeholder was presented and then periodically report about it at seminar sessions.

5. PHASE: Students had to make a questionnaire for the observed stakeholder. They were allowed to ask the questions first that they found most interesting. The questions from students' questionnaires were continuously discussed at seminar sessions. Based on suggestions given by the colleagues from other teams, some questions were modified, and some supplemented.

6. PHASE: Students had to analyse the financial reports of the observed stakeholders on the web pages of FINA. Those students who had international organisations as the objects of their research, contacted directly their stakeholders. The students who selected the institution in Croatia as their stakeholder collected the data in practical work guided their teacher.

7. PHASE: The analysis of the financial business of stakeholders. After the students had collected the data, they were able to analyse the company's balance sheet alone at the seminar sessions, as well as the financial activities of the stakeholders in the budget of the City of Zagreb, the stakeholders in the state budget, and the financing of international organisations.

8. PHASE: Students contacted directly the stakeholders and arranged a meeting at the physical location of the stakeholder, when it was possible. The students contacted the stakeholders at distant locations by phone or e-mail. In this work phase, the interviews with stakeholders were done.

9. PHASE: The teams presented their analyses of collected data in front of their colleagues.

10. PHASE: Two assignments were created in the e-learning environment of the course.

- **First assignment**:

The students needed to visit the web page of FINA register of public reports, study the balance sheets of the most successful entrepreneurs in 2012 and compare them with the balances of the business subject whose business they

<table>
<tr><td></td><td colspan="6">monitored within the scope of the task Stakeholder's profile in geodesy

➢ Second assignment:
During the seminar session, there was a discussion pro et contra opened about the public report on financial results of the company. The basic questions were focused on the usage of financial reports, why the financial reports should be read and whether the financial reports should be public.

11. PHASE: The working teams handed their presentations and essays to their teacher in digital and analogous forms. Their work resulted in the creation of 41 teaching materials about 42 stakeholders in geodesy.</td></tr>
<tr><td>2.6. Format of instruction:</td><td colspan="2">☒ lectures
☒ seminars and workshops
☒ exercises
☐ on line in entirety
☒ partial e-learning
☒ field work</td><td colspan="2">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☒ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="6">Create a stakeholder's profile in geodetic sector by student's own choice – company, institution, international organisation, media. The profile ought to be focused on kinds of business communication in geodesy and geoinformatics.

Obligatory class attendance of 70% lectures.

Obligatory class attendance of 70% seminars.

Obligatory two Moodle E-tests.</td></tr>
<tr><td rowspan="5">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>0.5</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Essay</td><td>0.5</td><td>Seminar essay</td><td>0.5</td><td>(other)</td><td></td></tr>
<tr><td>Tests</td><td>0.5</td><td>Oral exam</td><td>0.5</td><td>(other)</td><td></td></tr>
<tr><td>Written exam</td><td>0.5</td><td>Project</td><td></td><td>(other)</td><td></td></tr>
<tr><td>2.10. Grading and evaluating student work in class and at the final exam</td><td colspan="6">Written and oral exam, and two E-tests.</td></tr>
</table>

<table>
<tr><td></td><td colspan="3">Prerequisities for teacher's signature and partial immunity of the final exam

Prerequisities for teacher's signature
- minimum class attendance of 70%
- To make a stakeholder's profile in geodetic sector – seminar presentation and essay
- Two Moodle E-tests.

Immunity of written exam
-Student must pass both Moodle E-tests (2 to 5 rating)
-Presentation
-Essay
-Regular class attendance – lectures and seminars

Immunity of oral exam

- Student must pass both E-tests (4 to 5 rating)
-Presentation – rating 4 to 5
-Essay
-Regular class attendance – lectures and seminars</td></tr>
<tr><td rowspan="2">2.11. Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>Mraović, B., Poslovna komunikacija, E-Predavanja i seminari na E-učenju, Geodetski fakultet

Fisher, R., Ury, W., Patton, B. (2003.) Kako do DA: do dogovora pregovorom, a ne predajom, Zagreb: Impresum.</td><td>Available in the libraries of the city of Zagreb and other Croatian</td><td>Moodle</td></tr>
</table>

	Cutlip, S. M. (2003.) *Odnosi s javnošću*, Zagreb: Naklada MATE, Biblioteka gospodarska misao. Fox, R. (2001.) *Poslovna komunikacija*, Zagreb: Hrvatska Sveučilišna naklada & Pučko otvoreno učilište.	libraries	
	Mraović, B., Business communication E-Lectures and Seminars, Moodle, Faculty of Geodesy		Moodle
	Miljković, D. (2002.) *Komuniciranje u organizaciji*, Zagreb: IEP, Edicija Obelisk. Rouse, M. (2005.) *Poslovne komunikacije: kulturološki i strateški pristup*, Zagreb: Masmedia. Kliment, A. (2003.) *Tradicionalne i digitalne poslovne komunikacije*, Zagreb: Ekonomski fakultet & Mikrorad. Kliment, A. (1996.) *Poslovne komunikacije*, Zagreb: Zeus & Društvo za razvoj informacijske pismenosti, Biblioteka informacijsko društvo. Brajša, P. (1993.) *Menadžerska komunikologija: razgovor, problemi i konflikti u poduzeću*, Varaždin & Zagreb: Društvo za razvoj informacijske znanosti. Levine, M. ((2002.) *Umreženi gerilski*, Zagreb: Profil International. Osredečki, E. (1995.) *Poslovno komuniciranje & Poslovni bonton*, Zagreb & Samobor: Naklada EDO. Miljković, D., Rijavec, M. (1999.) *Kako se dobro prezentirati*, Zagreb: IEP, Edicija Obelisk. Jakovčević, T. (2000.) *Menadžer i tajnica u poslovnom komuniciranju*, Split: Knjigotisak. Verčić, D. (2004.) *Odnosi s medijima*, Zagreb: Mikrorad.	Available in the libraries of the city of Zagreb and other Croatian libraries	

	Jolić, S. (2003.) *Kako komunicirati s novinarima, medijima i javnošću*, Zagreb: Press data, medijska agencija HND. Bahtijari, H. (2002.) *Kako nastupati u javnosti*, Zagreb: Savez samostalnih sindikata Hrvatske. Novak, B. (2001.) *Krizno komuniciranje i upravljanje opasnostima*, Zagreb: Binoza press. Osredečki, E. (1995.) *Odnosi s javnošću*, Samobor & Zagreb: Naklada EDO. Fox, R., Osredečki, E. (1996.) *101 savjet u tržišnom i uredskom poslovanju*, Zagreb: Naklada EDO. Smithson, S. Whitehead, J. (1990.) *Business Communication*, Surrey: Croner Publications Ltd. King, N. (1991.) *Last Five Minutes*, London: Simon & Schuster. Lewis, R. D. (2000.) *When Cultures Colide*, London: Nicholas Brealey Publishing.		
2.12. Optional literature (at the time of submission of study programme proposal)	McQuail, D., Windahl, S. (1986.) *Communication Models*, London: Longman. Le Poole, S. (1991) *Never Take No for an Answer*, London: Kogan Page. Slater, R. (1994.) *Get Better or Get Beaten!* New York: IRWIN.		
2.13. Quality assurance methods that	- continuous monitoring of student knowledge		

ensure the acquisition of exit competences	**Rating** Continuous via project tasks: *Written* - Writing essays based on prescribed literature - Writing essyas based on itelligent search of websites - Writing critical essays - Making seminar presentations - Written exam *Oral* - Public presentation of seminar work in lecturing room - Oral exam *Electronic media* Analysing websites The final exam is written and oral.
2.14. Other (as the proposer wishes to add)	Student is expected to accept and respect the principles of academic honesty and integrity prescribed and regulated by the Ethical codex of the University of Zagreb (document available at: www.unizg.hr). In a lecturing room student is allowed to express his/her opinion in a tolerant and open minded way.

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Brankica Cigrovski-Detelić	1.6. Year of the study programme	2. (winter semester)
1.2. Name of the course	Topography	1.7. Credits (ECTS)	3
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	1L+0S+1E
1.4. Study programme (undergraduate, graduate, integrated)	bachelor	1.9. Expected enrolment in the course	80
1.5. Status of the course	elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	Capacitate students to recognize geomorphological forms on the field and geodetic maps. Apply geodetic land surveying methods for representation of relief. To produce, individualy or in team, analogue and digital presentation of relief for discret area by usage of one of CAD softwares.
2.2. Course enrolment requirements and entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	1. Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. 2. Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. 3. Make plans, maps and related presentations using modern methods and technologies on the basis of measured data and other sources. 4. Determine and interpret the size, properties and relations of objects in space on the basis of measured data, spatial databases, plans and maps.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	1. Define basic geomorphological forms in Croatia arise by activity od diferent endogene and egsogene forces. 2. Analize and select optimal geodetic surveying methods and graphical representation of Earth's geomorphological forms.

	3. Analize geodetic surveying methods of specific relief forms. 4. Produce relief reperesentations on large scale geodetic maps. 5. Implement achieved knowledge in presentation of relief in specific project tasks.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	1. Fundaments of geomorfphology. 2. Structure of Earth's core. 3. Structures and faults. Faults in Croatia. 4. Geomorphological forms arised by activity of denundation and abrasion. 5. Earth forms arised by activtiy of fluvial erosion. 6. Karst forms. Karst in Croatia. 7. Geomorphological forms arised by activity of glacial and eolian erosion. 8. Overview of geomorphological forms in Croatia by regions. 9. Election of optimal geodetic surveying method for production of each geomorphological form model. 10. Conture lines. Relief of costal sea bed. 11. Presentation of geomorphological forms by contur lines or special signs on large scale geodetic maps . 12. Height survey and representation of heights on geodetic maps for special purposes; spatial planing, environment protection, etc. 13. Survey methods, instruments and equpment for precise height determination in hydrotechnic.

DETAILED PROPOSAL OF THE STUDY PROGRAMME

	14. Hegiht survey and representation of heights for specific forms of relief and buildings. 15. Graphical software and topographical signs in official usage which are used for relief representation on large scale geodetic maps (till scale 1:5000).

2.6. Format of instruction:	☒ lectures ☒ seminars and workshops ☐ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work	☒ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:
2.8. Student responsibilities	Attending lectures, complete and presentation of seminars on a given topic.		

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	0,5	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay	1,0	(other)	
	Tests		Oral exam	0,5	(other)	
	Written exam	1,0	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	Subject has a written and oral exam. The seminar is recognized as a written exam.

2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Cigrovski-Detelić, B. (2010): Topografija, Geodetski fakultet, Zagreb.		
	Bognar, Juračić, Filipčić, Mihaljević (1997): Geografija 1, Profil, Zagreb.		
	Herak, M. (1984): Geologija, Školska knjiga, Zagreb.		

2.12. Optional literature (at the time of submission of study programme proposal)	Cigrovski-Detelić, B. (1998): Primjena GPS-mjerenja i geotektonskih informacija u obradi geodinamičke mreže CRODYN 94-96, Sveučilište u Zagrebu, Geodetski fakultet, doktorska disertacija, Zagreb. Jugoslavenski leksikografski zavod (1979): Opća enciklopedija, Zagreb. Riđanović, J. (1989): Hidrogeografija, Školska knjiga, Zagreb.

	Rukavina, D. (1996): Ledeno doba, Hrvatski prirodoslovni muzej, Zagreb.
2.13. Quality assurance methods that ensure the acquisition of exit competences	Studentska anketa.
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Dražen Tutić Nada Vučetić	1.6. Year of the study programme	2
1.2. Name of the course	Object Oriented Modelling and Programming	1.7. Credits (ECTS)	3
1.3. Associate teachers	Mario Miler Dražen Odobašić	1.8. Type of instruction (number of hours L + S + E + e-learning)	L15 + E30
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	30
1.5. Status of the course	optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2, 5%
2. COUSE DESCRIPTION			
2.1. Course objectives	Acquiring knowledge and skills necessary to solve problems in Geodesy and Geoinformatics using object oriented modeling and programming.		
2.2. Course enrolment requirements and entry competences required for the course	Passed exams in Analytical Geometry and Linear Algebra, Programming, Field Measurements and Land Surveying.		
2.3. Learning outcomes at the level of the programme to which the course contributes	**Applying knowledge and understanding:** Use information technology in solving geodetic and geoinformation tasks. **Making judgements:** Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution. **Communication skills:** Communicate the results obtained by means of geodesy and geoinformation to clients and experts of geodetic and other related professions. **Learning and ethical skills:** Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based		

	on the position, and the changes in regulations, norms and standards.		
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	1. Distinguish between the object oriented modeling and programming. 2. Describe the UML. Define the components and process of design using UML. 3. Design UML diagrams for solving geodetic and geoinformatics problems. 4. Apply the methodology of object oriented programming.		
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Lectures: 1. The objective and the content of the course. The organization of the teaching. 2. Modeling, UML. The basic elements of UML. 3. Use cases. 4. Static diagrams. 5. The dynamic model of the system. 6. Dynamic diagrams. 7. Physical diagrams. 8. The first test. 9. Objects, classes and packages in Java. 10. Inheritance, abstract classes, polymorphism and interfaces in Java. 11. Exceptions and their handling in Java. 12. Important Java classes. 13. Input-output subsystems in Java. 14. Graphical programming in Java. 15. The second test. Exercises: During exercises, the problems from the fields explained in the lecture are solved.		
2.6. Format of instruction:	X lectures ☐ seminars and workshops X exercises ☐ on line in entirety X partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:
2.8. Student responsibilities	Minimum attendance of the lectures 70%, and 70% of the exercises too. Active participation in class, solving and presentation of problems, taking part in the tests and the final exam successfully.		

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	1	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	1	Oral exam	0.5	(other)	
	Written exam	0.5	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	During the course: Two tests per semester. Written exam: A student can be exempted from the written part of the final exam if she/he scored at least 50% of the points in each of the two tests. If the student is not exempted from the written part of the final exam due to test results, she/he is obliged to take the written part of the exam during the regular examination dates. The exemption from he written part of the exam is valid only for one of the two first examination dates of the ongoing academic year. Oral exam: Students who successfully took the written part of the final exam based on the continuous knowledge tests during the course, have to take only the oral part of the exam. The remaining students have to take both the written and the oral parts. The precondition for taking the oral part of the exam is that at least 50% of the points were achieved in the written part.

	Title	Number of copies in the library	Availability via other media
2.11. Required literature (available in the library and via other media)	Miles, R., Hamilton, K., Learning UML 2.0, O'Reilly Media, 2006.		http://it-ebooks.info/book/307/
	Milićev, D., Zarić, M., Piroćanac, N., Objektno orijentisano modelovanje na jeziku UML: Skripta s praktikumom, Mikro knjiga, Beograd, 2001.	1	
	Skansholm, J., Java from the Beginning, 2nd edition, Addison-Wesley, Pearson Education, 2004.	1	

2.12. Optional literature (at the time of submission of study programme proposal)	Eckel, B., Thinking in Java, 3rd ed. Revision 4.0 (e-book), (http://www.mindview.net/Books/TIJ/) Fowler, M., UML ukratko: kratak vodič kroz standardni jezik za modelovanje objekata, Addison-Wesley, Mikro knjiga, Beograd, 2004. (Autorizirani prijevod s engleskog na srpski jezik knjige: UML Distilled: A Brief Guide to the Standard Object Modeling Language, 3rd ed., Addison Wesley).

2.13. Quality assurance methods that ensure the acquisition of exit competences	The quality will be surveyed based on the success in tests and exams, as well as by anonymous polls.
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Miljenko Lapaine	1.6. Year of the study programme	1st and 2nd
1.2. Name of the course	Transformation of Coordinates	1.7. Credits (ECTS)	3
1.3. Associate teachers	Dražen Tutić Martina Triplat Horvat Ana Kuveždić Divjak Marina Viličić	1.8. Type of instruction (number of hours L + S + E + e-learning)	45 (15L + 30E)
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	50
1.5. Status of the course	Optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION			
2.1. Course objectives	The objectives of this course are: • teach students basic mappings used in geodesy and geoinformatics • explain unavoidable distortions that appear in different mappings • create a foundation that will help in understanding the transformation and conversion that will be processed in details in other courses		
2.2. Course enrolment requirements and entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	**Knowledge and understanding** • Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. • Understand mathematical methods and physical laws applied in geodesy and geoinformatics. **Applying knowledge and understanding** • Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of problems in the field of geodesy and geoinformatics. • Use information technology in solving geodetic and geoinformation tasks. **Making judgements**		

	• Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	• Distinguish the basic coordinate systems in Geodesy and Geoinformatics • Describe basic types of mappings from a plane to a plane, from a plane to a space, from a space to a plane and from a space to a space and their characteristics • Estimate distortions that appears in mappings • Apply Helmert, affine and projective transformation • Apply transformations by using CAD and GIS computer programs, especially geocoding and georeferencing • Use software for coordinate transformations • Estimate suitability of different methods for coordinate transformation
2.5. Course content broken down in detail by weekly class schedule (syllabus)	1. Introduction 2. Coordinate systems 3. Mappings from a plan to a plane 4. Mappings from a plane to a space 5. Mappings from a space to a space 6. Distortions appearing in mappings 7. Inverse mappings 8. Helmert transformatino and its application in geodesy and surveying 9. Affine transformation and its application in geodesy and surveying 10. Projective transformation and its application in geodesy and surveying 11. Transformation and CAD software 12. Geocoding, georeferencing 13. Software for coordinate transformations
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☐ partial e-learning ☐ field work ☐ independent assignments ☐ multimedia and the internet ☒ laboratory ☐ work with mentor ☒ consultations ☒ evaluations of knowledge
2.7. Comments:	Exercises follow lectures in their content.
2.8. Student responsibilities	Regular attendance to lectures and exercises, the possibility of taking part in preliminary exams, the possibility of consulting the demonstrator and teachers, written and oral exams, activity through the system of E-learning. Attending lectures and exercises in the amount of 70% and active participation are conditions for signature.

	Above 30% of absences - loses the right to the signature, and the signature is a prerequisite for the exam registration.					
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	1.8	Research		Practical training	
	Experimental work		Report		Learning and preparation for preliminary and final exams (other)	2.2
	Essay		Seminar essay		(other)	
	Tests		Oral exam		(other)	
	Written exam		Project		(other)	
2.10. Grading and evaluating student work in class and at the final exam	During the semester, the two preliminary exams (tests) exist through which students can be exempted from the written part of the exam. In order to be exempted from the written part of the exam student should acquire a minimum of 50% marks at both preliminary exams. Student achieves a rating on every preliminary exam and the mean of these two ratings is equivalent to the grade of the written exam. Actual rating from continuous assessment applies to one of the first two examination periods in which students attend only the oral exam. If they do not pass the exam, the next time they should take part in the written part. Written exam consists of six tasks. It is necessary to solve three tasks, or 50%, to pass the written part of the exam.					

	Title	Number of copies in the library	Availability via other media
2.11. Required literature (available in the library and via other media)	Lapaine, M.: Transformacija koordinata, manuscript, Geodetski fakultet, Zagreb 2012.		e-learning
			e-learning

2.12. Optional literature (at the time of submission of study programme proposal)	Frančula, N., Lapaine, M., Petrović, S.: Transformacija sadržaja karte iz jedne kartografske projekcije u drugu. Zbornik radova VI međunarodnog simpozija Kompjuter na sveučilištu. Dubrovnik: Sveučilišni računski centar Zagreb, 1984, 608.1-608.8 Lapaine, M.: A New Direct Solution of the Transformation Problem of Cartesian into Ellipsoidal Coordinates. Presented at the First International Geoid Commission Symposium, Milano, 11-13. 6. 1990. Published in: Rapp, R. and Sansò, F. (Eds.): Determination of the Geoid, Present and Future. Springer Verlag, Proceedings from the International Association of Geodesy Symposia, 1991, Vol. 106, 395-404. Lapaine, M., Frančula, N.: Prilog ocjeni točnosti pri afinoj transformaciji. Zbornik radova Savetovanja "Katastar nepokretnosti". Ilidža-Sarajevo 26.-27. 10. 1990.: Savez geodetskih inženjera i geometara Jugoslavije, 63-76. Frančula, N., Vučetić, N., Lapaine, M.: Transformacije i geoinformacijski sistemi. Zbornik Geodetskog fakulteta Sveučilišta u Zagrebu u povodu 30. obljetnice samostalnog djelovanja, Zagreb, 1992, 177-186.

	Lapaine, M., Frančula, N.: Vpliv pogreška ene točke na natančnost afine transformacije. Referat: Kartografija, 26. geodetski dan Zveze geodetov Slovenije, Bled 14.-16. 10. 1993. Objavljeno u: Geodetski vestnik 1993, 3, 193-197. Lapaine, M., Frančula, N.: Osvrt na afinu transformaciju. Geodetski list 1994, 2, 159-168. Frančula, N., Lapaine, M.: Transformacija koordinata iz Krimskog sustava na području Istre u Gauss-Krügerovu projekciju, Geodetski list 2007, 3, 175-181. Frančula, N., Lapaine, M., Tutić, D., Manojlović, B.: Transformacija koordinata iz Bečkog sustava na području Hrvatske u Gauss-Krügerovu projekciju, sažetak u: Lapaine, M. (urednik): Program i sažetci / Program and Abstracts, 2. hrvatski NIPP i INSPIRE dan i savjetovanje Kartografija i geoinformacije, Opatija, 25–27. 11. 2010., 47. Tutić, D., Lapaine, M.: INSPIRE – servis za transformacije koordinata, sažetak u: Lapaine, M. (urednik): Program i sažetci / Program and Abstracts, 2. hrvatski NIPP i INSPIRE dan i savjetovanje Kartografija i geoinformacije, Opatija, 25–27. 11. 2010., 72. Lapaine, M., Tutić, D.: Helmertova i afina transformacija. 7. simpozij ovlaštenih inženjera geodezije, "Uloga geodezije u uređenju zemljišta i upravljanju prostorom", Opatija, 24–26. 10. 2014., Zbornik radova, ur. I. Racetin, Hrvatska komora ovlaštenih inženjera geodezije, 85–90.
2.13. Quality assurance methods that ensure the acquisition of exit competences	Two preliminary exams, written and oral exam. Student evaluation.
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Nikol Radović	1.6. Year of the study programme	III.semester
1.2. Name of the course	Space visualization	1.7. Credits (ECTS)	3
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	15L+30E(Auditory and planning)+e-learning
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	>10
1.5. Status of the course	optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	Level 2
2. COUSE DESCRIPTION			
2.1. Course objectives	The aim of the course is to develop students' space ability, creative thinking and solving spatial problems of geodetic profession with the use of construction methods of descriptive geometry.		
2.2. Course enrolment requirements and entry competences required for the course			
2.3. Learning outcomes at the level of the programme to which the course contributes	**Knowledge and understanding** - To know theoretical principals, procedures of computer processing and visualisation of surveying data. - To understand the mathematical methods and physical laws applied in geodesy and geoinformatics. **Application of knowledge and understanding** - To apply the knowledge in mathematics and physics for the purpose of recognizing, formulating and solving problems in the field of geodesy and geoinformatics, - To use information technology in solving geodetic and geoinformation tasks. **Learning and ethical skills** - To plan the continuation of academic education in the field of geodesy and geoinformatics, or related disciplines, and to develop the lifelong learning attitude.		
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- To define, to differentiate and to apply the central / parallel projection, - To draw/ to construct an accurate representation/drawing of any geometric figures (two-dimensional or three-dimensional) by the use of a projection methods (axonometric, perspective), - To analyze and to explain the interrelations of geometric figures and metric properties in the plane or space,		

<table>
<tr><td></td><td colspan="6">- To draw/ to construct orthogonal axonometric of sphere and on in it a point given with its geographic coordinates,
- To apply the method of the quoted projections in presentations of the fields,
- To construct a perspective image of geometric figures given by its projections,
- To construct thrown shadows of simple and complex geometric figures.</td></tr>
<tr><td>2.5. Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="6">- A brief history of descriptive geometry.
- Monge’s projection on two planes (points, lines, segments).
- Orthogonal projection plane and mutual relations between planes, lines and points
- Monge’s projections on three planes
- Solving different metric task by rotation method
- Axonometric method in visualization of geometric figures (application isometric triangular meshes points)
- Orthogonal Axonometric projection of sphere (construction point on sphere which is given by its geographic coordinates)
- Sections of geometric figures with planes and other geometrical figures
- Flashes square / rounded geometric figures listed projections
- Solving the topographic surface.
- Perspective projection basic concepts and rules.
- Alberti’s construction of perspective images
- The construction of perspective images of geometric figures with one / two vanishing points.
- Shadow. Construction thrown shadow geometric figures to another geometric figure</td></tr>
<tr><td>2.6. Format of instruction:</td><td colspan="2">☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☒ partial e-learning
☐ field work</td><td colspan="2">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☒ work with mentor
☒ homeworks</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="6">- Presence in 80% of lectures and exercises
- (correct) programs and homework’s delivered on timeopt are the condition for signature</td></tr>
<tr><td rowspan="4">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS</td><td>Class attendance</td><td>0.3</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>homework</td><td>0.5</td></tr>
<tr><td>Tests</td><td>0.5</td><td>Oral exam</td><td>0.5</td><td>(other)</td><td></td></tr>
</table>

value of the course)	Written exam	0.5	Project	0.7	(other)	

2.10. Grading and evaluating student work in class and at the final exam	Continuous monitoring of the exercises, homework, programs and colloquia. All activities will be evaluated. In the semester are two colloquia. 1./ 2. Colloquium (max.300 points) 0- 115 points ------------- >insufficient (1) 116-199 points ---------- > sufficient (2) 200-249 points ---------- > good (3) 250-289 points ---------- > very good (4) 290-300 points ---------- >excellent (5) All students who have earned a minimum of sufficient (2) per each of the activities, will be exempt from the written exam. All students who have earned a minimum of very good (4) per each of the activities, will be exempt from the exem.

	Title	Number of copies in the library	Availability via other media
2.11. Required literature (available in the library and via other media)	I.Babić, S. Gorjanc, A. Slijepčević, V. Szirovicza: *Descriptive geometry-exames*, HDKGIKG, Zagreb, 2007.		
	E. Jurkin, V.Szirovicza*: Decriptive geometry*, CD, HDKGIKG, Zagreb, 2005.		
	K. Horvatić-Baldasar, I. Babić: *Descriptive geometry* SAND d.o.o., Zagreb, 2007.		
	P. Kurilj, N. Sudeta, M. Šimić. *Perspective* – Textbook for architecture university, Golden marketing – Tehnička knjiga, Zagreb, 2005.		
	V. Niče. *Descriptive geometrx*, Školska knjiga, Zagreb, 1992.		
	V. Niče. *Descriptive geometry I i II*, Školska knjiga, Zagreb, 1987.		
	All course materials are available in electronic form for students.		

2.12. Optional literature (at the time of submission of study programme proposal)	S. Losbichhler, H. Müller. Darstellende Geometrie/ 3D – Geometry, Veritas, 2000.
2.13. Quality assurance methods that ensure the acquisition of exit	- A survey on the quality of teaching and learning materials - Class attendance and class participation

competences	- Evaluation of the results of the examination (year)
2.14. Other (as the proposer wishes to add)	By learning course Space visualization students will get a confidence and security in view of geometric figure drawing and develop spatial ability. They will learn how to use mathematical / geometric language and representations (in different software environments), and to generalize and study the regularities and relationships among geometric figures and think abstractly. Student will become active participants in the learning process and thus the train system to the whole life learning.

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher		1.6. Year of the study programme	2. (winter semester)
1.2. Name of the course	Professional practice	1.7. Credits (ECTS)	3
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	80 hours of practice
1.4. Study programme (undergraduate, graduate, integrated)	bachelor	1.9. Expected enrolment in the course	80
1.5. Status of the course	elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	
2. COUSE DESCRIPTION			
2.1. Course objectives	To enable students, by work in business subject which is engaged in geodetic-geoinformatic activities, to implement in practice acquired knowledges and skills and familiarize themselve with functioning and organization of business subject. Professional practice should enable linking the theoretical knowledges and skills in real environment in which business subjects are acting. To enable students understanding and perception of professional substance received ex catedra during the study as introduction for list of professional courses following from IV. till VI. semester		
2.2. Course enrolment requirements and entry competences required for the course	None		
2.3. Learning outcomes at the level of the programme to which the course contributes	1. Solve practical tasks in surveying, spatial data collection, real estate evaluation and management. 2. Use information technology in solving geodetic and geoinformation tasks. 3. Make plans, maps and related presentations using modern methods and technologies on the basis of measured data and other sources. 4. Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution.		

DETAILED PROPOSAL OF THE STUDY PROGRAMME

2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	1. Acquaint organization of work in business subject. 2. Implement acquired knowledge in practical situations in business subject. 3. Individual execution, under the supervison of mentor, specific geodetic-geoinformatic tasks. 4. To link theoretical knowledge with work in practice.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	

2.6. Format of instruction:	☐ lectures ☐ seminars and workshops ☐ exercises ☐ on line in entirety ☐ partial e-learning ☐ field work	☒ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:
2.8. Student responsibilities			

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance		Research		Practical training	3
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests		Oral exam		(other)	
	Written exam		Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	Course has no notes.

2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**

DETAILED PROPOSAL OF THE STUDY PROGRAMME

2.12. Optional literature (at the time of submission of study programme proposal)			
2.13. Quality assurance methods that ensure the acquisition of exit competences	Feedback from students (log file) and employer which accepted students on professional practice.		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Stanislav Frangeš	1.6. Year of the study programme	2
1.2. Name of the course	Cartography	1.7. Credits (ECTS)	5
1.3. Associate teachers	Robert Župan Vesna Poslončec-Petrić Igor Birin	1.8. Type of instruction (number of hours L + S + E + e-learning)	60 (30L+30E) e-learning = yes
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	80-90
1.5. Status of the course	Mandatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	level 2

2. COUSE DESCRIPTION	
2.1. Course objectives	The acquisition of basic knowledge of cartography, its development and methods of producing maps, cartographic visualization and generalization with an emphasis on achieving the ability to distinguish objects viewed at different cartographic representations and the application of the elements of cartography in order to develop simple maps and map related representations.
2.2. Course enrolment requirements and entry competences required for the course	Passed exams in courses: "Basics of Geoinformatics" "Engineering Graphics in Geodesy and Geoinformatics"
2.3. Learning outcomes at the level of the programme to which the course contributes	Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. Make plans, maps and related presentations using modern methods and technologies on the basis of measured data and other sources. Determine and interpret the size, properties and relations of objects in space on the basis of measured data, spatial databases, plans and maps. Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. Prepare official public documents, reports, graphic and cartographic presentations using the surveying results related to objects in space.

2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	The students will: - Explain cartography and its tasks, the development of cartography and cartography division, - Allocate objects display and object names (toponyms) on different representations, - Compare the types of cartographic distinction between their properties, elements, scale, size, etc., - Set aside the originals for development of cartographic representations, - Explain the map graphics and use elements of cartography, - Explain the cartographic generalization, factors and basic procedures of cartographic generalization, - Create a cartographic representation of the implementation of all procedures necessary for its development, - Create a set of data (metadata) required for use of cartographic representation, - Recommend the use of methods and ways of maintaining cartographic representations, - Compare the modern official and unofficial map products in the Republic of Croatia.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Lectures (per 2-hour lectures): 1. Introductory lecture and valuation rules of students through the semester. Second Cartography and its tasks. The definition of cartography. Divisions of cartography. Periods and epochs of the development of cartography. 3. During the preparation of cartographic representation. 4. Facilities display. The division of objects displaying. Object names - toponyms. 5. Types of cartographic representations. Map and its properties. Components of the map. Map sizes. Basics on topographic maps. Basics of thematic maps. Maps like graphic presentations. Atlases. Reliefs and relief maps. Modern maps of Croatia. 6. Mid term exam 1 7. Sources for the production of cartographic representation. 8. General Symbols Systems. The map graphics. Map Symbols. Minimum size. Properties and formatting characters. The basic geometric and graphic elements. Signature. The divisions signature. Size and scale of signatures. Diagrams. The divisions diagrams. Graphic variables. Wisetone. Colour. Letter. Cartographic visualization. 9. Fundamentals of cartographic generalization. Factors affecting the generalization. The methods of cartographic generalization. 10. Mid term exam 2 11. Development of cartographic representation. The influence of hardware on map reproduction. The impact of software on map reproduction. Screens and screening in digital cartography. Press Office procedures. 12. Dataset for the use of various cartographic presentations. 13 Determination requirements for update. 14. Mid term exam 3

	15. Repeated and makeup exam Exercises (for the tasks within the project): Making mental maps (2 hours) Exercise 1 - Creating a selected cartographic symbols and their variation through different scales (8 hours) Exercise 2 - Creating authoring original maps to the overall external description (8 hours) Exercise 3 - Creating a default simple thematic maps 12 hours)					
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work		☒ independent assignments ☐ multimedia and the internet ☒ laboratory ☐ work with mentor ☒ Team work (other)		2.7. Comments:	
2.8. Student responsibilities	Compulsory attendance at 70% of teaching - lectures. Compulsory attendance at 70% of classes - exercises. Mandatory deposited three colloquia. Compulsory surrender three projects tasks.					
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	0,5	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	1,5	Oral exam	1,0	(other)	
	Written exam	1,0	Project	1,0	(other)	
2.10. Grading and evaluating student work in class and at the final exam	The general principles by which runs scoring: Maximum points are for: theoretical knowledge (in the lecture) 51 presence and work on exercises 15 projects (in the exercises) 34 TOTAL 100 Mandatory requirement for entry into the evaluation system is the realization of minimum conditions (the right to the signature). The right to the signature and exam:					

	Credits: attend the exercises 4 minimum points for mid term exam (5 + 5 + 5) 15 minimum points for projects (4 + 4 + 6) 14 TOTAL 33 For recognition of the written exam is necessary to achieve: credits for sufficient (2) 66-75 for good (3) 76-84 for very good (4) 85-93 for excellent (5) 94-100 Students who are not satisfied with their grade achieved through the semester, and in recognition of the written exam with this assessment, can access the written part of the exam on the regular examination periods. In addition they score achieved through the semester is no longer valid. A regular examination period: for passing the written exam required to achieve the scores for sufficient (2) 36-45 for good (3) 46-55 for Very good (4) 56-64 for excellent (5) 65-72 Oral exam is mandatory access for all students, regardless of whether the assessment of the written exam achieved by collecting points through the semester or at the regular examination period. The final grade for students who are recognized as the written part of the exam (achieved 66 or more points) is formed on the basis of this assessment and response to oral exam. For students who access the written part of the exam, because it did not release the semester (achieved less than 66 points) or are not satisfied with their grade achieved through the semester, the total score for the written part is formed on the basis of medium-marks over semester and written exam, the manner strictly prescribed in the respective tables. At the oral exam can raise the final grade for an assessment in relation to the assessment recognized in the written part, but also unlimited reduce it.		
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**

	Lovrić, P. (1988): Opća kartografija, University of Zagreb.	5	
	Frančula, N. (2001): Digitalna kartografija, Faculty of Geodesy, Fakulty script, Zagreb.	10	
	Frančula, N. (2000): Kartografska generalizacija, Faculty of Geodesy, Fakulty script, Zagreb.	10	
	Frangeš, S. (2014): Opća kartografija - lectures (pdf, 1 MB)		e-learning
	Frangeš, S. (2014): Kartografska reprodukcija - lectures (pdf, 0,4 MB)		e-learning

2.12. Optional literature (at the time of submission of study programme proposal)	Robinson, A.H., Morrison, J.L., Muehrcke, P.C., Kimerling, a.J., Guptill, S.C.: Elements of Cartography. New York, J. Wiley and Sons 1995. Hake, G., Grünreich, D., Meng, L.: Kartographie – Visualisirung raum-zeitlicher Informationen. Walter de Gruyter, Berlin, New York 2002. Frangeš, S.: Grafika karte u digitalnoj kartografiji, Sveučilište u Zagrebu, Geodetski fakultet, Zagreb, 1998. Ćosić, Alilović, Frangeš, Landek: Topografske karte na području Hrvatske (glavni urednik: Frangeš), Državna geodetska uprava, Zagreb, 2012.
2.13. Quality assurance methods that ensure the acquisition of exit competences	Periodic testing of the acquired knowledge of students - three mid term exams.. Periodic testing adopted practical knowledge of students - tests in three tasks when submitting the same. Passing the written and oral examination. Self-evaluation of teachers and interviewing participants.
2.14. Other (as the proposer wishes to add)	The course is designed to level the program in terms of learning skills and ethics provide monitoring and adoption of new technological developments in the field of geoinformation systems and services based on position and changes in regulations, norms and standards, as well as the basis for further academic training in the field of geodesy and geoinformatics or related disciplines, and developemnt of culture of lifelong and professional education

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Dubravko Gajski	1.6. Year of the study programme	2
1.2. Name of the course	Photogrammetry	1.7. Credits (ECTS)	5
1.3. Associate teachers	Ljiljana Pleše Dubravka Maurer	1.8. Type of instruction (number of hours L + S + E + e-learning)	60 (30L + 30 E)
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	80
1.5. Status of the course	obligate	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION			
2.1. Course objectives	- reach the basic knowledges about principles of photogrammetric measuring - know to choose the optimal methods of aerophotogrammetric measuring - to undestand the technology of aerophotogrammetric instrumentation - to know the procedures of photogrammetric data processing and measuring of images		
2.2. Course enrolment requirements and entry competences required for the course	No requirements		
2.3. Learning outcomes at the level of the programme to which the course contributes	**Knowledge and understanding** Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. Understand mathematical methods and physical laws applied in geodesy and geoinformatics. **Applying knowledge and understanding** Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of problems in the field of geodesy and geoinformatics. Handle geodetic instruments and appropriate measuring equipment properly, and perform geodetic measurements. Solve practical tasks in surveying, spatial data collection, real estate evaluation and management.		

	Make plans, maps and related presentations using modern methods and technologies on the basis of measured data and other sources. Determine and interpret the size, properties and relations of objects in space on the basis of measured data, spatial databases, plans and maps. Maintain topographic, cartographic, maritime and navigation, and land information systems, integrate and visualise spatial information. Use information technology in solving geodetic and geoinformation tasks. **Making judgements** Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution. **Communication skills** Prepare official public documents, reports, graphic and cartographic presentations using the surveying results related to objects in space. Communicate the results obtained by means of geodesy and geoinformation to clients and experts of geodetic and other related professions **Learning and ethical skills** Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards. Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- compare photogrammetric measuring methods to other surveying measuring methods - know the relevant features of metric cameras, and classify them according their metric features - Use the possibilities of digital photographic camera to achieve technical photography. - Define the coordinate systems in photogrammetry. Transform photogrammetric measurements between different coordinate systems in photogrammetry. - Evaluate the abilities of the human eye in the photogrammetric survey.

<table>
<tr><td></td><td colspan="6">- Interpret photogrammetric image and identify the orientation point.
- measure photogrammetric images at the digital monocomparator.
- Use the principles of stereoscopic vision to measure photogrammetric images.

- Recognise elements of metric images and use them in the photogrammetric survey.</td></tr>
<tr><td>2.5. Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="6">1.The content and organization of the course, an introduction, the concept and definition of photogrammetry
2. Basics of photography and imaging, parameters and properties of technical photos. Depth of field.
3. Cameras and other systems for imaging, metric and non-metric cameras. Digital Camera with area-, line- and point- sensors Technical characteristics and measurement properties
4. measuring of images, coordinate systems in photogrammetry, 2D coordinate transformations.
5. Terrestrial photogrammetry, accessories, and applications. Producing of documents of cultural heritage.
6. Aerial photogrammetry, equipment. Distribution, stabilisation and determination of control points. Flight planning
7. Flight plan, imaging geometry in rows and blocks Photosignalization.
8. Stereophotogrametry, eye, resolving power of the eye, sensitivity to the color, stereoscopic viewing, subjective model
9. Principles of stereo-measurements, analytical and digital systems Digital stereo- and mono- comparators.
10. Photogrammetric orientation, the purpose and elements of particular orientation. inner orientation, outer orientation
11. The relative orientation, absolute orientation, dangerous surfaces, deformation of the model
12. Aerial triangulation in rows and blocks: method of independent models and bundle block adjustement
13. Standard photogrammetric products, orthophoto,
14. LIDAR
15. Accuracy of photogrammetric measurements</td></tr>
<tr><td>2.6. Format of instruction:</td><td colspan="2">☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="2">☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="6">attendance at lectures and exercises more than 70%
1. Project: Orientation tics
2. Project: Creating a 3D-display anaglyph ifskog assessment (2 tests and / or written and oral exams)</td></tr>
<tr><td rowspan="2">2.9. Screening student work (name the proportion of ECTS credits for each</td><td>Class attendance</td><td>1.5</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td><td></td></tr>
</table>

activity so that the total number of ECTS credits is equal to the ECTS value of the course)	Essay		Seminar essay		(other)	
	Tests	0.5	Oral exam	0.5	(other)	
	Written exam	0.5	Project	2	(other)	

2.10. Grading and evaluating student work in class and at the final exam	The success of development of project tasks, and their understanding is evaluated upon completion of work. Rating of the written exam and the colloquium is determined as follows: percentage Rating 50% to 71% is sufficient (2) 72% to 80% good (3) 81% to 90% very good (4) 91% to 100% excellent (5)		
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Kraus, K.: Photogrammetry – basic principles vol.4.	7	
2.12. Optional literature (at the time of submission of study programme proposal)			
2.13. Quality assurance methods that ensure the acquisition of exit competences			
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Tomislav Bašić ŽeljkoHećimović	1.6. Year of the study programme	II
1.2. Name of the course	Geodetic Reference Frame	1.7. Credits (ECTS)	5
1.3. Associate teachers	Marko Pavasović Olga Bjelotomić MarijaPejaković Marijan Grgić Matej Varga	1.8. Type of instruction (number of hours L + S + E + e-learning)	30 L + 30 E
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	70
1.5. Status of the course	obligatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	e-learning level 2
2. COUSE DESCRIPTION			
2.1. Course objectives	Adopting theoretical and practical knowledge in the field of geodetic reference systems and frames and their importance for the state survey and the basic geodetic works at the state level.		
2.2. Course enrolment requirements and entry competences required for the course	Passed exams: Analytic geometry and linear algebra (I sem.), Physics (I. sem.), Vector analysis (II. sem.), Absolved courses: Mathematical analysis (I sem.), Basics of geoinformatics (I sem.), Analysis and processing of geodetic measurements (III sem.).		
2.3. Learning outcomes at the level of the programme to which the course contributes	Knowledge and understanding: Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Understand mathematical methods and physical laws applied in geodesy and geoinformatics. Applying knowledge and understanding: Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of problems in the field of geodesy and geoinformatics. Establish geodetic networks needed in surveying and stakeout in order to provide the required quality of the works		

	performed in certain space. Use information technology in solving geodetic and geoinformation tasks. Adoption of conclusions and judgments: Recognize problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution. Presentations and team work: Prepare official public documents, reports, graphic and cartographic presentations using the surveying results related to objects in space. Learning skills and ethics: Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will: - Define basic concepts related to the coordinate reference systems and frames, - Analyze the physical and mathematical characteristics of reference system with respect to the fundamental parameters in respect to which it defines as well as the essential role of the reference frames in positioning, navigation and orientation of objects in space, - Analyze measurement techniques and classify the differences between spatial, terrestrial and local (instrument fixed) reference frame, - Analyze the old and the new official coordinate system, reference system and reference frame of Croatia, as well as old and new official height systems of Croatia, and adopt necessary knowledge about the relationship between HTRS96, ETRF89 and ITRFYY reference frames, - Acquire knowledge and mathematical procedures to solve practical problems of numerical transformation and conversion of coordinates and time coordinate transformation.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Lectures (two-hour lectures): <u>0. The course organization</u>: getting to know the teachers, subject content, literature, schedule and time of teaching, the use of e-learning, obligations and rights of students, examination methods, rules of conduct of the class and experience from previous years. <u>1. Introduction to Geodetic reference frames</u>: concept, review and thematic scope of the course. Basic terms, acronyms and abbreviations. The fundamental role of the reference frames in the issue of positioning, navigation and orientation of the

	object in space. 2. Mathematical foundations of coordinate systems: metric coordinate system, the metric tensor, Christoffel's symbols, orthonormal coordinate base, coordinate axes, coordinate surfaces, singularities and others. Differential field operations expressed in a particular coordinate system (gradient, divergence, turbulence fields, Laplace operator, etc.). 3.The divisions of reference systems: physical principles of the coordinate system with respect to the Newtonian and relativistic theory. Cartesian coordinate system, ellipsoid coordinate system, a spherical coordinate system, the curved coordinate systems, natural (astronomical) coordinate system, the space-fixed reference systems, Earth-fixed reference systems, instrument (sensor) - fixed (local) reference systems. 4. Celestial Reference Systems (CRS): Horizontal coordinate system, Equatorial coordinate system, Ecliptic coordinate system, Galactic coordinate system, Super-galactic coordinate system. International Celestial Reference System (ICRS), the International Celestial Reference Framework (ICRF), time stability of ICRF's. 5. Mathematical-physical characteristics of the reference systems: with regard to the fundamental objects / parameters in respect of which it defines. Measurement techniques for defining reference systems (VLBI, SLR, LLR, DORIS, GNSS, FK, Hipparcos, etc.). 6.Earth Orientation:Earth Orientation Parameters (EOP), precession and nutation of the Earth's axis of rotation, daily rotation of the Earth, the motion of the pole due to the Earth's crust, the International Earth Rotation Service (IERS), IERS EOP parameters. 7. International Terrestrial Reference System (ITRS) and Frame (ITRF): The definition of the ITRS and ITRF, the measurement techniques to determine the ITRF, the Very Long Base Interferometry (VLBI) and HIPPARCOS satellite astrometric mission. 8. ITRF - continuation: the Doppler effect, Doppler Orbitography by Radiopositioning Integrated on Satellite (DORIS), International DORIS Service, Satellite Laser Ranging (SLR), International Laser Ranging Service (ILRS), ITRF realizations (ITRFYY), use of ITRFs. 9. European positional and height reference systems: the European positional and height datums, the European Terrestrial Reference System 1989 (ETRS89), ETRF's realizations (ETRFYY), European Vertical Reference Network (EUVN), the European internet portal of national coordinate reference systems. 10. Instrument (sensor) - fixed (local) systems: Local astronomical reference systems, local ellipsoidal reference systems, examples of implementation of the local reference frames when measuring with terrestrial instruments / sensors (total stations, GNSS antenna, ...), sensors on floating platforms (car, boat, plane, ...), sensors on satellites and others. 11. Height Systems: Ellipsoidal heights, geopotentialnumbers, othometric heights, dynamical heights, normal heights, normal orthometric heights, national height systems in Europe, height system datums, precise leveling (I and II. NVT) on Croatian territory, new height systems of the Republic of Croatia, United European Leveling Network (UELN). 12. Reference systems in Croatia: Old and new coordinate reference systems and frame in Croatia, old and new geodetic

	datums (positional and height), the coordinate transformation from the old projection reference system (HDKS01/GK) into the new projection reference system (HTRS96/TM) and the reverse transformation, the accuracy of the transformation. Exercises (to each proceeds auditoria exercise): <u>1. Transformation and conversion of three-dimensional Cartesian coordinates</u>: Mastering the process of transformation of Cartesian rectangular 3D coordinates between the reference coordinate frames and the conversion of 3D Cartesian coordinates in the 3D ellipsoidal coordinates: a) seven-parametric 3D Helmert's transformation: (X, Y, Z) → ITRF93 (X ', Y', Z ') ITRF89 b) conversion of coordinates: (X, Y, Z) → ITRF93 (ϕ, λ, h) ITRF93 <u>2. Conversion and transformation of geodetic (ellipsoidal) coordinates</u>:Mastering the conversion of 3D ellipsoidal coordinates in 3D Cartesian coordinates and transformation of ellipsoidal 3D coordinates in 3D ellipsoidal coordinates: a) conversion of 3D ellipsoidal in 3D Cartesian coordinates: (ϕ, λ, h) ETRF89 → (X, Y, Z) ETRF89 b) transformation of 3D ellipsoidal coordinates from the old to the new reference frame RH: (ϕ, λ, h) HDKS (Bessel 1841) → (X, Y, Z) → HDKS (X ', Y', Z ') ETRF89 → (ϕ', λ ', h') ETRF89 (GRS80) <u>3. Determination of three-dimensional Helmert's 7-parameters transformation</u>: Mastering the procedure of determining the parameters of the Helmert's 7-parametric 3D transformations. Based on the coordinates of identical points in the two reference frames is determined: Tx, Ty, Tz (translations), dα, dβ, dγ (rotations), dD (scale). 4. Transformations of coordinates with respect to time changes: Application of Helmert 7-parametric 3D transformation with the addition of temporal changes of coordinates between two geodetic reference frames. In the process of transformation are used: 7Helmert's transformation parameters (Tx, Ty, Tz, dD, dα, dβ, dγ), velocities of movement points (vx, vy, vz) and rotation matrix of geotectonic plate R: (X, Y, Z) ITRF92 (94.6) → (X ', Y', Z ') ETRF89 (89.0) Submit of all calculated task is through e-learning systems (LMS).

2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work	☐ independent assignments ☒ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:
2.8. Studentresponsibilities	- Attendance at least 70% of lectures and at least 70% of the hours of training (in accordance with the Regulation of Studies), - Orderly handover of all tasks exercises (implies submission and assessment of the program on time as evidence of individual performance computing).		

2.9. Screening student work *(name the proportion of ECTS credits for eachactivity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	1.0	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	2.0	Oral exam	1.0	(other)	
	Written exam	1.0	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	Preliminary exams (colloquia) during the semester (2): Colloquia are assessment covering the content of lectures and exercises. Points collected at colloquia allow the release of the written exam or the release of the examination. During the semester are held two regular colloquia. To qualify a student access to first or second colloquium must meet the following requirements: - To access the first colloquium student must "regularly" hand over first and second assignment of exercises that cover the topic of the first tests, - To access the second colloquium student must achieve a minimum of 34% (17) points from the first colloquium and "orderly" hand over the third and fourth task of exercises that cover the topic of the second colloquium. On each of the two preliminary exams can collect a maximum of 50 points, i.e. from both colloquium maximum of 100 points. Preliminary exams consist of five theoretical issues which bring a maximum of 60% of the total possible points and two numerical tasks that deliver a maximum of 40% of the total possible points in each colloquium. Total collected points at colloquia are valued as follows: - < 50 points - the obligation of take the written and oral part of the exam, - 50 - 61 points - score enough (2), the obligation to take the oral part of the exam,

<table>
<tr><td></td><td colspan="3">- 62 - 74 points - good (3), the release of the exam,
- 75 - 87 points - very good (4), the release of the exam,
- 88 - 100 points - an excellent score (5), the release of the exam.

Students who collect enough points for a good (3) or very good (4), and are not satisfied with their grade, may take the examination at the regular examination period. In this case, evaluation is based on the knowledge shown in this test. The collected points at colloquia are only valid for one taking the exam, which means that in case of a fall on the exam the student has the following term access written and oral exam when evaluated only knowledge expressed in this exam.

Exams (summer and autumn period):
Each exam consists of a written and an oral part. Written exam consists of seven theoretical questions that need answering comprehensive (more extensive) response and one calculation task. Any theoretical question is scored with 1 point, a correct solution calculation task with 3 points, so the total number of points a student can achieve the final examination is 10. Solving the exam a student can earn a direct entry of grades in courses according to the following scoring system:

5.0 - 6.1 points - sufficient (2)
6.2 - 7.4 points - good (3)
7.5 - 8.7 points - very good (4)
8.8 - 10 points - excellent (5)

A student who wishes to respond to a higher grade access to the oral exam, which generally corresponds to 3-5 questions. Rating oral examination shall be determined on the basis of correctness and completeness of answers to the questions. Overall rating is result of the written and oral examination with equal share (weight).</td></tr>
<tr><td rowspan="4">2.11. Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>Bašić, T., Hećimović Ž. (2014): Geodetic Reference Frames, ppt lectures in pdf format (updated yearly)</td><td></td><td>Moodle</td></tr>
<tr><td>Altamimi, Z.; X. Collilieux; L. Métivier (2012): Analysis and results of ITRF2008. IERS Technical Note. No. 37, Frankfurt am Main (http://www.iers.org)</td><td></td><td>web</td></tr>
<tr><td>Jekeli, Ch. (2012): Geometric Reference Systems in Geodesy, Ohio State University (pdf)</td><td>5 chair</td><td></td></tr>
</table>

	Fey, A.; D. Gordon; C.S. Jacobs (eds.) (2009): The Second Realization of the International Celestial Reference Frame by Very Long Baseline Interferometry. IERS IVS Working Group. IERS Technical Note, No. 35. Frankfurt am Main.		web
2.12. Optional literature (at the time of submission of study programme proposal)	Moritz, H., Hofmann-Wellenhof, B. (1993): Geometry, Relativity, Geodesy. Wichmann, Karlsruhe, Hofmann-Wellenhof, B., Lichtenegger, H. Collins, J. (2000): GPS Theory and Practice, 5th Revised Edition, Springer, Wien - New York. Neutsch, W. (1996): Coordinates. Walter de Gruyter. Soffel, M.,Langhans, R. (2013): Space-Time Reference Systems. Springer, Wien - New York. Jean Souchay and Martine Feissel-Vernier (eds.) (2008): The International Celestial Reference System and Frame. IERS Technical Notes, No. 34, http://www.iers.org/, European Reference Frame (EUREF), http:www.euref-iag.net.		
2.13. Quality assurance methods that ensure the acquisition of exit competences	The students are required on four occasions (when submitting assignments exercises) preliminary exam on each task in order to show that he was self-created. During the semester, students have the opportunity to access the two colloquia that check their monitoring and learning from lectures and performing obligations during the exercises. Successfully mastering both colloquium allows partial or complete exemption from the exam.		
2.14. Other (as the proposer wishes to add)	Students are expected to respect the principles of academic integrity which are regulated by the Code of Ethics of the University (www.unizg.hr).		

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Damir Medak Vlado Cetl	1.6. Year of the study programme	II.
1.2. Name of the course	Modeling of Geoinformation	1.7. Credits (ECTS)	5
1.3. Associate teachers	Mario Miler Dražen Odobašić Ela Vela-Bagić	1.8. Type of instruction (number of hours L + S + E + e-learning)	60 (30P-30V)
1.4. Study programme (undergraduate, graduate, integrated)	study of geodesy and geoinformatics, BSc	1.9. Expected enrolment in the course	80
1.5. Status of the course	mandatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	20
2. COUSE DESCRIPTION			
2.1. Course objectives	Students will acquire theoretical background and practical usage of geoinformation modeling according to contemporary international norms and standards		
2.2. Course enrolment requirements and entry competences required for the course	Accomplished the course „Programming“.		
2.3. Learning outcomes at the level of the programme to which the course contributes	Maintain topographic, cartographic, maritime and navigation, and land information systems, integrate and visualise spatial information. Use information technology in solving geodetic and geoinformation tasks. Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution. Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards.		
2.4. Learning outcomes expected at the level of the course (4 to 10 learning	enumerate parts and functions of a geoinformation system, recognize the need for modeling of geospatial information in contemporary GIS applications,		

outcomes)	create a conceptual model of a geoinformation system using ER and UML notation, explain geospatial data indexing methods, differentiate metric and topological operations on geospatial data, apply the operations of raster algebra for solving interdisciplinary tasks, analyze benefits and drawbacks of topological model, describe the universe of discourse using geospatial models, describe the purpose of normizations of geoinformation, enumerate normization iniciatives, apply appropriate norms and standards in modeling of geoinformation		
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Introduction to the course. Motivation for geoinformation modeling. Survey experiment: „where am I now?“. Concepts: geographic, spatial, geospatial. Ontology, modeling, geoinformation. geoinformation systems. Partitions of space. Fields. Raster model. Attribute types: nominal, ordinal, interval, ratio, cyclic. Raster operations: local, focal and zonal. Spatial access methods. Tree structures. R-tree. Geohash. Geospatial objects. Point, Polyline Polygon. Normization of geoinformation. OGC standards, ISO 19xxx set of norms. UML diagrams. Class diagram. Application of UML in normization. Object orientation in geoinformation modeling. Hierarchies. Generalization. Composition. TIN. Voronoi diagrams. Delaunays triangulation. Network model: nodes and links. 3D modeling. CityGMS. Levels of detail. Temporal dimension. Spatio-temporal models. Future of geoinformation model. Technological and social challenges.		
2.6. Format of instruction:	☐ lectures ☐ seminars and workshops ☐ exercises ☐ on line in entirety	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor	2.7. Comments:

	☒ partial e-learning ☐ field work		☐ (other)			
2.8. Student responsibilities						
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance		Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	2	Oral exam	1	(other)	
	Written exam	1	Project	1	(other)	
2.10. Grading and evaluating student work in class and at the final exam						

	Title	Number of copies in the library	Availability via other media
2.11. Required literature (available in the library and via other media)	Paul A. Longley Michael F. Goodchild David J. Maguire David W. Rhind (2010): Geographic Information Systems and Science, 3rd edition Wiley	10	
	Michael Worboys Matt Duckham (2004): GIS A Computing Perspective Second Edition. CRC PRESS	1	
	P A Burrough; Rachael McDonnell; Branislav Bajat; Dragan Blagojević (2006) Principi geografskih informacionih sistema, Građevinski fakultet Univerziteta u Beogradu	1	

2.12. Optional literature (at the time of submission of study programme proposal)	Anita Graser (2013): Learning QGIS 2.0. Böhner, J., McCloy, K.R., Strobl, J. (2006): SAGA - Analysis and Modelling Applications. Göttinger Geographische Abhandlungen, Vol.115 Böhner, J., Blaschke, T., Montanarella, L. (2008): SAGA – Seconds Out. Hamburger Beiträge zur Physischen Geographie und Landschaftsökologie, Vol.19 Open Geospatial Consortium norms and standards: www.opengis.org
2.13. Quality assurance methods that ensure the acquisition of exit competences	
2.14. Other (as the proposer wishes to	

add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Miodrag Roić	1.6. Year of the study programme	II.
1.2. Name of the course	Cadastre	1.7. Credits (ECTS)	5
1.3. Associate teachers	Mario Mađer Baldo Stančić	1.8. Type of instruction (number of hours L + S + E + e-learning)	75 (30L-45E)
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	90
1.5. Status of the course	Mandatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	e-learning level 2

2. COUSE DESCRIPTION	
2.1. Course objectives	Introduce students to the key registers of land / real estates and enable them to participate in their manufacture and maintenance.
2.2. Course enrolment requirements and entry competences required for the course	Passed course "Land Surveying" Inscribed course "Principles of Land Rigistry Law"
2.3. Learning outcomes at the level of the programme to which the course contributes	Knowledge and understanding • To be familiar with real restate registers and interests on them, to understand the measures of land development and the methods of land evaluation. • To know the regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy rights, publishing and exchange of spatial data. Application of knowledge and understanding • To produce geodetic documentation needed for registration in cadastral and land registers, and the documentation needed in engineering works. • To determine and interpret the size, properties and relations between objects in space on the basis of measured data, spatial databases, plans and maps. • To maintain topographic, cartographic, maritime navigation and land information systems, to integrate and visualize spatial information.

	Learning and ethical skills • To follow and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, as well as changes of regulations and standards.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	1. Distinguish relations between people and land and the concepts and content of: land administration, land management and land policy 2. Recognize the land features to be registered in the cadastre and recognize their boundaries and other borders 3. Collect data about the land and carry out the registration of those data in the Cadastre 4. Distinguish ways of registration of certain land features in the Cadastre and Land registry in accordance with regulations 5. Link registers of real estates (Cadastre) and interest on them (Land registry) and distinguish the role of surveyors and other experts 6. Distinguish the conceptual, logical and physical models which are applied in cadastral systems 7. Maintain the data registered in the Cadastre and Land registry in accordance with assigned authorisation 8. Apply acquired knowledge about the cadastre on the real estate market and during the preparation of spatial representations for sustainable development projects, urban planning and environmental protection projects
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Week 1: Introduction (learning outcomes, evaluation of students, literature, program of lectures, terms) Week 2: Land and interests (land and interests, terms about land, land administration, land policy) Week 3: Land / real estate registers (the need for a registers, structure, principles, content and purpose of the particular registers) Week 4: Historical overview of the development of land registers (cadastral periods, cadastres throughout history, today's cadastres) Week 5: Land cadastre and representation of the data (data models, data management, metadata) Week 6: Spatial basis (units of measurement, projection reference coordinate systems, development of the cadastre) Week 7: Cadastral survey - methods (overview of measurement methods throughout history, cadastral mapping, monumentation of cadastral parcels, determination of area) Week 8: Land valuation and public display of data (different approaches of land valuation, public display of data) Week 9: 1st preliminary exam Week 10: Maintenance of cadastral data (different approaches to the maintenance of cadastral data, implementation of changes, cadastral survey of field changes) Week 11: Production of geodetic documentation on the changes (types of geodetic documentation, content and purpose of the particular documentation, numeration of cadastral parcels when changes on the land occur) Week 12: Reconstruction of cadastral data (redrawing of cadastral map sheets, digitization of cadastral documentation, (re)construction of cadastral map, vectorization of cadastral map, georeferencing of cadastral map)

	Week 13: Responsibilities (land administration system factors, organization of cadastral activities, organization of the public authorities) Week 14: Spatial units (hierarchy of spatial units, types of spatial units, Register of spatial units) Week 15: 2nd preliminary exam				
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:		
2.8. Student responsibilities	Activities: • Task: Public insight into data • Project: Geodetic documentation on parcel division • Checking the self-development of project: Geodetic documentation on parcel division • Project: Other geodetic documentation • Checking the self-development of project: Other geodetic documentation • 2 preliminary exams • Attendance (lectures and exercises) • Written exam • Oral exam				

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	0,25	Research		Practical training	0,75
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests		Oral exam	2	(other)	
	Written exam	1	Project	1	(other)	

2.10. Grading and evaluating student work in class and at the final exam	Continuous monitoring and the possibility of the earlier passing of written exam. Attendance, projects, task and preliminary exams are evaluated. The final grade is achieved at the final oral exam.

2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Roić, M. (2012): Upravljanje zemljišnim informacijama - katastar, University of Zagreb,	10	

	Faculty of Geodesy, ISBN 978-953-6082-16-2, Zagreb.		
	Roić, M., Medić, V., Fanton, I., : Katastar zemljišta i zemljišna knjiga - skripta, Faculty of Geodesy, Zagreb 1999.		PDF
	Regulations on cadastre and real estates		http://www.nn.hr, ...

2.12. Optional literature (at the time of submission of study programme proposal)	• Roić, M.: Katastar - presentation slides, Faculty of Geodesy • Roić, M., Fjalestad, J. B., Steiwer, F. (2008): Regionalna studija o katastru/Regional Cadastral Study. State geodetic Administration, Zagreb • Dale, P., McLaughlin, J. (1999): Land Administration. Oxford University Press, Oxford • Larsson, G.: Land registration and cadastral systems, Longman Scientific Tehnical, London 1991 • Kaufman, J., Staudler, D. (1998): Cadastre 2014, FIG publication
2.13. Quality assurance methods that ensure the acquisition of exit competences	In accordance with the Quality Policy and Quality Manual provided by the University of Zagreb and the Quality Assurance System of the Faculty. Survey evaluation of the course and teachers. Self-evaluation of teachers.
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

<table>
<tr><td colspan="4">1. GENERAL INFORMATION</td></tr>
<tr><td>1.1. Course teacher</td><td>Miljenko Lapaine
Ivka Kljajić</td><td>1.6. Year of the study programme</td><td>2nd year, 4th semester</td></tr>
<tr><td>1.2. Name of the course</td><td>Geoinformation Manipulation</td><td>1.7. Credits (ECTS)</td><td>5</td></tr>
<tr><td>1.3. Associate teachers</td><td>Lili Gracin</td><td>1.8. Type of instruction (number of hours L + S + E + e-learning)</td><td>60 (30L + 15E)</td></tr>
<tr><td>1.4. Study programme (undergraduate, graduate, integrated)</td><td>Undergraduate</td><td>1.9. Expected enrolment in the course</td><td>50</td></tr>
<tr><td>1.5. Status of the course</td><td>Optional</td><td>1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)</td><td>2</td></tr>
<tr><td colspan="4">2. COUSE DESCRIPTION</td></tr>
<tr><td>2.1. Course objectives</td><td colspan="3">The objectives of this course are:
to provide students knowledge about different forms of geoinformation and possibilities of different ways of their input into computer's memory, about reference coordinate systems and transformations between them
to train students for interpretation and application of different functions to customize and edit geoinformation, for their analyzing and presentation of results, for insight into importance of quality, intellectual property and copyright of geoinformation
to continue development of knowledge and skills that students have acquired in the course Basics of Geoinformatics and to give wider insight into the issues that will processed more detailed in other courses</td></tr>
<tr><td>2.2. Course enrolment requirements and entry competences required for the course</td><td colspan="3"></td></tr>
<tr><td>2.3. Learning outcomes at the level of the programme to which the course contributes</td><td colspan="3">Knowledge and understanding
Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection.
Demonstrate competences in regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copyright, publishing and exchange of spatial data.
Applying knowledge and understanding
Make plans, maps and related presentations using modern methods and technologies on the basis of measured data</td></tr>
</table>

	and other sources. ○ Use information technology in solving geodetic and geoinformation tasks. **Making judgements** ○ Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution. **Learning and ethical skills** ○ Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	1. Define reference coordinate systems and implement data transformations between different coordinate systems or to common coordinate system 2. Define and explain various forms of input of geoinformation into a computer memory and choose most convenient way of geoinformation storage 3. Interpret and apply different functions for customize and editing geoinformation, and choose method of assigning attributes to geoinformation 4. Analyze selected geoinformation at various levels and present results in graphical form (map and/or report) 5. Explain importance of intellectual property and copyright and access to geoinformation 6. Define concept of data quality
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Week 1 Lectures: Course content and organization of teaching. Basic concepts and definitions. Overview of problems and needs of geoinformation users. Steps in geoinformation manipulation. Exercises: Introduction to software for geoinformation manipulation. Week 2 Lectures: Coordinate systems and georeferencing. Continuous georeferencing systems. Discrete georeferencing systems. Exercises: Define and assign (setting) of coordinate system for map projection. Georeferencing raster data. Week 3 Lectures: Entering and storing data. Organization of data storage. Functions for data entry. Importing existing digital data. Exercises: Collection and entry spatial and attribute data. Week 4 Lectures: Editing and adapting data. Functions for correcting and adapting of spatial data. General user functions. Editing and correcting of errors and omissions. Generalization and line smoothing. Exercises: Editing and correcting of spatial data. Week 5

	Lectures: Transformations to a common map projection. Transformations to a common coordinate system. Exercises: Simplification and smoothing of line objects. Week 6 Lectures: Customizing of map edges and neighboring areas. Creating topology. Editing attribute data. Exercises: Transformation of data from one coordinate system to another. Transformation of data from different sources in different coordinate systems into a common coordinate system of map projection. Week 7 Lectures: Analysis of geoinformation. Logic operations. General arithmetic operations. General statistical operations. Geometric operations. Exercises: Creating and editing topologies. Week 8 Lectures: Creating reports from attribute data. Searching data from maps. Complex operations with attribute data. Classification and reclassification. Exercises: Editing and correcting of attribute data. Week 9 Lectures: 1st preliminary exam. Exercises: Creating reports from attribute data. Searching data from maps. Creating thematic maps using classification and reclassification. Week 10 Lectures: Integrated processing of geometry and attributes. Overlay. Polygon overlay. Points in polygons. Lines in polygons. Exercises: Analysis of finding shortest path. Week 11 Lectures: Buffer zones. Raster data overlay. Procedures in integrated data analyses. Exercises: Analysis by overlying polygons. Week 12 Lectures: Presentation of geoinformation. Geoinformation access, standardization and copyright. Ownership and copyright. Cost recovery and pricing. Public or private organization of geoinformation. Geoinformation security. Exercises: Creating buffer zones around points, lines and polygons. Week 13 Lectures: Geoinformation quality. Selection criteria. Lineage. Accuracy. Positional accuracy. Attribute data accuracy. Exercises: Presenting results of analyses in the form of maps and reports.

	Week 14 Lectures: Logical consistency. Completeness. Timeliness of data. Accessibility. Probable sources of error. Exercises: Research of free access to geoinformation, respect of copyrights and rights to their use. Week 15 Lectures: 2nd preliminary exam. Exercises: Project submitions.					
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work		☒ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☒ consultations ☒ evaluations of knowledge		2.7. Comments:	
2.8. Student responsibilities	Conditions for signature are regular attendance to lectures and exercises (at least 70%) and submition of a project. Possibility of accession on preliminary exams and the possibility of consultations with teachers. Written and oral exam.					
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	0,8	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	1,2	Oral exam	1	(other)	
	Written exam	1	Project	1	(other)	
2.10. Grading and evaluating student work in class and at the final exam	Two evaluations of knowledge (preliminary exams) are planned during the semester. A student does not to take a written part of the exam if he/she obtained a minimum of 50% points at each preliminary exams. If a student does not collect enough points by preliminary exams, he/she is obliged to access written exam at regular exam terms. Exemption from the written exam is valid on the first or second regular exam terms in the current academic year. The final grade based on continuous evaluations of knowledge by preliminary exams is determined as the mean grades of two positive grades. Students who passed written exam by preliminary exams take only oral exam. Other students take written and oral exam. Condition for taking oral exam is 50% points achieved on written exam. The grade from preliminary exams and written exam is determined in the following way: Percentage – Grade 50–65% – sufficient (2) 66–80% – good (3) 81–90% – very good (4)					

	91–100% – excellent (5)		
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Lapaine, M.: Rukovanje geoinformacijama, internal script, Geodetski fakultet, Zagreb, 2006.		e-learning
	Kljajić, I.: Rukovanje geoinformacijama, lectures, Geodetski fakultet Sveučilišta u Zagrebu, 2009–2014.		e-learning
2.12. Optional literature (at the time of submission of study programme proposal)	Lapaine, M. (ur.): Elementi kvalitete prostornih podataka, urednici izvornika Elements of Spatial Data Quality S. C. Guptill i J. L. Morrison; preveli D. Tutić i M. Lapaine; Državna geodetska uprava RH, Zagreb, 2001. Bernhardsen, T.: Geographic Information Systems, An Introduction, 2nd edition, John Wiley & Sons, Inc., New York, 1999. Jones, Ch.: Geographical Information Systems and Computer Cartography, Prentice Hall, Harlow, England, 1997. Longley, P. A., Goodchild, M. F., Maguire, D. J., Rhind, D. W.: Geographic Information Systems and Science, 3rd edition, John Wiley & Sons, Inc., New York, 2010. Maguire, D. J., Goodchild, M. F., Rhind, D.: Geographical Information Systems, Vol. 1 and 2, Longman Scientific & Technical, New York, 1991.		
2.13. Quality assurance methods that ensure the acquisition of exit competences	Evidence of attendance to lectures and student activities. Evaluation of project tasks produced during exercises. Analysis of student success on oral and written exam. Student evaluation of teacher work.		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Nevio Rožić	1.6. Year of the study programme	2
1.2. Name of the course	Quality of Geoinformations	1.7. Credits (ECTS)	5
1.3. Associate teachers	Mariana Andrić	1.8. Type of instruction (number of hours L + S + E + e-learning)	60 (30 L + 30 S + 0 E + 0 e-learning)
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	10-30
1.5. Status of the course	obligatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	e-learning level 1

2. COUSE DESCRIPTION	
2.1. Course objectives	Adoption of theoretical knowledge and empirical skills of determination, valuation and presentation of geoinformation and geodata quality. Active empirical application of processes, procedures and methods of determination, valuation and presentation of geoinformation and geodata quality.
2.2. Course enrolment requirements and entry competences required for the course	Passed the subject "Basics of Geoinformatics"
2.3. Learning outcomes at the level of the programme to which the course contributes	<u>Knowledge and understanding</u> Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. Demonstrate competences in regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy right, publishing and exchange of spatial data. <u>Applying knowledge and understanding</u> Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of problems in the field of geodesy and geoinformatics. <u>Making judgements</u> Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. <u>Communication skills</u> Communicate the results obtained by means of geodesy and geoinformation to clients and experts of geodetic and other

	related professions Learning and ethical skills Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Define the general framework of international and national processes related to manufacturing quality of surveying products with a focus on the production of geospatial information and geodata; and taking into account the aspect of analogue and digital production technologies. Use appropriate technical terminology in the field of geoinformation and geodata quality in Croatian and English. Declare contemporary principles, concepts, methods and procedures for determining the quality and presentation of geoinformation and geodata quality. Explain the methodology, concepts and content of standardization processes in products production and products definition as a prerequisite for determining and presenting the quality of geoinformation and geodata. Compare the different types and ways of standards systematization and relations between the standards and specifications of geoinformation, geodata and geoinformation products. Systematize in accordance with ISO and Croatian standards quality components to describe the quality of geoinformation and geodata (numerical and descriptive), the quality elements of geoinformation and geodata, descriptors and measures of the quality of geoinformation and geodata. Systematize in accordance with ISO and Croatian standards methods of samples determining for the purpose of evaluating and labeling geoinformation and geodata quality (direct and indirect, non-automatic and automatic, internal and external). Develop a plan to evaluate the quality of geoinformation and geodata, including definition of processes, procedures and methods to evaluate the quality with the refinement of relevant numerical and descriptive elements of quality. Implement the evaluation of the geoinformation and geodata quality, and reporting on the outcome of quality determination using a standardized framework for reporting (report on quality, metadata). Describe the Croatian national geoinformation and geodata production system, the specifics of the system, national geoinformation products, data sets and Croatian national quality control system.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Lectures (15 weeks with two lecture hours per week) 1. Overview of the teaching process methodology and implementation, an overview of the course theoretical content, an overview to the teaching performance and evaluation standards. Operational details necessary for the teaching. 2. Introduction to the quality of geodata and geoinformation. 3. Methodological and technological basis for the creation and collection of geoinformation: yesterday, today and tomorrow. 4. Basic definitions of geodata, geoinformation and GIS, relationship and properties of analog and digital sets of geodata. 5. The fundamental concepts and methodologies for determining and evaluating of the geodata and geoinformation quality.

	6. Standardization of geodata and geodata production. National and internacional standards and their classification. 7. Principles and quality components for determining and assessing the quality of geodata and geoinformation. 8. Definition and classification of quality elements and sub-elements of geodata and geoinformation. 9. Geodata and geoinformation quality elements and sub-elements descriptors. 10. Procedures and processes for determining and evaluating the quality of geodata and geoinformation. 11. Direct and indirect methods of determining and evaluating the quality of geodata and geoinformation. Manual and automatic methods. 12. Principles and methods of sampling geodata in order to determine and evaluate the quality of geodata and geoinformation. 13. Measures of quality and their classification. Geodata and geoinformation specifications as a necessary basis for determining quality. The relationship between internal and external quality. 14. Croatian national model of geodata and geoinformation production, geodata national specifications and quality control system. 15. Review and analysis of the results of the teaching process. 15. Review and analysis of the results of the teaching process. Exercises (15 weeks, 2 excercise hours per week) 1. Overview of the teaching process methodology and implementation, an overview of the course exercises content, an overview to the teaching performance, evaluation standards and operational details necessary for the exercises. 2. Project no. 1: Analysis of the Law of State Survey and Real Estate Cadastre from the viewpoint of geodata and geoinformation and quality standards. 3. Project no. 2: Bylaw of topographic surveying and state maps production from the viewpoint of geodata and geoinformation and quality standards. 4. Project no. 3: Public and private sector in the production of geodata and geoinformation. 5. Project no. 4: Standardization of geodata, geoinformation and geodata products. 6. Project no. 5: Analysis of geodetic spatial reference systems from the viewpoint of absolute and relative positioning quality 7. Colloquium no. 1. 8. Project no. 6: Evaluation and presentation of geodata quality in accordance with the quality element "positional accuracy" and quality subelement "absolute accuracy". 9. Project no. 6: Evaluation and presentation of geodata quality in accordance with the quality element "positional accuracy" and quality subelement "absolute accuracy". 10. Project no. 7: Evaluation and presentation of geodata quality in accordance with the quality element "completeness" and quality subelement "omission".

DETAILED PROPOSAL OF THE STUDY PROGRAMME

	11. Project no. 8: Evaluation and presentation of geodata quality in accordance with the quality element "completeness" and quality subelement "comission". 12. Project no. 9: Evaluation and presentation of geodata quality in accordance with the quality element "thematic accuracy" and quality subelement "accuracy of classification". 13. Project no. 9: Evaluation and presentation of geodata quality in accordance with the quality element "thematic accuracy" and quality subelement "accuracy of classification". 14. Colloquium no. 2. 15. Review and analysis of the results of the exercises teaching process.

2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☐ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	**2.7. Comments:** Realization of teaching process presupposes continuous interaction of students with the course website, especially in the process of the project tasks solving.

2.8. Student responsibilities	Mandatory attendance at 70% of all lectures. Mandatory attendance at 70% of all exercises. Mandatory creation and delivery of nine projects.

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	1	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	1	Oral exam	1	(other)	
	Written exam	1	Project	1	(other)	

2.10. Grading and evaluating student work in class and at the final exam	<u>Colloquia</u> During the semester two colloquia are scheduled. The knowledge and skills are checked. Colloquium lasts 120 minutes. Each colloquium contains six empirical questions. Evaluation criteria: one question = one point, without penalty. The minimum number of points for a positive outcome of the colloquium is three and the maximum number of points is the sixth. All passed colloquia substitute a written component of final exam. <u>Final exam</u> Written exam contain six questions. The exam lasts 120 minutes. Evaluation criteria: one question = one point, without penalty. The minimum number of points for a positive outcome of the colloquium is three and the maximum number of points is the sixth. Written exam is eliminatory. The written exam is not mandatory in the case of all positive colloquia. The

	mean scores for all of the Colloquia is adopted as the appropriate number of points. Oral exam contain six questions. The exam lasts 30 minutes. Evaluation criteria: one question = one point, without penalty. The minimum number of points for a positive outcome of the exam is 3, the maximum number of points is sixth. The final grade is determined by the total number of points: 0, 1, 2, 3, 4, 5 points - poor, 6 points - enough, 7 and 8 points - good, 9 and 10 points - very good, 11 and 12 points - excellent.

2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Rožić, N.: Quality of Geoinformation. Faculty of Geodesy University of Zagreb, internal manuscript, Zagreb,2007.		yes
	Guptill, S. C., Morrison, J. L.: Elements of Spatial Data Quality. International Cartographic Association, ISBN 953-6972-00-3, Croatian translation, State Geodetic Administration, Zagreb, 2001.	1	
	Rožić, N. : Quality of Geoinformations. Faculty of Geodesy University of Zagreb, lectures in form of PPT presentations, Zagreb, 2007. (on Croatian)		yes
	Rožić, N.: Geoinformatics III. Faculty of Geodesy University of Zagreb, internal manuscript, Zagreb,1996.		yes

2.12. Optional literature (at the time of submission of study programme proposal)	Rožić, N.: Course internet site, www2.geof.unizg.hr/~nrozic/kvaliteta/. State Geodetic Administration: Official geodetic reference coordinate systems of the Republic of Croatia. Zagreb, 2004. (on Croatian) International organization for standardization: Geographic information - Quality evaluation procedures. Technical specification ISO/DIS 191114:2001(E). International organization for standardization: Geographic information - Quality principles. Technical specification ISO/FDIS 19113:2002(E). Republic of Croatia: Decision about official geodetic datums and cartographic projections of the Republic of Croatia. Official gazette, 110/2004. Republic of Croatia: Decision about official geodetic datums and cartographic projections of the Republic of Croatia. Official gazette, 110/2004. Republika Hrvatska: Correction of the decision about official geodetic datums and cartographic projections of the Republic of Croatia. Official gazette, 117/2004. Republic of Croatia: Law of state survey and real estate cadastre. Official gazette, 17/2007. Republic of Croatia: Law of geodetic activities. Official gazette, 152/2008.

	Republic of Croatia: Bylaw of topographic survey and state maps production. Official gazette, 109/2008. Republic of Croatia: Bylaw of fundamental geodetic works conducting. Official gazette, 87/2009.
2.13. Quality assurance methods that ensure the acquisition of exit competences	Recording of presence in the classroom during the teaching process. Check and recording the validity of making and delivery of all projects. Test the knowledge and skills on the two colloquia during the teaching process. Testing of knowledge on the final written and oral exam. Self-evaluation and students questioner.
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Miljenko Lapaine Dražen Tutić	1.6. Year of the study programme	2
1.2. Name of the course	Open Geoinformation	1.7. Credits (ECTS)	2
1.3. Associate teachers	Dražen Odobašić	1.8. Type of instruction (number of hours L + S + E + e-learning)	15L + 15E
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	30
1.5. Status of the course	Elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION			
2.1. Course objectives	The course gives insight into impact and importance of open geoinformation and open source software for geoinformation systems as two mainstream concepts of modern development of geoinformation science influenced by social networking. The course contents includes review of open spatial data and open technologies and introduces to participation in open spatial data and technology projects. Practical part of the course includes finding and basic work with open spatial data and technologies and participation in projects of collecting free spatial data.		
2.2. Course enrolment requirements and entry competences required for the course	No requirements.		
2.3. Learning outcomes at the level of the programme to which the course contributes	Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Demonstrate competences in regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy right, publishing and exchange of spatial data. Communicate the results obtained by means of geodesy and geoinformation to clients and experts of geodetic and other related professions. Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services		

	based on the position, and the changes in regulations, norms and standards.		
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Describe licences for open and free spatial data and software. Identify and discuss advantages and disadvantages of open geoinformation for modern society. Estimate quality and applications of open geoinformation datasets and software. Participate in projects for collecting open geoinformation and developing geoinformation software. Find and plan usage or application of open geoinformation and software.		
2.5. Course content broken down in detail by weekly class schedule (syllabus)	1. Motivation and aims of establishing open geoinformation projects. Open geoinformation by society, companies and clearing houses. 2. Licences and copyright of open geoinformation and software. Main sources of open geoinformation. 3. Formats and services for distribution of open geoinformation. 4. OsGEO – Open Source Geospatial Foundation - mission, projects and services. 5. GeoForAll – Network of open geospatial labs – mission and role. 6. OGC – Open Geospatial Consortium – mission, role and standards. 7. OpenStreetMap – Free Wiki Map of the World 8. OpenStreetMap – participation in creating new map content 9. Open education for geoinformation. Mass Open Online Courses. 10. Publishing in Open Access 11. Services based on open geoinformation. 12. Creating new services based on open geoinformation. 13. Role of spatial data infrastructures for open access to geoinformation. 14. Roles of open geoinformation in society. Open geoinformation in crises management. 15.Preliminary exam.		
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☐ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:

2.8. Student responsibilities						
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	1	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests		Oral exam		(other)	
	Written exam	1	Project		(other)	
2.10. Grading and evaluating student work in class and at the final exam	One preliminary exam at the end of semester will be given. It includes written part to evaluate knowledge and practical exam to evaluate skills. Preliminary exam is not obligatory. Grade from preliminary exam counts for final exam. Regular exam has the same structure as preliminary exam and includes written and practical part.					

2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	ELOGeo – E-learning for the Open Geospatial Community – Repository		online
	Open Geospatial Consortium - Standards		online
	OpenStreetMap – Free Wiki Map of the World		online
	FreeGis project		online
	Lecture notes on e-learning		online

2.12. Optional literature (at the time of submission of study programme proposal)	
2.13. Quality assurance methods that ensure the acquisition of exit competences	In accordance with the Quality Policy and Quality Manual provided by the University of Zagreb and the Quality Assurance System of the Faculty. Survey evaluation of the course and teachers. Self-evaluation of teachers.
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Gorana Novaković	1.6. Year of the study programme	3.
1.2. Name of the course	Engineering geodetic control	1.7. Credits (ECTS)	5,0
1.3. Associate teachers	Ante Marendić Igor Grgac	1.8. Type of instruction (number of hours L + S + E + e-learning)	60 (30L+30E)
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	85
1.5. Status of the course	Mandatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	level 2

2. COUSE DESCRIPTION	
2.1. Course objectives	Adopting theoretical and practical knowledge related to the establishment and analysis of the quality of geodetic control for engineering work.
2.2. Course enrolment requirements and entry competences required for the course	Completed course „Analysis and processing of geodetic measurements“
2.3. Learning outcomes at the level of the programme to which the course contributes	**Knowledge and understanding** • Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. **Applying knowledge and understanding** • Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of problems in the field of geodesy and geoinformatics. • Establish geodetic networks needed in surveying and stake out in order to provide the required quality of the works performed in certain space. **Making judgements** • Exercise appropriate judgments on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results.

	Communication skills • Prepare official public documents, reports, graphic and cartographic presentations using the surveying results related to the objects in space. • Communicate the results obtained by means of geodesy and geoinformation to clients and experts of geodetic and other related professions. **Learning and ethical skills** • Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	• Define geodetic works in the design, construction and exploitation of construction objects • Select geodetic maps and plans for technical projects and analyze their accuracy • Define geodetic network - geometric and algebraic definition • Distinguish geodetic control for surveying and geodetic control for engineering tasks • Define the phases of the establishment of geodetic network (project design, execution, analysis) • Compare different terrestrial methods for surveying the engineering geodetic control • Identify and analyze the quality (accuracy) of geodetic control and its elements • Make a specific connection of engineering geodetic control to existing geodetic control.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	**Lectures** 1. The organization and content of the course. Application of geodesy in engineering tasks. Project planning and project. 2. Preliminary design. The main design. Detailed design. Geodetic works in the designing, construction and exploitation of constructions. Geodetic survey project. 3. Geodetic maps and plans for projecting. Types of geodetic maps and plans for different phases of surveying projects. The accuracy of geodetic maps and plans in horizontal and vertical means. 4. Geodetic control for the design and staking out. The network of points. The network of lines. General and specific characteristics of the networks for staking out. 5. Geometric and algebraic definition of geodetic network. Types and methods of surveying engineering geodetic control. 6. Phases of establishing the geodetic network. Horizontal networks. The project of the networks - design of the network and measuring plan. Types of geodetic networks for determination the displacements and deformations. Establishment of the network in the field.

7. Quality analysis of the geodetic network. Precision and reliability. Microtringulation networks. Accuracy analysis of the triangulation network. Methods of surveying.
8. The uncertainty of the measurement of angles in triangulation network. Estimation of the measured angles precision. Uncertainty of other elements in the network. Trilateration network. The uncertainty of the electro-optical distance measurements. The combined network.
9. Adjustment of geodetic network. Rigorous adjustment method. Estimation of the positional accuracy of the points and the measured values, after adjustment.
10. Traverse networks. Project of traverses. Traverse with respect to the connection. Estimation of the precision of angular and linear measurements in the traverses.
11. Impact of measurement uncertainty on individual elements of the traverse - the azimuth and coordinates of traverse points. Adjustment of traverses and polygon networks.
12. Network of points determined by the section of the arches. Determination of the approximate coordinates of the point. The network of lines for staking out.
13. Vertical control on the construction site. Project of levelling network. Types of benchmarks on the site. Uncertainty of the measurement of height differences by different methods.
14. Adjustment of levelling networks. The calculation of accuracy in levelling network.
15. Spatial (3D) networks. The basics of satellite positioning. The application for the establishment of engineering geodetic control. Technical report of the project.

Exercises

Auditory, field and projecting exercises.

<u>Field exercises</u>: the establishment of precise traverse, where the initial direction is determined by connection to the several existing geodetic points.

<u>Projecting exercises</u>:
1. Adjustment of traverse (established in the field) and accuracy estimation
2. Adjustment of levelling network and accuracy estimation.

2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises	☐ independent assignments ☐ multimedia and the internet ☐ laboratory	2.7. Comments:

	☐ on line in entirety ☒ partial e-learning ☒ field work		☐ work with mentor ☒ team tasks			
2.8. Student responsibilities	• presence at lectures 20/30 • presence at exercises 24/30 • preparation and delivery of two project tasks • passed the written exam or two preliminary written exams • passed the oral exam					
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	1,5	Research		Practical training	
	Experimental work		Report		Independent work and learning	1,0
	Essay		Seminar essay		(other)	
	Tests		Oral exam	1,5	(other)	
	Written exam	1,0	Project		(other)	
2.10. Grading and evaluating student work in class and at the final exam	To obtain the signature students must submit two project tasks. - Accession to two preliminary written exams in which students solve one computational task and respond to five theoretical questions. To pass the preliminary exam it is necessary to solve computational task and respond to at least one theoretical question. Computational task brings 50 points and each theoretical question 10 points. - **Written**: the students may be released of written part of the exam if they passed both two preliminary exams. If the students do not passed preliminary exams, they are required to take the written exam, in regular examination periods. In the written part of the exam a student solve two computational tasks and responds to five theoretical questions. To pass the written part of the exam it is necessary to solve both computational tasks and respond to at least one theoretical question. Computational tasks bring 50 points and each theoretical question 10 points. - **Oral**: theoretical knowledge is tested on regular examination periods. All students are required to take the oral examination. The final grade consists of the success of the activities: • two preliminary exams or written part of exam 40%					

<table>
<tr><td></td><td colspan="3">• oral exam 60%.

Grade of preliminary exam or written part of the exam, shall be determined as follows:
60 - 70 points: sufficient (2)
71 - 80 points: good (3)
81 - 90 points: very good (4)
91 - 100 points: excellent (5)</td></tr>
<tr><td rowspan="4">2.11. Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>Janković, M.: Inženjerska geodezija I. Tehnička knjiga, Zagreb, 1982.</td><td>34</td><td></td></tr>
<tr><td>Novaković, G.: Inženjerska geodetska osnova</td><td></td><td>On-line at e-learning</td></tr>
<tr><td>Novaković, G.: PPT lectures presentation</td><td></td><td>On-line at e-learning</td></tr>
<tr><td>2.12. Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">Novaković, G. (2006): Geodetske mreže posebnih namjena, Fakultetska skripta, Geodetski fakultet Sveučiliašta u Zagrebu
Uren, J., Price, W. F.: Surveying for Engineers. MacMillan Press Ltd, London, 1992.
Ghilani, C. D., Wolf, P. R., (1997): Adjustment computations - Statistics and least squares in surveying and GIS, John Wiley & Sons, New York.
Möser, M: Handbuch Ingenieurgeodäsie Grundlagen, Herbert Wichmann Verlag, Hüthig GmbH, Heidelberg, 2000.</td></tr>
<tr><td>2.13. Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">Quality assurance will be based on:
• preparation of two projects
• two preliminary exams or written exam
• oral exam.</td></tr>
<tr><td>2.14. Other (as the proposer wishes to add)</td><td colspan="3"></td></tr>
</table>

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Željko Bačić	1.6. Year of the study programme	III.
1.2. Name of the course	Satellite positionig	1.7. Credits (ECTS)	5
1.3. Associate teachers	Danijel Šugar Marijan Grgić Matej Varga	1.8. Type of instruction (number of hours L + S + E + e-learning)	60 (30P-30V)
1.4. Study programme (undergraduate, graduate, integrated)	Aforegraduate study	1.9. Expected enrolment in the course	85
1.5. Status of the course	Obligtory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	e-učenje razine 2

2. COUSE DESCRIPTION	
2.1. Course objectives	Adopting the theoretical and practical knowledge about Global Navigation Satellite Systems and their implementation in navigation and positioning with special emphasys on geodetic applications.
2.2. Course enrolment requirements and entry competences required for the course	Passed course „Analysis and processing of geodetic measurements“ Passed course „Geodetic reference frame“
2.3. Learning outcomes at the level of the programme to which the course contributes	**Knowledge and understanding** Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. **Applying knowledge and understanding** Handle geodetic instruments and appropriate measuring equipment properly, and perform geodetic measurements. Establish geodetic networks needed in surveying and stakeout in order to provide the required quality of the works performed in certain space. **Making judgements** Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. **Communication skills** Prepare official public documents, reports, graphic and cartographic presentations using the surveying results related to

	objects in space. **Learning and ethical skills** Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will: - overmaster the concepts of satellite positioning and their implementation in Global Navigation Satellite Systems (GNSS), - explaine satellite orbit and Keplerian as well as Newtonian laws, - describe satellite positioning systems, structure, types and propagation of GNSS signals as well as error sources, - distinct code and phase measurements and know different mathematical models used for apsolute and relative positioning, - overwhelm usage and plan, prepare and execute static and kinematic measurement with GNSS receivers, - compute and analyse GNSS measurements (base vectors), adjust the network and deliver technical report for the project in accordance to existing rules.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	<u>Course content</u> (in two-hour lectures): 0. <u>Course organization</u> – presentation of teachers, course content, literature, course timetable, usage of e-learning, obligations and right of students, the ways of reviewing the knowledge, rules of behaviour and course statitstics in previous years. 1. <u>Introduction to satellite positioning</u> – concept, historical overview, satellite positioning systems in the past, present Global Navigation Satellite Systems (GNSS) (skort overview), fundamental equation of satellite positioning, advantages and limitations of satellite positioning systems. 2. <u>Reference systems</u> – fundamental equaiton of distance determination, coordinate systems (temeljna jednadžba određivanja udaljenosti, koordinatni sustavi (celestial and terrestrial), reference vectors motion, transformations between the systems, time scales, calender, GPS datum. 3. <u>Satellite orbits</u> – orbit determination accuracy influence on positioning accuracy, undisturbed satellite orbits, Kepler laws, Newton laws of motion, disturbed satellite orbits and disturbing accelerations, satellite tracking systems and orbit determination, parameters (ephemeries) for orbit path and satellite position computation. 4. <u>Atmosphere and satellite signal propagation</u> – atmosphere structure, electromagnetic signals and their propagation through the atmosphere, phase and group velocity, ionospheric refraction, total electron content (TEC) and elimitation of TEC effect, tropospheric refraction, multipath, shift and variation of antenna phase center. 5. <u>Global positioning system (GPS)</u> – definition, history of GPS, segments, space segment, satellite categories and

	characteristics, satellite signal, control segment, restrictions of accuracy and access, user segment, receivers, user services. 6. Other GNSS systems – Russian GLONASS system (configuration, satellites, signals, segments, services, status), European Galileo system (foreseen configuration, services, status), Chinese Beidou 2 system (configuration, services, status), Indian IRNSS system (configuration, services, status) and Japanese QZSS system (configuration, services, status). 7. GPS signals and observables – oscilators, signal components, PRN codes and their characteristics, signal processing, GPS receiver antennas, signal processing techniques, observables: code ranges, phase ranges, observable acquistion. 8. Biases and noise, data combinations, mathematical models – observation biases and noises, its sources and characteristics, Standard Positioning Sevice, biases and noises character. Data combinations: linear phase combinations, phase and code pseudoranges combinations. Mathematical models: point positioning, diferential positioning, relative positioning . 9. Relative positioning and GPS measurement – phase differences: single-, double- and triple-differences, phase differences correlation. Static and kinematic relative positioning, initialization of kinematic measurement. Measurement techniques, parameters, single point positioning, differential GPS, relative positioning: static, fast static, kinematic, pseudokinematic, real-time kinematic. 10. Planning and execution of GNSS measurement – network design, observation window definition, sesion definition, field reconnaissance, organizational design. Surveying procedure: equipment calibration, observation, controls. Regulations prescribing usage of GNSS for surveying measurement. 11. GNSS data processing I – data transfer, cycle slip detection and repair, software packages for GNSS measurements, baseline adjustement, static measurement computation, kinematic measurement computation, measurement computation quaility control, vector processing optimization. 12. GNSS data processing II – software packages for GNSS network adjstement, correlation and choosing vectors, GNSS network adjustement, quality control, technical report, content of technical report, regulations. 13. Permanent GNSS networks, augmented GNSS, services – permanent GNSS network concepts, their development and characteristics, services provided, Croatian permanent GNSS network CROPOS, overview of augmented GNSS systems, their purpose and characteristics, GNSS services, GNSS publications. Exercise (according to tasks inside of practical proejct): 1. task– preparation, execution and computation of static measurement (12 hours) – becoming familiar with the equipment, fieldwork planning, preparation of equipment, surveying with GNSS, becoming familiar with the software package, data dowload, creating project, baseline computation, interpretation of results and drafting first part of tehnical report. 2. task - preparation, execution and computation of kinematic measurement (8 hours) – fieldwork plannin, preparation of equipment, surveying with GNSS, data downlaoda, creating project, baseline computation, interpretation of results and drafting second part of tehnical report. 3. task – preparation and adjustement of measured GNSS network (8 hours) – project preparation, network configuration

<table>
<tr><td></td><td colspan="8">(elimination og correlated measurements), adjustement with elimination of gross errors, interpretation of results and drafting third part of tehnical report.</td></tr>
<tr><td>2.6. Format of instruction:</td><td colspan="2">☒ lectures
☐ seminars and workshops
☐ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ team work</td><td colspan="3">2.7. Comments:

6 out of 30 hours of excersises is conducted outdoor (field excersises – GNSS equipment measurement)</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="8">Obligatory presence on 70% of lectures.
Obligatory presence on 70% of exercise.
Obligatory delivery and successfull prelimiray exam when delivering 3 project tasks.</td></tr>
<tr><td rowspan="5">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>1,5</td><td>Research</td><td></td><td colspan="2">Practical training</td><td colspan="2"></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td colspan="2">(other)</td><td colspan="2"></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td colspan="2">(other)</td><td colspan="2"></td></tr>
<tr><td>Tests</td><td>1,0</td><td>Oral exam</td><td>1,5</td><td colspan="2">(other)</td><td colspan="2"></td></tr>
<tr><td>Written exam</td><td>1,0</td><td>Project</td><td></td><td colspan="2">(other)</td><td colspan="2"></td></tr>
</table>

2.10. Grading and evaluating student work in class and at the final exam	Colloquiums during the semester: - 3 colloquiums, - each colloquium consist of 5 theoretical or simple problem questionsa on which a short answer (in size of one paragraph) is required, - colloquium takes 20 minutes, - grading: – for correct answer 5 points, – maksimal number of points per colloquium = 25 – total number of points = 75 - to pass the colloquium 13 points have to be captivated, - passing the previous colloquium is requirement to attend next one, - passing all 3 colloquiums grants exemption of writen part of final exam and dependent on amount of achieved points: – 39 – 48 points – note <u>Below Average (2),</u> exemption of writen part of final exam in winter exame term, – 49 – 58 points – note <u>Average (3)</u>, exemption of writen part of final exam in winter exame term, – 59 – 68 points – note <u>Good (4)</u>, exemption of writen part of final exam in winter and summer exame term, – 69 – 75 points – note <u>Excellent (5)</u>, exemption of writen part of final exam in winter and summer exame term. Writen part of final exam: - consists out of 6 question on which extended answer is required, - correct answer is noted with 1 point (maximu of 6 points for writen exam) with gradation in noting on one tenth of point, - to pass writen part of exam it is necessear y to achieve 4 points, - notes on writen part of exam are determined as follows: 4,0 – 4,5 points: Below Average (2) 4,6 – 5,0 points: Average (3) 5,1 – 5,5 points: Good (4) 5,6 – 6,0 points: Excellent (5) Oral part of final exam: - all students are obliged to apporach oral part of exam, - students have to answer on 3 – 5 questions, - the note of oral part of exam is determined by the teacher in accordance to correctnes and completeness of answers on given questions.

<table>
<tr><td></td><td colspan="3">Final note is formed from notes achived on writen and oral part of exam to which each part contributes 50%.</td></tr>
<tr><td rowspan="7">2.11. Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>Bilajbegović, Lichtenegger, Hofmann-Wellenhof (1991). Osnovni geodetski radovi – suvremene metode – GPS, Tehnička knjiga Zagreb</td><td>8</td><td></td></tr>
<tr><td>Hofmann-Wellenhof, Lichtenegger, Collins: Global Positioning System, Theory and Application. Springer Verlag Wien, New York, 2001.</td><td>1</td><td></td></tr>
<tr><td>Bačić (2014): lectures in form of PPT presentatios</td><td></td><td>On line e-learning</td></tr>
<tr><td>Bačić, Bašić (1997): Satelitska geodezija II, Faculty of Geodesy, internal script</td><td></td><td>On line e-learning</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>2.12. Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">Web-page of Chair for Satellite Geodesy at the Faculty of Geodesy www.satgeo.geof.hr,
Space Journal – e-newsletter of Chair for Satellite Geodesy (published in average bi-weekly),
Web-page of Internationa GNSS service – IGS www.igscb.jpl.nasa.gov i
Web-page of European GNSS Agency – GSA) www.gsa.europa.eu .</td></tr>
<tr><td>2.13. Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">Periodical testing of adopted theoretical knowledge – 3 colloquiums.
Periodical testing of adopted practical knowledge – passing 3 excersises while submiting them.
Attending writen and oral part of final exam.
Selfevaluation of teachers and by filling the writen questionaire by students.</td></tr>
<tr><td>2.14. Other (as the proposer wishes to add)</td><td colspan="3">For execution of excersise special measurement ecquipment is used: dual frequency GNSS receiverss (6) and software packages for computation of GNSS measurements as well as computers computer rooms (15 computers). Excesises are conducted on the High-school playgorund and streets and squares arround the Faculty of geodesy building in realistic field conditions what recquires attention of stuents executing the excersise.</td></tr>
</table>

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Dubravko Gajski	1.6. Year of the study programme	2.
1.2. Name of the course	Remote Sensing	1.7. Credits (ECTS)	5
1.3. Associate teachers	Andrija Krtalic	1.8. Type of instruction (number of hours L + S + E + e-learning)	30+15+0+0 (2+1+0+0)
1.4. Study programme (undergraduate, graduate, integrated)	Graduate Studies	1.9. Expected enrolment in the course	80 - 90
1.5. Status of the course	mandatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	Students through lectures acquire knowledge about the following topics: Overview and definition of remote sensing. Features of the physical fields that are used in remote sensing. Sensors and systems for recording, the impact of platforms and environments. Usable characteristics of sensors. Electro - optical digital matrix cameras, line scanner, thermal cameras, multi-spectral cameras, hyperspectral scanner. Spatial resolution, modulation transfer function, the minimum discriminable contrast, the minimum resolved temperature difference, calibration. Synthetic aperture radar, interferometric and polarimetric mode, usable features. Improving of images. Enhencement, ranking and reduce the amount of features. The method of principal components. Unsupervised classification. Supervised classification. Evaluation of the classification results. Registration and geocoding. Joining of images. Using of softwers for remote sensing in geoscience. Analysis and evaluation of interpretation results. Confusion matrix. Students through practical work on exercies neet to acquire proficiency in the following skills: Using of softwer tools (TNTlite, ImageJ, MiltiSpec) for remote sensing. Improving the images. Geometric transformations, joining of images, geocoding. Feature enhencement. Segmentation. Transformation of images in principal components (PCA). Unsupervised and supervised classification. Interpretation of multispectral images (visible, infrared, thermal). Interpretation of hyperspectral and radar images.
2.2. Course enrolment requirements and entry competences required for the course	-
2.3. Learning outcomes at the level of the programme to which the course	**Professional knowledge, abilities and skills** *Knowledge and understanding of:*

contributes	The research process in geography. Theoretical basis of remote sensing in regional and spatial planning, characteristic of remote sensing, principles, methods and technology of data acquiring and interpretation of images. Softwer tools for remote sensing. **Cognitive, practical and generic abilities and skills:** Applying knowledge in determining, defining and solving spatial problems of high complexity. The skills needed for evaluation, interpretation and synthesis of relevant information. The skills needed for presenting scientific contents and stances in written and oral form. Applying mapping of geografical contents, georeferencing. Applying corrresponding maps and cartografical methods in analysis and presentation of the results. Applying corrresponding skills needed for acquiring and interpretation of creation conclusions which include relevant socially, scientific and etical theme. Problem solving related to qualitative and quantitative geographic information. Information-technology skills. Functioning effectively as an individual and as a team member. Autonomous continuous professional improvement needed in professional development. Appying skills of learning needed for entire-llife education.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- know and distinguish the features of physical fields which were base of remote sensing, characteristics of remote sensing features in different wavelength regions (multi-spectral, radar, hyperspectral, thermal), principles, methods and technology of the recording, interpretations - apply knowledge and understanding of the scene based on multisensor recordings, data processing and interpretation by addressing selected problems within the independent assignments in the remote sensing - applying initial skills for interpretation of multisensor, multispectral and hyperspectral images - independently drawing the conclusions about the quality and reliability of interpretation - publicly present selected problem and its solution through the example from remote sensing - identify areas, methods and techniques where necessary lifelong learning - used independently one of leading software tool for remote sensing
2.5. Course content broken down in detail by weekly class schedule (syllabus)	**LECTURES** 1. Introdaction, review and definitions. 2. Features of physical fields which are using in remote sensing. 3. Sensors and systems for aerial image aquisition, impact of platform and environment, effectiveness. Electro - optical digital

	sensors, line scanners, matrix CCD cameras, thermal cameras, multi-spectral cameras, hyperspectral scanner; usable features. 4. Spatial resolution, modulation transfer function, the minimum discriminable contrast, the minimum resolved temperature difference, calibration. Synthetic aperture radar, interferometric and polarimetric mode, usable features. 5. Interpretation techniques in remote sensing. 6. Subjective interpretation, characteristics and limitations. 7. Interactive interpretation with partially automated functions. 8. Improving of images. Enhencement, ranking and reduce the amount of features. 9. Method of principal components 10. Segmentation. 11. Automatic classification. Supervised classification. 12. Registration and geocoding. 13. Joining of images. 14. Using software tools for remote sensing. 15. Presentation of independent assignments. **EXERCISES** 1. Digital multispectral camera, thermovision camera, hyperspectral scanner. 2. Softwer tools for remote sensing. 3. Improving of images. 4. Geometric transformation, joining of images, geocoding. 5. Feature enhencement. 6. Segmentation. 7. Transformation of images in principal components (PCA). 8. Unsupervised and supervised classification. 9. Interpretation of multispectral images (visible, infrared, thermal). 10. Interpretation of hyperspectral and radar images.		
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☐ partial e-learning ☐ field work	☒ independent assignments ☒ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments: Lectures are interactive and combined with exercises that are purely computational, working with digital images. Independent assignments are made on the basis of the obtained

						individual practical tasks.	
2.8. Student responsibilities							
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	0.2	Research		Practical training	0.15	
	Experimental work		Report		(other)		
	Essay		Seminar essay	0.35	(other)		
	Tests	0.3	Oral exam	3	(other)		
	Written exam	1	Project		(other)		
2.10. Grading and evaluating student work in class and at the final exam	- Systematic monitoring the presence and active participation in all the activities during the semester. - Oral examination when submitting the results of exercises (mandatory). - Oral examination when submitting the results of independent assignments (mandatory). - Problem-solving at the colloquia by writing (optional, not mandatory). - Problem-solving on the written part of the exam (mandatory, if a student has not passed the colloquia). - Oral examination (mandatory).						
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**				
	1. Krtalic, A: Remote sensing, lectures - presentations		e-learning				
2.12. Optional literature (at the time of submission of study programme proposal)	1. Tutorial: Fundamentals of Remote Sensing (http://www.nrcan.gc.ca/earth-sciences/geography-boundary/remote-sensing/fundamentals/1430) 2. Oluić, M. 2001: Snimanje i istraživanje Zemlje iz svemira, sateliti, senzori, primjena, HAZU i GEOSAT (in croatian), Zagreb 3. Lillesand, T.M., Kiefer, R.W. 1994: Remote sensing and image interpetation, 3.ed, John Wiley and Sons, New York						
2.13. Quality assurance methods that ensure the acquisition of exit competences	The procedures mentioned in the Rules and the Manual of Quality Management at the University of Zagreb and the Faculty of Science: - University's and faculty's student polls - Self-evaluation of teaching: updating and revising the objectives and subject content and teaching and learning strategies, assessment of learning outcomes by analysis of students efficacy on the basis of data from Student Administration Office. - Exit polls for graduates - Interviews with companies, institutes and institutions in which students perform internships.						
2.14. Other (as the proposer wishes to add)							

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Siniša Mastelić Ivić	1.6. Year of the study programme	II.
1.2. Name of the course	Land Management	1.7. Credits (ECTS)	5
1.3. Associate teachers	Hrvoje Tomić	1.8. Type of instruction (number of hours L + S + E + e-learning)	60 (30L + 30E)
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	90
1.5. Status of the course	mandatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	e-learning, level 2
2. COUSE DESCRIPTION			
2.1. Course objectives	To introduce students to: The global framework of land management as a resource. Spatial management as combination of valuation, market demand and availability of space. Spatial support Information system for management of natural resources in project planning and monitoring the impact. Technical procedures that affect the change of the situation in space, especially agricultural and construction. The geospatial data as the basis of physical planning. Rural and urban development and physical planning legislation as the influence on the projects in the area. The basic principles of sustainable development through forms of land use. Various methods of physical planning documents implementation.		
2.2. Course enrolment requirements and entry competences required for the course	Passed course exams: Cadastre Land Book / Real estate law		
2.3. Learning outcomes at the level of the programme to which the course contributes	Determine and interpret the size, properties and relations of objects in space on the basis of measured data, spatial databases, plans and maps. Demonstrate competences in regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy right, publishing and exchange of spatial data. Demonstrate competences in real estate registers and interests in real estates, understand land development measures and		

	methods of land evaluation. Solve practical tasks in surveying, spatial data collection, real estate evaluation and management. Prepare geodetic documents needed to establish and maintain cadastral records and land registry, as well as the documents for engineering works. Maintain topographic, cartographic, maritime and navigation, and land information systems, integrate and visualise spatial information.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	The students will be able to: Prepare geospatial data as the basis of geomarketing for land management, to support the preparation of development strategy. Assess the values of agricultural land, classify land in the individual cultures on the basis of fertility, developmental stage, texture, geological origin and degree of humidity. Assess the values of urban space with different types of values of the space, assess the main social, economic, environmental, and political influences on the value. Implement the estimated value in the information system for the spatial presentation of the space values – value maps. Distinguish the principles of Land Policy and realization of physical planning, and the role of monitoring and control. Conduct geodetic technical measures land regulation: land consolidation, readjustment, urban land consolidation, expropriation and allotment, as consolidation method in the two opposed concepts (static and dynamic) care of space. To analyse the characteristics of the water catchment area for the implementation of geodetic and technical measures land development. Distinguish the hierarchy of organizing spatial planning, the purpose of public planning, planning methods and legal status.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	The concept the land and the importance of its role in society and the dynamics of civilization and the land. Different perspectives and perceptions of land, rights, responsibilities and obligations on the land. Relationship development of civilization and the land. L6 Spatial data as the basis of geomarketing analysis as support the creation of strategic development plan. Hierarchical approach to organizing spatial planning, the purpose of public planning, planning methods, levels of planning and legal status of planning. Creating vector spatial data using web services. L2, E6 Estimating the value of agricultural land by land classification of individual cultures in fertility classes based on developmental

<table>
<tr><td></td><td colspan="3">stage, texture, geological origin and degree of humidity. The implementation of the information system for spatial presentation of fertility classes. L4

Assess the values of urban space with different types of values of the space, assess the main social, economic, environmental, and political influences on the value. Implement the estimated value in the information system for the spatial presentation of the space values – value maps. L4

Modelling of vector spatial data and the establishment of GIS for spatial analysis using GIS desktop applications. E14

The implementation of spatial plans with monitoring and control. The official implementation of incentives for efficiency of implementation. The objectives and purposes of public influence in the development of the area. Independent and procedural planning control. The Spatial Presentation Information System of the impact assessment of development on the natural environment. L4

Distinguish the principles of Land Policy and realization of physical planning, and the role of monitoring and control.
Conduct geodetic technical measures land regulation: land consolidation, readjustment, urban land consolidation, expropriation and allotment, as consolidation method in the two opposed concepts (static and dynamic) care of space. L6, E10

The river information system to support river basin management with the physical characteristics of the water catchment area, modelling the relief the water catchment area with the identification of watershed area, network of canals and cascades of surface flow. L4</td></tr>
<tr><td>2.6. Format of instruction:</td><td>☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☒ partial e-learning
☐ field work</td><td>☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td>2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="3">Activities:

Project: Creating of a vector spatial data using web services.
Project: Establishment of GIS for spatial analysis</td></tr>
</table>

	2 mid-term exams The presence in classes (lectures and exercises).

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	0.25	Research		Practical training	0.75
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests		Oral exam	1.0	(other)	
	Written exam	2.0	Project	1.0	(other)	

2.10. Grading and evaluating student work in class and at the final exam	Valuated are: attendance and project. The final exam consists from two parts: written and the oral exam.

	Title	Number of copies in the library	Availability via other media
2.11. Required literature (available in the library and via other media)	Vjenceslav Medić (1978): AGRARNE OPERACIJE, Geodetski fakultet, Zagreb		Electronic document via e-learning
	Gerhard Larsson (1997): Land Management, Stockholm.		
	Robert Laurini (2001): Information Systems for Urban Planning, Taylor and Francis.		
	Mastelić, I. S.: Uređenje zemljišta - folije s predavanja, Geodetski fakultet, Zagreb 2013.		Electronic document via e-learning

2.12. Optional literature (at the time of submission of study programme proposal)	
2.13. Quality assurance methods that ensure the acquisition of exit competences	In accordance with the University of Zagreb Quality Policy and Quality Manual and the Faculty of Geodesy quality assurance system. Student evaluation of subject and teachers. Self-evaluation of teachers.
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Mladen Zrinjski Brankica Cigrovski-Detelić	1.6. Year of the study programme	3
1.2. Name of the course	Professional Project	1.7. Credits (ECTS)	3
1.3. Associate teachers	Radan Vujnović	1.8. Type of instruction (number of hours L + S + E + e-learning)	45E
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	85
1.5. Status of the course	Compulsory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	level 2
2. COUSE DESCRIPTION			
2.1. Course objectives	Understand and apply knowledge and skills acquired during the first four semesters of undergraduate study to perform field measurements and processing of measurement data. Make geodetic project assignments.		
2.2. Course enrolment requirements and entry competences required for the course	Completed course ''Geodetic Instruments'' Completed course ''Field Measurements'' Completed course ''Analysis and Processing of Geodetic Measurements'' Completed course ''Geodetic Plans'' Completed course ''Cadastre''		
2.3. Learning outcomes at the level of the programme to which the course contributes	Knowledge and understanding - Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. - Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. Applying knowledge and understanding - Handle geodetic instruments and appropriate measuring equipment properly, and perform geodetic measurements. - Solve practical tasks in surveying, spatial data collection, real estate evaluation and management. - Determine and interpret the size, properties and relations of objects in space on the basis of measured data, spatial databases, plans and maps. Making judgements		

	- Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results.					
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- Define the objective of geodetic project assignments. - Reconnaissance of terrain and establish new geodetic network in accordance with geodetic assignment. - Apply gyrus method for measuring horizontal directions and vertical angles. - Apply direct and indirect methods of measurement slope and horizontal distances. - Apply measurement of height differences with the methods of geometric and trigonometric levelling. - Apply different methods of land survey. - Apply different methods of calculating the coordinates of points and other elements from the measurement data. - Make geodetic project assignments and studies after the geodetic measurements.					
2.5. Course content broken down in detail by weekly class schedule (syllabus)	1. Defining the objective of geodetic project assignments. (1E) 2. Reconnaissance of terrain. (1E) 3. Establishment of new geodetic network in accordance with geodetic assignment. (3E) 4. Application gyrus methods for measuring horizontal directions and vertical angles. (2E) 5. Application of direct and indirect methods of measuring slope and horizontal distances. (1E) 6. Measurement of height differences with geometrical levelling method. (2E) 7. Measurement of height differences using trigonometric levelling. (2E) 8. Application of different methods of land survey. (8E) 9. Application of different methods of calculating the coordinates of points and other elements from the measurement data. (5E) 10. Make geodetic project assignments and studies after the geodetic measurements. (20E)					
2.6. Format of instruction:	☐ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☒ field work		☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☒ team assignments		2.7. Comments:	
2.8. Student responsibilities	Compulsory attendance at 70% of teaching – exercises. Compulsory submit and oral testing of two project assignments.					
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of*	Class attendance	0.5	Research		Practical training	1.0
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

ECTS credits is equal to the ECTS value of the course)	Tests		Oral exam		(other)	
	Written exam		Project	1.5	(other)	

2.10. Grading and evaluating student work in class and at the final exam	Oral testing of two project assignments. From this course has no written nor oral exam.

	Title	**Number of copies in the library**	**Availability via other media**
2.11. Required literature (available in the library and via other media)	Benčić, D. (1990): Geodetski instrumenti (Geodetic Instruments), Školska knjiga, Zagreb.		
	Benčić, D., Solarić, N. (2008): Mjerni instrumenti i sustavi u geodeziji i geoinformatici (Measuring Instruments and Systems in Geodesy and Geoinformatics), Školska knjiga, Zagreb.		
	Macarol, S. (1985): Praktična geodezija (Practical Geodesy), Tehnička knjiga, Zagreb.		
	Rezo, M. (2013): Ravninska geodezija – Zbirka zadataka (Plane Geodesy – Collection of Assignments), Faculty of Geotechnical Engineering – University of Zagreb, Varaždin.		
	Rožić, N. (1993): Repetitorij i zbirka zadataka iz teorije pogrešaka i računa izjednačenja (Repetitorium and Example Collection from Theory of Errors and Adjustments), Faculty of Geodesy – University of Zagreb, Zagreb.		
	Rožić, N. (2007): Računska obrada geodetskih mjerenja (Mathematical Processing of Geodetic Measurements), Faculty of Geodesy – University of Zagreb, Zagreb.		

2.12. Optional literature (at the time of submission of study programme proposal)	Barković, Đ., Zrinjski, M. (2014): Terenska mjerenja (Field Measurements), internal script, Faculty of Geodesy – University of Zagreb, Zagreb.
2.13. Quality assurance methods that ensure the acquisition of exit competences	Oral testing of two project assignments. Self-evaluation of teacher and polling participants.
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Mladen Zrinjski	1.6. Year of the study programme	3
1.2. Name of the course	Practical Work with Geodetic Instruments	1.7. Credits (ECTS)	4
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	30 (15L+15E)
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	50
1.5. Status of the course	Optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	level 2

2. COUSE DESCRIPTION	
2.1. Course objectives	Adopting theoretical and practical knowledge and skills about geodetic instruments and geodetic measurement methods. The application of acquired knowledge and skills to testing the correctness of geodetic instruments and use in geodetic project assignments.
2.2. Course enrolment requirements and entry competences required for the course	Completed course ''Geodetic Instruments'' Completed course ''Land Surveying'' Completed course ''Field Measurements''
2.3. Learning outcomes at the level of the programme to which the course contributes	Knowledge and understanding - Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. - Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. Applying knowledge and understanding - Handle geodetic instruments and appropriate measuring equipment properly, and perform geodetic measurements. - Solve practical tasks in surveying, spatial data collection, real estate evaluation and management. - Determine and interpret the size, properties and relations of objects in space on the basis of measured data, spatial databases, plans and maps. Learning and ethical skills - Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services

	based on the position, and the changes in regulations, norms and standards.		
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- Testing and user adjustment: alidade level, telescope level, circular level, optical plummet, laser plummet. - Testing on the optical collimator: collimation error, error of horizontal axis, error vertical axis, error of vertical collimation, micrometer device of theodolite. - Testing: compensator of optical/digital level, micrometer device of precise levels. - Testing of the main conditions level. - Stake out the horizontal, vertical and slope plane with rotating laser level. - Testing the errors in the measurement of the distances of phase and impulse mode. - Testing on the optical collimator dual axis compensator of geodetic stations. - Testing the meteorological influences on the measurement of basic geodetic parameters. - Differentiate formats of digital records measurements in electronic geodetic instruments. - Carry out continuous flow of data from measurements with geodetic instruments to computer processing.		
2.5. Course content broken down in detail by weekly class schedule (syllabus)	1. Alidade level. Telescope level. Circular level. Electronic level. Optical plummet. Laser plummet. (1L+1E) 2. Optical collimator. Collimation error. Error of horizontal axis. (1L+1E) 3. Error of vertical collimation. Error vertical axis. Micrometer device of theodolite. (1L+1E) 4. Digital level. Compensator of level. Micrometer device of precise levels. (1L+1E) 5. Main condition of level. Laboratory and field test procedure of the main conditions level. (1L+1E) 6. Rotating laser level. Electro-optical distance meter. Laser distance meter. (1L+1E) 7. Errors in the measurement of the distances of phase and impulse mode. (1L+1E) 8. Dual axis compensator of geodetic stations. Automated geodetic station. (1L+1E) 9. Meteorological influences on the measurement of basic geodetic parameters. (1L+1E) 10. Formats of digital records measurements in electronic geodetic instruments. (1L+1E) 11. Continuous flow of data from measurement to computer processing. (1L+1E) 12. Automated measurements with geodetic measuring instruments. (2L+2E) 13. Processing data measured with automated geodetic instruments. (2L+2E)		
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☒ field work	☒ independent assignments ☐ multimedia and the internet ☒ laboratory ☐ work with mentor ☒ team assignments	2.7. Comments:
2.8. Student responsibilities	Compulsory attendance at 70% of teaching – lectures.		

DETAILED PROPOSAL OF THE STUDY PROGRAMME

<table>
<tr><td></td><td colspan="6">Compulsory attendance at 70% of teaching – exercises.
Compulsory submit and oral testing of two project assignments.</td></tr>
<tr><td rowspan="5">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>0.5</td><td>Research</td><td></td><td>Practical training</td><td>0.5</td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Tests</td><td>0.5</td><td>Oral exam</td><td>1.5</td><td>(other)</td><td></td></tr>
<tr><td>Written exam</td><td>0.5</td><td>Project</td><td>0.5</td><td>(other)</td><td></td></tr>
<tr><td>2.10. Grading and evaluating student work in class and at the final exam</td><td colspan="6">Testing one preliminary exam.
Testing the written and oral exam.</td></tr>
<tr><td rowspan="6">2.11. Required literature (available in the library and via other media)</td><td colspan="4">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="4">Benčić, D. (1990): Geodetski instrumenti (Geodetic Instruments), Školska knjiga, Zagreb.</td><td></td><td></td></tr>
<tr><td colspan="4">Benčić, D., Solarić, N. (2008): Mjerni instrumenti i sustavi u geodeziji i geoinformatici (Measuring Instruments and Systems in Geodesy and Geoinformatics), Školska knjiga, Zagreb.</td><td></td><td></td></tr>
<tr><td colspan="4">Macarol, S. (1985): Praktična geodezija (Practical Geodesy), Tehnička knjiga, Zagreb.</td><td></td><td></td></tr>
<tr><td colspan="4">Rezo, M. (2013): Ravninska geodezija – Zbirka zadataka (Plane Geodesy – Collection of Assignments), Faculty of Geotechnical Engineering – University of Zagreb, Varaždin.</td><td></td><td></td></tr>
<tr><td colspan="4">Zrinjski, M. (2014): Praktični rad s geodetskim instrumentima (Practical Work with Geodetic Instruments), internal script, Faculty of Geodesy – University of Zagreb, Zagreb.</td><td></td><td></td></tr>
<tr><td>2.12. Optional literature (at the time of submission of study programme proposal)</td><td colspan="6"></td></tr>
<tr><td>2.13. Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="6">Testing one preliminary exam.
Testing the written and oral exam.
Self-evaluation of teacher and polling participants.</td></tr>
<tr><td>2.14. Other (as the proposer wishes to add)</td><td colspan="6"></td></tr>
</table>

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Miodrag Roić	1.6. Year of the study programme	III.
1.2. Name of the course	Land Information Services	1.7. Credits (ECTS)	5
1.3. Associate teachers	Hrvoje Matijević Mario Mađer	1.8. Type of instruction (number of hours L + S + E + e-learning)	60 (30L + 30E)
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	50
1.5. Status of the course	Optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	e-learning level 2
2. COUSE DESCRIPTION			
2.1. Course objectives	To introduce the students to the key land information services, in the aspect of interaction with the general public as well as with the professional users, primarily of geodetic profession. To capacitate the students for using the land information services within the course of day-to-day business and to prepare them for participation on advanced projects related to those services.		
2.2. Course enrolment requirements and entry competences required for the course	The course “Cadastre” passed		
2.3. Learning outcomes at the level of the programme to which the course contributes	**Knowledge and understanding** -To be familiar with real restate registers and interests on them, to understand the measures of land development and the methods of land evaluation. -To know the regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy rights, publishing and exchange of spatial data. **Application of knowledge and understanding** -To solve practical surveying tasks, collect spatial data and deal with real estate evaluation and management. -To maintain topographic, cartographic, maritime navigation and land information systems, to integrate and visualize spatial information. -To use information technology in solving geodetic and geoinformation tasks. **Learning and ethical skills**		

	-To follow and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, as well as changes of regulations and standards.		
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	The students will: -Differentiate the methods and manners for collecting the land related data -Describe the process of land data modeling -Create the vector, layer based model of digital cadastral map -Analyze the compliance of spatial and descriptive components of cadastral data -Practically use the land information services -Explain the technological integration of separate registers on the technological level (Joint Information System of Land Books and Cadastre) -Describe and demonstrate the methods for improving the cadastral maps (homogenization) -Describe the principles of establishment of land information services and the underlying data management		
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Week 1: introductory lecture (Learning outcomes, Valuation rules, Literature, Lectures schedule) Week 2: Land information services (Types of land information services, Purpose of land information services, Services for experts, Services for general public) Week 3: Implementation of land information services (Data collecting, System design, Initial loading of the data) Week 4: Computer technologies in service of land information services (CAD/GIS, Spatial databases, Web technologies) Week 5: Primary data collection techniques (Using surveying technology, Using widely available technology, Crowdsourcing) Week 6: Secondary data collection techniques (Digitalization, Vectorization, Constructing from measurements) Week 7: The first test Week 8: Land management services (Alphanumerical data of Cadastre and Land Book, Geometric and alphanumerical data of Cadastre, Technological integration of separate institutions, Joint Information System of Land Books and Cadastre) Week 9: Land Administration Domain Model (Basic administrative units, Rights, restrictions and responsibilities, Spatial units, Spatial representations, Related external systems) Week 10: Other land related initiatives (Food and Agriculture Organization (FAO), Social Tenure Domain Model (STDM)) Week 11: Quality of land administration data – Cadastre (Causes for disharmonicity, Homogenization of cadstral maps) Week 12: Quality of land administration data – Cadastre and Land Book (Causes for disharmonization, Harmonizing the Cadastre and Land Book data) Week 13: Land information services for agricultural subsidies (EU regulations, Croatia, Europe) Week 14: Other land information services (Address register, Real estate valuation, Buildings register) Week 15: The second test		
2.6. Format of instruction:	☒ lectures	☐ independent assignments	2.7. Comments:

<table>
<tr><td></td><td colspan="2">☐ seminars and workshops
☒ exercises
☐ on line in entirety
☒ partial e-learning
☐ field work</td><td colspan="2">☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2"></td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="6">-Project 1: vectorization
-Testing of competence for preparation of project 1
-Project 2: Analysis of compliance of descriptive and spatial components of cadastral data
-Testing of competence for preparation of project 2
-Attendance of lectures and exercises</td></tr>
<tr><td rowspan="5">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Tests</td><td>2</td><td>Oral exam</td><td>1</td><td>(other)</td><td></td></tr>
<tr><td>Written exam</td><td>1</td><td>Project</td><td></td><td>(other)</td><td></td></tr>
<tr><td>2.10. Grading and evaluating student work in class and at the final exam</td><td colspan="6">Continuous control and the option to pass the exam by being within the group of the most successful students at the two tests. Classes attendance, projects and the test are valuated, and the final grade is given at the oral examination.</td></tr>
<tr><td rowspan="5">2.11. Required literature (available in the library and via other media)</td><td colspan="4">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="4">Roić, M. (2012): Upravljanje zemljišnim informacijama - katastar, University of Zagreb, Faculty of Geodesy, ISBN 978-953-6082-16-2, Zagreb.</td><td>10</td><td></td></tr>
<tr><td colspan="4">Larsson, G.: Land registration and cadastral systems, Longman Scientific Technical, London 1991.</td><td>1</td><td></td></tr>
<tr><td colspan="4">Sources published on the e-learning</td><td>0</td><td>PDF</td></tr>
<tr><td colspan="4"></td><td></td><td></td></tr>
<tr><td>2.12. Optional literature (at the time of submission of study programme proposal)</td><td colspan="6">Regulation available at www.nn.hr</td></tr>
<tr><td>2.13. Quality assurance methods that ensure the acquisition of exit</td><td colspan="6">In accordance with the Quality Policy and Quality Manual provided by the University of Zagreb and the Quality Assurance System of the Faculty.</td></tr>
</table>

competences	Survey evaluation of the course and teachers. Self-evaluation of teachers.
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Stanislav Frangeš	1.6. Year of the study programme	3
1.2. Name of the course	Topographic Cartography	1.7. Credits (ECTS)	4
1.3. Associate teachers	Robert Župan Vesna Poslončec-Petrić Igor Birin	1.8. Type of instruction (number of hours L + S + E + e-learning)	45 (30L+15E) e-learning = yes
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	40-60
1.5. Status of the course	Elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	level 2
2. COUSE DESCRIPTION			
2.1. Course objectives	The acquisition of basic knowledge of about topographic cartography with a focus on achieving the ability to distinguish topographic objects and their display on topographic maps in accordance with the Topographic Information System of Croatia (CROTIS). The acquisition of basic knowledge of visualization and communication with the help of topographic maps in order to establish and maintain topographic maps.		
2.2. Course enrolment requirements and entry competences required for the course	Passed exam on courses: "Databases" Already listened courses: "Cartography" "Geoinformations handling"		
2.3. Learning outcomes at the level of the programme to which the course contributes	Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Make plans, maps and related presentations using modern methods and technologies on the basis of measured data and other sources. Determine and interpret the size, properties and relations of objects in space on the basis of measured data, spatial databases, plans and maps. Maintain topographic, cartographic, maritime and navigation, and land information systems, integrate and visualise spatial information. Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by		

	means of surveying and its results. Prepare official public documents, reports, graphic and cartographic presentations using the surveying results related to objects in space.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	The students will: - Explain the topographic mapping and its purpose and tasks, view the development of topographic maps and topographic surveys, - Describe the Official Topographic-Cartographic Information System RC (STOKIS), - Explain the organization of the Topographic Information System of Croatia (CROTIS), development of data models CROTIS (object entities, groups, types, attributes), - Explain the purpose and structure of the Military's information system (VoGIS), - Analyze and argue the purpose and use of topographic maps, and topographic information users and their needs, - Differentiate and analyze topographic data themes and their features, and use the method of their display on topographic maps at different scales, - Define the formation of map graphics of topographic maps, and analyze and use cartographic key for topographic maps, - Describe and analyze the Ordinance on the method of topographic survey and on the elaboration of national maps and Rules on keeping and use of documents and data state survey and real estate cadastre, - Describe and differentiate existing topographic maps for the territory of Croatia and contemporary official topographic maps of the Republic of Croatia (civil and military).
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Lectures (per 2-hour lectures): 1. Introductory lecture and valuation rules of students through the semester. 2. Definition of topographic cartography. Development and tasks topographic cartography. 3. Topographic survey. The creation of topographic maps. 4 Definitions topographic maps. The basics of the topographic information systems (TIS). The purpose and use of topographic maps and TIS's. 5. In topographical information and their needs. A series of benchmarks topographic maps. 6th Topographic objects and their features. Settlements, roads, water, vegetation, relief and boundaries and their display on topographic maps. 7. Midterm exam 1 8. Creation of map graphics of topographic maps. Cartographic keys for topographic maps. 9. accuracy of topographic maps. 10. Overview of topographic maps for the territory of the Republic of Croatia. Modern topographic map of Croatia - civilian

	and military. 11. Regulation on the manner of Topographic Survey and preparation of state map. 12. Rules on keeping and use of documents and data state survey and real estate cadastre. 13. National topographic and cartographic information system Croatia (STOKIS). Structure of the Topographic Information System of Croatia - CROTIS and military geoinformation system - VoGIS. 14. Midterm exam 2 15. Repeated and makeup test Exercises: Making the default display of objects on topographic maps of different scales with different software and analysis made tasks.						
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work		☒ independent assignments ☐ multimedia and the internet ☒ laboratory ☐ work with mentor ☐ (other)		2.7. Comments:		
2.8. Student responsibilities	Compulsory attendance at 70% of teaching - lectures. Compulsory attendance at 70% of classes - exercises. Mandatory deposited 3 midterm exams. Compulsory submission of one projects task.						
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	0,5	Research		Practical training		
	Experimental work		Report		(other)		
	Essay		Seminar essay		(other)		
	Tests	1,0	Oral exam	0,8	(other)		
	Written exam	0,7	Project	1,0	(other)		
2.10. Grading and evaluating student work in class and at the final exam	The general principles by which runs scoring: Maximum points are for: theoretical knowledge (in the lecture) 51 presence and work on exercises 15 projects (in the exercises) 34 TOTAL 100						

	Mandatory requirement for entry into the evaluation system is the realization of minimum conditions (the right to the signature). The right to the signature and exam: Credits: attend the exercises 4 minimum points for mid term exam (5 + 5 + 5) 15 minimum points for projects (4 + 4 + 6) 14 TOTAL 33 For recognition of the written exam is necessary to achieve: credits for sufficient (2) 66-75 for good (3) 76-84 for very good (4) 85-93 for excellent (5) 94-100 Students who are not satisfied with their grade achieved through the semester, and in recognition of the written exam with this assessment, can access the written part of the exam on the regular examination periods. In addition they score achieved through the semester is no longer valid. A regular examination period: for passing the written exam required to achieve the scores: for sufficient (2) 36-45 for good (3) 46-55 for Very good (4) 56-64 for excellent (5) 65-72 Oral exam is mandatory access for all students, regardless of whether the assessment of the written exam achieved by collecting points through the semester or at the regular examination period. The final grade for students who are recognized as the written part of the exam (achieved 66 or more points) is formed on the basis of this assessment and response to oral exam. For students who access the written part of the exam, because it did not release the semester (achieved less than 66 points) or are not satisfied with their grade achieved through the semester, the total score for the written part is formed on the basis of medium-marks over semester and written exam, the manner strictly prescribed in the respective tables. At the oral exam can raise the final grade for an assessment in relation to the assessment recognized in the written part, but also unlimited reduce it.

<table>
<tr><td rowspan="4">2.11. Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>Lovrić, P. (1988): Opća kartografija, University of Zagreb.</td><td>5</td><td></td></tr>
<tr><td>Frangeš, S. (2014): Topografska kartografija – lectures (pdf, 0,56 MB)</td><td></td><td>e-learning</td></tr>
<tr><td>Lovrić, P. (1992): Topografska kartografija, Faculty of Geodesy, internal script, Zagreb.</td><td>5</td><td></td></tr>
<tr><td>2.12. Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">Hake, G., Grünreich, D., Meng, L.: Kartographie – Visualisirung raum-zeitlicher Informationen. Walter de Gruyter, Berlin, New York 2002.
Ćosić, Alilović, Frangeš, Landek: Topografske karte na području Hrvatske (glavni urednik: Frangeš), State Geodetic Administration, Zagreb, 2012.
DGU: Topografsko informacijski sustav Republike Hrvatske – CROTIS, Basic Principles–Objects Catalogue. version 1.0, Geofoto d.o.o., Zagreb 2000.
MORH (2004): VoGIS – Vojni geografski informacijski sustav. Idea project. Ministry of Defence of The Republic of Croatia, 2004.</td></tr>
<tr><td>2.13. Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">Periodic testing of the acquired knowledge of students - two midterm exams.
Periodic testing adopted practical knowledge of students – submission tests when submitting the project.
Passing the written and oral examination.
Self-evaluation of teachers and interviewing participants.</td></tr>
<tr><td>2.14. Other (as the proposer wishes to add)</td><td colspan="3">The course is designed to level the program in terms of learning skills and ethics provide monitoring and adoption of new technological developments in the field of geoinformation systems and services based on position and changes in regulations, norms and standards, as well as the basis for further academic training in the field of geodesy and geoinformatics or related disciplines, and development of culture of lifelong and professional education</td></tr>
</table>

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Miodrag Roić	1.6. Year of the study programme	1, 2 i 3. (1, 3 i 5 sem.)
1.2. Name of the course	Franciscan cadastre	1.7. Credits (ECTS)	3
1.3. Associate teachers	Baldo Stančić Mario Mađer	1.8. Type of instruction (number of hours L + S + E + e-learning)	15+0+30
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	30
1.5. Status of the course	optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	e-learning level 2
2. COUSE DESCRIPTION			
2.1. Course objectives	Introduce students to the social environment of origin and maintenance of the cadastre in the 19th century. Show technical capabilities and limitations of establishing and maintaining the Franciscan cadastre. Purposeful interpretation and use of cadastral data in practical work.		
2.2. Course enrolment requirements and entry competences required for the course	None.		
2.3. Learning outcomes at the level of the programme to which the course contributes	Knowledge and understanding 1. To understand the role of geodesy, geoinformatics and spatial data in the modern world, to know measuring systems, measuring methods and technologies, and the methods of collecting spatial data. 2. To know theoretical principals, procedures of computer processing and visualisation of surveying data. 3. To be familiar with real restate registers and interests on them, to understand the measures of land development and the methods of land evaluation. 4. To know the regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy rights, publishing and exchange of spatial data. Making conclusions and judgements 15. To make conclusions on the basis of performed computational processing and interpretation of surveying data and obtained results.		
2.4. Learning outcomes expected at the	1. to get familiar with relations between people and land after the abolition of feudalism and regulations with which they		

<table>
<tr><td>level of the course (4 to 10 learning outcomes)</td><td colspan="3">were formalized
2. understand the reasons for the establishment of today's cadastres in the 19th century and the importance and scope of the job that was donne
3. describe the spatial (geodetic) basis and methods of surveying along with creation of cadastral plan of the Franciscan cadastre
4. use historical records of land registered in the Franciscan cadastre</td></tr>
<tr><td>2.5. Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="3">Week 1: Introduction (learning outcomes, students tasks and valuation, literature, lectures concept, terms)
Week 2: A Review of establishing of the cadastral systems in the world (time of of establishing, the purpose of establishing, a division of cadastral systems)
Week 3: The environment of establishment of of the Franciscan cadastre (social planning, land policy, regulations, and dynamics of establishment)
Week 4: Regulations about the introduction of the Franciscan cadastre (tax and cadastral regulations, training of cadastral surveyors)
Week 5: Spatial (geodetic) basis of Franciscan cadastre (the unit of measure, coordinate systems, Soldner coordinates, geodetic basis)
Week 6: Methods of survey (graphical method, plane table)
Week 7: first preliminary exam
Week 8: The Franciscan cadastre data model (cadastral documentation, content, analog data storage environment, limitations and disadvantages)
Week 9: Cadastral map (scale, determination of area of the cadastral parcels)
Week 10: Maintaining of the Franciscan cadastre data (surveying, mapping changes)
Week 11: Changes for purpose of maintenance (labeling cadastral parcels, labels of use)
Week 12: Restoration of Franciscan cadastre documentation (litography, pantography, tracing)
Week 13: Especiallity of areas (Austrian part, the Hungarian part)
Week 14: Possibilities of usage of Franciscan cadastre data (excerpts and copies of transcripts, analysis and statistics)
Week 15: second preliminary exam</td></tr>
<tr><td>2.6. Format of instruction:</td><td>☒ lectures
☒ seminars and workshops
☐ exercises
☐ on line in entirety
☒ partial e-learning
☒ field work</td><td>☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☒ team assignments (other)</td><td>2.7. Comments:

Field work involves collecting of data by visiting the respective institutions (cadastre, land registry, archives, etc.).</td></tr>
</table>

2.8. Student responsibilities	Activities: seminar, workshop, 2 preliminary exams attendance at lectures written exam oral exam					
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance		Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay	1	(other)	
	Tests		Oral exam	2	(other)	
	Written exam		Project		(other)	
2.10. Grading and evaluating student work in class and at the final exam	Continuous monitoring and the possibility of the earlier passing of written exam. Attendance, projects, tasks and preliminary exams are evaluated. The final grade is achieved at the final oral exam.					

2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Roić, M. (2012): Upravljanje zemljišnim informacijama - katastar, University of Zagreb, Faculty of Geodesy, ISBN 978-953-6082-16-2, Zagreb.	10	
	Roić, M., Fanton, I., Medić, V. (1999): Katastar zemljišta i zemljišna knjiga. Skripta, Faculty of Geodesy, Zagreb.		PDF
	Roić, M., Fjalestad, J. B., Steiwer, F. (2008): Regionalna studija o katastru/Regional Cadastral Study. State Geodetic Administration, Zagreb.		PDF
	Borčić, B., Frančula, N. (1969): Stari koordinatni sustavi na području SR Hrvatske i njihova transformacija u sustave Gauss–Krügerove projekcije. University of Zagreb, Faculty of Geodesy, Zagreb.	1	
	Regulations		www.ris.bka.gv.at www.nn.hr
2.12. Optional literature (at the time of submission of study programme			

proposal)	
2.13. Quality assurance methods that ensure the acquisition of exit competences	In accordance with the Quality Policy and Quality Manual provided by the University of Zagreb and the Quality Assurance System of the Faculty. Survey evaluation of the course and teachers. Self-evaluation of teachers.
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Miljenko Lapaine Dražen Tutić	1.6. Year of the study programme	3
1.2. Name of the course	Algorithms in Geoinformation Systems	1.7. Credits (ECTS)	3
1.3. Associate teachers	Dražen Odobašić	1.8. Type of instruction (number of hours L + S + E + e-learning)	10S + 30E + 5e-learning
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	15
1.5. Status of the course	Elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2, online 12.5%

2. COUSE DESCRIPTION	
2.1. Course objectives	The course gives an overview of application of mathematics and computer science into geoinformation systems (GIS). Understanding algorithmic base of GIS is prerequisite for evaluation of results of GIS analysis and performing more complex spatial data analysis with typical GIS software. Spatial data structures and most important basic and more complex GIS algorithms are explained. Practical work includes implementation of known algorithms in selected programming language.
2.2. Course enrolment requirements and entry competences required for the course	Passed courses: Engineering Graphics in Geodesy and Geoinformatics, Basics of Geoinformacitcs, Programming and Databases.
2.3. Learning outcomes at the level of the programme to which the course contributes	Maintain topographic, cartographic, maritime and navigation, and land information systems, integrate and visualise spatial information. Use information technology in solving geodetic and geoinformation tasks. Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution. Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards.

DETAILED PROPOSAL OF THE STUDY PROGRAMME

<table>
<tr><td>2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="6">Describe theory behind basic algorithms for raster and vector data used for geoinformation processing.

Analyse and define concepts of spatial data structures.

Structure and solve geometrical problems in processing and anlaysis of geoinformation.

Write programs for basic algorithms used for geoinformation processing.

Evaluate existing geoinformation software by identifying advantages and constraints.</td></tr>
<tr><td>2.5. Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="6">1. Introduction to course and computer programming. Review of basic data models: point, line, polygon.
2. Review and selection of programming language. Compiling and executing programs.
3. Calculating lines intersection. Calculating polygon centroid.
4. Length and area of polygon. Point in polygon. Polygons overlap.
5. Raster data – compression, quad-tree structure, area calculation, classification.
6. Data sorting.
7. Line simplification.
8. Overview of advanced algorithms. Shortest path in network.
9. Analysing and planning the implementation of selected algorithm.
10., 11., 12. Implementation of selected algorithm.
13. Algorithm and program testing.
14. Writing program documentation.
15. Presentation of project of algorithm implementation.</td></tr>
<tr><td>2.6. Format of instruction:</td><td colspan="2">☐ lectures
☒ seminars and workshops
☒ exercises
☐ on line in entirety
☒ partial e-learning
☐ field work</td><td colspan="2">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="6"></td></tr>
<tr><td rowspan="3">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of</td><td>Class attendance</td><td>0.5</td><td>Research</td><td></td><td>Practical training</td><td>1</td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>1</td><td>(other)</td><td></td></tr>
</table>

ECTS credits is equal to the ECTS value of the course)	Tests		Oral exam		(other)	
	Written exam	0.5	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	For assessment of the course student project seminar has to be evaluated positively ba teacher and student group. Programming code must correctly implement selected algorithm and give expected results on test dateset. Final exam on e-learning system includes written exam by which tests knowledge andunderstanding the logic of GIS algorithms.

2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Fogel, E., Halperin, D., Wein, R. (2012): CGAL Arrangements and Their Applications, Spinger.	3	
	de Berg, M., Cheong, O., van Kreveld, M., Overmars, M. (2008): Computational Geometry, Springer.	3	
	Worboys, M. F., and M. Duckham, 2004. GIS: A Computing Perspective, 2nd edition. Taylor & Francis.	3	
	Lecture notes on e-learning		online

2.12. Optional literature (at the time of submission of study programme proposal)	Google Summer of Code OsGeo Development
2.13. Quality assurance methods that ensure the acquisition of exit competences	In accordance with the Quality Policy and Quality Manual provided by the University of Zagreb and the Quality Assurance System of the Faculty. Survey evaluation of the course and teachers. Self-evaluation of teachers.
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Damir Medak	1.6. Year of the study programme	III.
1.2. Name of the course	Scripting languages in geodesy and geoinformatics	1.7. Credits (ECTS)	3
1.3. Associate teachers	Mario Miler Dražen Odobašić	1.8. Type of instruction (number of hours L + S + E + e-learning)	45 (15P-30V)
1.4. Study programme (undergraduate, graduate, integrated)	study of geodesy and geoinformatics, BSc	1.9. Expected enrolment in the course	40
1.5. Status of the course	elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2, 20

2. COUSE DESCRIPTION	
2.1. Course objectives	Students will acquire theoretical background and practical usage of scripting languages used in geodesy and geoinfromatics in order to automate data processing in CAD and GIS applications
2.2. Course enrolment requirements and entry competences required for the course	Accomplished the course „Programming“.
2.3. Learning outcomes at the level of the programme to which the course contributes	Maintain topographic, cartographic, maritime and navigation, and land information systems, integrate and visualise spatial information. Use information technology in solving geodetic and geoinformation tasks. Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution. Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	differentiate scripting and another programming languages, apply the programming methodology in scripting languages,

DETAILED PROPOSAL OF THE STUDY PROGRAMME

<table>
<tr><td></td><td colspan="6">automatize processing of text files, spreadsheets and CAD drawings using scripting languages
analyze applicability and the quality of solutions in comparison to non-scripting languages,
integrate network geoinformation services and automatize processing of geospatial datasets using scripting programming languages.</td></tr>
<tr><td>2.5. Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="6">Content and organization of the course.
Introduction to Python (introspection and help, loops, lists, dictionaries).
Functions and type conversions in Python.
Reading and processing of textual data.
Usage of Python for solving the problems in geodesy and geoinformatics.
Gathering of data in the Internet using Python.
Independent project task discussion.
Introduction to AutoLISp (list processing).
Using the command line.
AutoLISP function.
Access to CAD objects with AutoLISP.
Creation of new CAD objects with AutoLISP.
Introduction to Visual LISP.
Independent project task discussion.</td></tr>
<tr><td>2.6. Format of instruction:</td><td colspan="2">☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☒ partial e-learning
☐ field work</td><td colspan="2">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="6"></td></tr>
<tr><td rowspan="3">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of</td><td>Class attendance</td><td></td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(other)</td><td></td></tr>
</table>

ECTS credits is equal to the ECTS value of the course)	Tests	2	Oral exam	1	(other)	
	Written exam	1	Project	1	(other)	

2.10. Grading and evaluating student work in class and at the final exam			
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Autodesk (2012): AutoLISP Developer's Guide	1	
	Autodesk (2004): The Visual LISP Developers Bible	1	
	Jeffrey Elkner, Allen B. Downey, and Chris Meyers (2012): How to Think Like a Computer Scientist.	1	
	Wesley Chun (2009) - Core Python Programming, Prentice Hall		
2.12. Optional literature (at the time of submission of study programme proposal)			
2.13. Quality assurance methods that ensure the acquisition of exit competences			
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Mario Brkić	1.6. Year of the study programme	3rd year, 5th semester
1.2. Name of the course	Evolution of Physics	1.7. Credits (ECTS)	2
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	15*2S
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	>10
1.5. Status of the course	elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	Through qualitative recapitulation of mechanics and field theory, along with an introduction to relativity and quantum physics, the intention is "... to sketch in broad outline the attempts of the human mind to find a connection between the world of ideas and the world of phenomena." (A. Einstein and L. Infeld), and illustrate paths of science.
2.2. Course enrolment requirements and entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	Knowledge and understanding 5. Understand mathematical methods and physical laws applied in geodesy and geoinformatics. Applying knowledge and understanding 6. Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of problems in the field of geodesy and geoinformatics. Making judgments 16. Exercise appropriate judgments on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. Learning and ethical skills 20. Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines,

<table>
<tr><td></td><td colspan="6">and for the development of interest in lifelong learning and further professional education.</td></tr>
<tr><td>2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="6">1. Describe limits of classical mechanics.
2. Describe the foundations of field theory.
3. Describe the concepts of general relativity.
4. Describe the emergence of quantum physics.</td></tr>
<tr><td>2.5. Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="6">1. The rise of the mechanical view. The riddle of motion; Is heat a substance ?; The rate of exchange;
2. The philosophical background; The kinetic theory of matter.
3. The decline of the mechanical views. The two electric fluids; The magnetic fluids;
4. The velocity of light; Light as substance; The riddle of colour;
5. What is the wave ?; The wave theory of light; Ether and the mechanical view.
6. Field. The field as representation; The two pillars of the field theory; The reality of the field; Field and ether; Ether and motion;
7. Time, distance and relativity; Relativity and mechanics;
8. The time-space continuum; General relativity; Outside and inside the lift;
9. Geometry and experiment;
10. General relativity and its verification;
11. Field and matter.
12. Quanta. Continuity, discontinuity; Elementary quanta of matter and electricity; The quanta of light;
13. Light spectra; The waves of matter; Probability waves;
14. Physics and reality.</td></tr>
<tr><td>2.6. Format of instruction:</td><td colspan="2">☐ lectures
☒ seminars and workshops
☐ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="2">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="6">Attendance. Seminar essays.</td></tr>
<tr><td rowspan="4">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS</td><td>Class attendance</td><td></td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>2</td><td>(other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(other)</td><td></td></tr>
</table>

value of the course)	Written exam		Project		(other)	
2.10. Grading and evaluating student work in class and at the final exam	Seminar essays.					

2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	A. Einstein, L. Infeld: The Evolution of Physics, Pub. Simon & Schuster, ISBN 0-671-20156-5.		www
2.12. Optional literature (at the time of submission of study programme proposal)			
2.13. Quality assurance methods that ensure the acquisition of exit competences	Seminars. Student polls.		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Tomislav Bašić	1.6. Year of the study programme	III
1.2. Name of the course	State Survey	1.7. Credits (ECTS)	5
1.3. Associate teachers	Marko Pavasović Olga Bjelotomić MarijaPejaković Marijan Grgić Matej Varga	1.8. Type of instruction (number of hours L + S + E + e-learning)	30 L + 30 E
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	60
1.5. Status of the course	obligatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	e-learning level 2

2. COUSE DESCRIPTION	
2.1. Course objectives	Adopting theoretical and practical knowledge in the areas of the State Survey and its importance for basic geodetic works at the state level (Croatia) and / or more states (region, continent).
2.2. Course enrolment requirements and entry competences required for the course	Passed exams: Differential Geometry (III sem.), Analysis and Processing of Geodetic Measurements (III. sem.), Geodetic Reference Frames (IV. sem.), Absolved courses: Satellite Positioning (V sem.).
2.3. Learning outcomes at the level of the programme to which the course contributes	Knowledge and understanding: Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Demonstrate competences in theoretical principles, procedures of computing and visualizing the surveying data. Understand mathematical methods and physical laws applied in geodesy and geoinformatics. Applying knowledge and understanding: Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of problems in the field of geodesy and geoinformatics. Establish geodetic networks needed in surveying and stakeout in order to provide the required quality of the works performed in certain space.

	Use information technology in solving geodetic and geoinformation tasks. Adoption of conclusions and judgments: Exercise appropriate judgments on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. Presentations and team work: Prepare official public documents,reports, graphic and cartographic presentations using the surveying results related to objects in space. Communicate the results obtained by means of geodesy and geoinformation to clients and experts of geodetic and other related professions Learning skills and ethics: Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards. Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will: - To master the method of calculation of the parameters of level-ellipsoid as a basic mathematical-physical body in geodesy and basic mathematical relations of ellipsoidal geodesy and their application in everyday geodetic surveys, - To master the process of conversion of geodetic or ellipsoidal coordinates in the plane mapping and vice versa, and adopt necessary knowledge about inherited (positional HDKS, height Trieste 1875) and the new official (positional HTRS96, height HVRS71) geodetic reference systems and datums in Croatia, as well as master the process of their mutual transformation, - Adopt the necessary knowledge of the methods of calculating the main surveying tasks on a rotational ellipsoid and the reduction of measured values (azimuths, directions and lengths) from the physical surface of the Earth to the surface of the ellipsoid, - Become familiar with the height systems in geodesy and mutual transformations between them as well as with leveling in the real Earth's gravity field and its application in basic geodetic works, - Acquire knowledge and mathematical procedures of coordinate transformations in the State survey, including "GNSS leveling" and T7D grid transformation for the territory of Croatia.
2.5. Course content broken down in detail by weekly class schedule	<u>Lectures (two-hour lectures):</u> 0. The organization of the course - Introduction to the course content, the carrier and the teachers who teach, literature, way

(syllabus)	of verifying the fulfillment of obligations and knowledge, the conditions for signature resp. evaluation, rules of conduct of the class and statistics of successful filling out of the course and examinationsof previous generations. 1. Introduction to State Survey - Definition and classification of geodesy, Definition of State survey (Higher geodesy), Basic surfaces in geodesy, The ways of solving geodetic tasks 2. Introduction to State Survey-continued: Glossary - basic terms underlying lectures, inherited geodetic datums, the new official geodetic datumsin Croatia. 3. Basic formulas and relations on the Earth's ellipsoid surface: Basic parameters of the ellipsoid, coordinate systems of an ellipsoid, a binding relationship between coordinate systems, the main radii of curvature, determine the length of the meridian arc and parallel. 4. Curves of the Earth's rotational ellipsoid: The duality of the normal section, divergence of the mutual normal sections, the length of arc of normal section, the formula for mutual angles between the normal sections, geodesic line - its nature and properties, a simplified derivation of the basic equations of geodesic line, shape and gait of the geodesic line on a rotational ellipsoid, the angle between the geodetic line and direct normal section, azimuthal correction or correction due to the height of sight point. 5. Main surveying tasks on a rotational ellipsoid: The reduction of astronomical azimuth and spatial length to the ellipsoid, basic considerations in connection with the main surveying tasks on the ellipsoid surface, and Conformal mapping of ellipsoid into the plane for the needs of the state survey: Generally about the mapping, conformal mapping of the ellipsoid into the plane, Gauss-Krueger mapping (Transverse Mercator projection). 6. Positionalnetworks: Generally on the positional networks, construction of positional network, designing positional network, stabilization and signalization points of order I, measured values in triangulation network, computing (adjustment) triangulation networks, measurement of directions, processing (adjustment) of complete gyrus and processing (adjustment) of incomplete gyrus, centering of directions and azimuths. 7. Electronic distance measuring: Wave equation and its application in measuring distance, the expansion rate and spectrum of electromagnetic waves, temperature, pressure and humidity, and the refractive index of the atmosphere, instruments and instrumental corrections, (right) meteorological reduction, geometric reduction, height and positional centering. 8. Indirect network adjustment: Improvement equations for lengths (on the ellipsoid and in the plane), improvement equations for directions (on the ellipsoid and in the plane), normal equations, accuracy estimates, pedal curves and ellipses of errors, example: 10km GPS network of the Republic of Croatia. 9. Height systems: Methods of height transfer, the theoretical basis of geometric leveling, height systems, height transformation (correction because of the place), combined leveling (correction because of leveling route). 10. State Survey and transformation: 7-parametric (3D-similar) transformation, 5-parameter transformation by Molodensky, method of "simple block shift", method of GRID transformation (official T7D transformation of the Republic of Croatia),

	transformation between ITRFxx systems. <u>Exercises (to each precedes auditoria exercises):</u> 1. Calculating the parameters of the ellipsoid and coordinate systems and basic formula of the ellipsoidal geodesy: Introduction to the concepts of "rotational ellipsoid" and "level-ellipsoid" and calculating of their parameters according to a known mathematical expressions; definition of ellipsoidal and Cartesian coordinate system and application binding relations between them; transition from ellipsoidal in planar coordinates. Submit calculated task via e-learning systems (LMS). 2. The importance of physical parameters in the reduction of measured values from the physical Earth's surface to the surface of the ellipsoid: Introduction to the linear functionals of disturbing potential of gravity, geoid computation methods and the application of vertical deflection in the reduction of measured values from the physical surface of the Earth to the surface of the ellipsoid. Submit calculated task via e-learning systems (LMS). 3. Height Systems: Introduction to the concept "Geopotentialnumbers" and their use in defining the individual height system, taking into account the corresponding value of gravity. Submit calculated task via e-learning systems (LMS). 4. Adjustment of 2D/3D network with measured directions and lengths: Application of Gauss-Markov model of indirect adjustment in the treatment of a triangulation-trilateration geodetic network. Submit calculated task via e-learning systems (LMS).				
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work		☐ independent assignments ☒ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)		2.7. Comments:
2.8. Studentresponsibilities	- Attendance at least 70% of lectures and at least 70% of the hours of training (in accordance with the Regulation of Studies), - Orderly handover of all tasks exercises (implies submission and assessment of the program on time as evidence of individual performance computing).				
2.9. Screening student work *(name the proportion of ECTS credits for eachactivity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	1.0	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	2.0	Oral exam	1.0	(other)	
	Written exam	1.0	Project		(other)	
2.10. Grading and evaluating student	Preliminary exams (colloquia) during the semester (2):				

work in class and at the final exam	Colloquia are assessment covering the content of lectures and exercises. Points collected at colloquia allow the release of the written exam or the release of the examination. During the semester are held two regular colloquia. To qualify a student access to first or second colloquium must meet the following requirements: - To access the first colloquium student must "regularly" hand over first and second assignment of exercises that cover the topic of the first tests, - To access the second colloquium student must achieve a minimum of 34% (17) points from the first colloquium and "orderly" hand over the third and fourth task of exercises that cover the topic of the second colloquium. On each of the two preliminary exams can collect a maximum of 50 points, i.e.from both colloquium maximum of 100 points. Preliminary exams consist of five theoretical issues which bring a maximum of 60% of the total possible points and two numerical tasks that deliver a maximum of 40% of the total possible points in each colloquium. Total collected points at colloquia are valued as follows: - < 50 points - the obligation of take the written and oral part of the exam, - 50-61 points - score enough (2), the obligation to take the oral part of the exam, - 62-74 points - good (3), the release of the exam, - 75 - 87 points - very good (4), the release of the exam, - 88 - 100 points - an excellent score (5), the release of the exam. Students who collect enough points for a good (3) or very good (4), and are not satisfied with their grade, may take the examination at the regular examination period. In this case, evaluation is based on the knowledge shown in this test. The collected points at colloquia are only valid for one taking the exam, which means that in case of a fall on the exam the student has the following term access written and oral exam when evaluated only knowledge expressed in this exam. Exams (summer and autumn period): Each exam consists of a written and an oral part. Written exam consists of seven theoretical questions that need answering comprehensive (more extensive) response and one calculation task. Any theoretical question is scored with 1 point, a correct solution calculation task with 3 points, so the total number of points a student can achieve the final examination is 10. Solving the exam a student can earn a direct entry of grades in courses according to the following scoring system: 5.0 - 6.1 points - sufficient (2)

	6.2 - 7.4 points - good (3) 7.5 - 8.7 points - very good (4) 8.8 - 10 points - excellent (5) A student who wishes to respond to a higher grade access to the oral exam, which generally corresponds to 3-5 questions. Rating oral examination shall be determined on the basis of correctness and completeness of answers to the questions. Overall rating is result of the written and oral examination with equal share (weight).		
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Bašić, T. (2014): State Survey, ppt lectures in pdf format (updated yearly)		on Moodle
	Bašić, T. (2004/2005): State Surveying, Faculty of Geodesy, Internal script (pdf)	3 chair	
	Torge, W., Müller, J. (2012): Geodesy, 4th Edition, DeGruyter, (eng.)	1 AGG library	DeGruyter
	Torge, W. (2003): Geodesy, 2nd Edition, deGruyterLehrbuch (germ.).	1 chair	DeGruyter
	Jekeli, Ch. (2012): Geometric Reference Systems in Geodesy, Ohio State University (pdf)	5 chair	web
2.12. Optional literature (at the time of submission of study programme proposal)	Vaniček, P., Krakiwski, E. (1986): Geodesy - The Concept, North-Holland, Čubranić, N. (1974): Higher Geodesy I and II, Tehnickaknjiga, Zagreb Kontaktstudium (1985): GeodätischeNetzeinLandes- und Ingenieurvermessung II, Hannover Research project GeomaticaCroatica: papers on http://bib.irb.hr/ Research project Geopotencijal and geodynamics of the Adriatic: papers on http://bib.irb.hr/ State Geodetic Administration: documents available on www.dgu.hr .		
2.13. Quality assurance methods that ensure the acquisition of exit competences	The students are required on four occasions (when submitting assignments exercises) preliminary exam on each task in order to show that he was self-created. During the semester, students have the opportunity to access the two colloquia that check their monitoring and learning from lectures and performing obligations during the exercises. Successfully mastering both colloquium allows partial or complete exemption from the exam.		
2.14. Other (as the proposer wishes to add)	To successfully solve numerical problems in the framework of this course it is desirable that every student, in addition to work in faculty computer rooms, has his own notebook.		

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Rinaldo Paar	1.6. Year of the study programme	3
1.2. Name of the course	Engineering geodesy	1.7. Credits (ECTS)	5
1.3. Associate teachers	Ante Marendić Igor Grgac	1.8. Type of instruction (number of hours L + S + E + e-learning)	60 (L-30, E-30)
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	80-90
1.5. Status of the course	obligatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	The aim of the course is to teach students the specifics of engineering geodesy, and theoretical and practical knowledge of engineering geodesy. Preparing students for the works in the field of engineering geodesy, with an emphasis on mastering the methods of staking out points and directions, as well as their practical application for the needs of the civil engineering. In the practical application of these methods the emphasis is on their application on the road construction. Student after successful completion of the course will be able to decide which method of staking out point or direction is best suited for a specific engineering task.
2.2. Course enrolment requirements and entry competences required for the course	AttendedEngineeringgeodetic basis
2.3. Learning outcomes at the level of the programme to which the course contributes	**Knowledge and understanding** - Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. - Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data.. **Applying knowledge and understanding** - Handle geodetic instruments and appropriate measuring equipment properly, and perform geodetic measurements. - Establish geodetic networks needed in surveying and stakeout in order to provide the required quality of the works performed in certain space. - Prepare geodetic documents needed to establish and maintain cadastral records and land registry, as well as the documents

	for engineering works. **Making judgements** - Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. - Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	**The studentswill:** 1. Definethe basictasks ofengineering geodesyincivil engineering,staking outelements of constructionsand how todetermine them. 2.Explainandapply methods ofstakingout pointsanddirections. 3. Make stakingout elaborate of construction. 4. Determine theassessment ofthe accuracyof different methods for stakingout buildings. 5. Evaluatewhich methodis best suited forstaking outa specificengineeringtaskin the constructionof buildings. 6.Describe and apply a method for transferring the staking out axis to the batter boards. 7. Describe thebasic types oftrafficandroadelementsin the horizontal(directions, circular, transitional andcompound curvature) andvertical direction(vertical alignment). 8.Define thelongitudinal and transverseprofilesof roads.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	**Week/Lectures(two hours per week) /Exercises(two hours per week)** 1. L:Introductory lecture, course curriculum andsyllabus,the assignmentsof engineering geodesyin constructionandstakingout elements. E: Introduction exercises 2. L:Methodsof staking out, methods ofstakingout points-primary(classical). E: Exercises–Project number 1-stakingout axisoflong jumppath (practical application of methodsforstaking outpoints). 3. L:Methodsfor refinementpoints, combined methods, staking outpointsusing thebuilt-inmodulesina total station. E: Field exercises. 4.

	L:Stakingout of designedbuildings, coarseand finestakingout methods, and staking out oftransmissionaxisof the buildingon thebatter boards. E: Field exercises- surveyingpath forlong jump 5. L:Methodsof stakingout directions. E: Design practice-makingmodelof pathforlong jump. 6. L:Basic conceptsanddivisionsof public roads. E: Design practice-makingof staking out elaborate. 7. Firstpreliminary exam. 8. L:Planningthe road network, the designof public roads/legal regulations, records of public roadsin the cadastreandland registry, land surveyingin the designof public roads, horizontallyand vertically routeelements(roads/public road). E: Field exercises-stakingout axisof long jump path. 9. L:Road transport. E: Design practice-oral presentationof firstproject. 10. Q:Materialsfor road construction. E: Exercises-Projectnumber 2 -Quality assessment ofdifferent methods for staking out points(determination of the accuracyof different methods for stakingout points). 11. L:Cross-section ofthe road, planningroad network. E: Design practice-oral presentation of secondproject.

	12. L:Surveyingworksfor the designandconstruction of bridges, Geodeticbasis forthe purpose of buildingthe bridge, surveying works forstaking outthe bridge. E: Exercises-Projectnumber 3. -stakingout objectaxisonbatter boards(practical application of differentmethods for transferringconstruction axisonbatter boards). 13. L:Movements and deformations. E: Field exercises-stakingout objectaxisonbatter boards. 14. L:Consultations- repeatingthe entirecourse material. E: Design practice-oral presentationof thirdproject. 15. Second preliminary exam.						
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☒ field work		☒ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☒team work (other)		2.7. Comments:		
2.8. Studentresponsibilities	Obligatorypresence inmore than70% of lectures and exercises. Creatingprojecttasksduring the exercises. For each projectthe studentwill present resultsof his workwith theverificationof independencewiththreequestions. Exercises projectsare: 1. Evaluation ofthe accuracy ofmethodsfor stakingout points. 2.Stakingout andanalysisof staking outpointsusing differentsurveyingmethods. 3.Staking outandanalysisof stakingout direction-axis using differentsurveyingmethods. 4. Transferringthe objectaxis tothe batter boards. Accessingthetwopreliminary exams inwhich studentssolvecomputationalandtheoretical tasks.						
2.9. Screening student work *(name the proportion of ECTS credits for*	Class attendance	1	Research		Practical training	0,5	
	Experimental work		Report		(other)		

eachactivity so that the total number of ECTS credits is equal to the ECTS value of the course)	Essay		Seminar essay		(other)	
	Tests	0,5	Oral exam	1,5	(other)	
	Written exam	1	Project	0,5	(other)	

2.10. Grading and evaluating student work in class and at the final exam	**In writing**: the written part ofthe exam studentsmay be releasedifsuch material isdepositedthroughtwo preliminary examsthat take placeduring the semester. If thestudent does notdeliverthe written part ofthe examby means of preliminary exams he is required totake the writtenpart attheregular examination periods. Exemption fromthe written part ofthe examis valid for allregularexamination periods(any of the four testperiod). The rightto exemption fromthe written examexercisestudentswho achievea minimumscore of 2out ofbothpreliminary exams. **Ratingofthe written examandthe colloquiumset as follows**: Percentage–ratings 61% to 70% -is sufficient(2) 71% to80% -good(3) 81% to 90% -verygood(4) 91% to 100% -excellent(5) **Oral**: theoretical knowledgeis tested onregular examination periodsby placing3-5questions. Oral exam ratingforms ateacheron the basis ofcorrectnessandcompletenessof answers to thequestions. **The finalrating**is determinedbased on the totalknowledgeandcommitmentshownby thestudentduring the semesterwhen makingproject assignments, through testsandexams. The final assessmentis madeofthe success oftheactivities: -Oral exam50% -Preliminary exams orwritten exam 30% - Project tasks20%

	Title	Number of copies in the library	Availability via other media
2.11. Required literature (available in the library and via other media)	Kapović, Z.: Geodesy in civil engineering, University textbook, Faculty of Geodesy, University of Zagreb, 2010.	10	
	Janković, M.: Engineering Geodesy II and III, 1981.	10	
	Hennecke, Muller, Werner: HandbuchIngenieurvermessung, Band 1, Grundlagen, 2. volliguberarbeitete und erweiterteAuflage, 1994.	1	

	Moser, M, Muller, G, Schlemmer H, Werner H (2000): HandbuchIngenieurgeodasie - Grundlagen	1	
	Paar, R. 2013: The manuscript from lectures.		Through e-learning systems for the course
2.12. Optional literature (at the time of submission of study programme proposal)			
2.13. Quality assurance methods that ensure the acquisition of exit competences	Via: 1. Creation ofproject tasks-4task 2.Preliminary exams –2 exams 3.Written exam 4.Oral examination 5. Value theteacherby the students through thesurvey – studentevaluation.		
2.14. Other (as the proposer wishes to add)	Studentsare expected torespectthe principles ofacademic integritywhich are regulated bythe Code of Ethicsof the University(available at: www.unizg.hr). In classit is expectedthateveryone has the rightto speak your mindas long as itdoes not offendthe other person. To perform theexercisesspecialmeasuring equipment is used: dual frequencyGNSSreceivers(2 pieces), robotictotal station(1 piece), preciselevellingwith the addition ofplane-parallelplates (2 pieces), all instrumentswithall necessary equipment, andsoftware packagesforprocessingGNSSmeasurementsandcomputerinclass(15 pcs). Exercises are performedinhigh schoolplaygroundoppositethe Faculty of Geodesyin realisticfield conditionsrequiringthe attentionof students, whicharespecificallywarnedbeforeperforming the exercises.		

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Miljenko Lapaine	1.6. Year of the study programme	3nd year, 6th semester
1.2. Name of the course	Map Projections	1.7. Credits (ECTS)	5
1.3. Associate teachers	Dražen Tutić Martina Triplat Horvat Ana Kuveždić Divjak Marina Viličić Lili Gracin	1.8. Type of instruction (number of hours L + S + E + e-learning)	60 (30L + 30E)
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	100
1.5. Status of the course	Mandatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION			
2.1. Course objectives	The objectives of this course are: • To introduce students into basic map projections used in geodesy, surveying and geoinformatics • To explain unavoidable distortions in different map projections • To make a foundation that will help in the application and choice of suitable map projections		
2.2. Course enrolment requirements and entry competences required for the course	Mathematical Analysis. Differential Geometry.		
2.3. Learning outcomes at the level of the programme to which the course contributes	**Knowledge and understanding** • Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. **Applying knowledge and understanding** • Make plans, maps and related presentations using modern methods and technologies on the basis of measured data and other sources. • Determine and interpret the size, properties and relations of objects in space on the basis of measured data, spatial databases, plans and maps. • Maintain topographic, cartographic, maritime and navigation, and land information systems, integrate and visualise spatial information.		

	• Use information technology in solving geodetic and geoinformation tasks. **Making judgements** • Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. **Communication skills** • Prepare official public documents, reports, graphic and cartographic presentations using the surveying results related to objects in space. • Communicate the results obtained by means of geodesy and geoinformation to clients and experts of geodetic and other related professions. **Learning and ethical skills** • Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards. • Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.		
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	• Define coordinate systems in cartography • Describe Earth's sphere and ellipsoid • Interpert general theory of map projections including their distortion evaluation and distribution • Define map projections classifications • Define important map projections • Solve problems in the official map projections • Choose the appropriate map projection		
2.5. Course content broken down in detail by weekly class schedule (syllabus)	• Coordinate systems in cartography, Earth's sphere and ellipsoid (4 hours) • General theory of map projections including the evaluation and distribution of distortions (2 hours) • Classifications of map projections (normal, transverzal, oblique, equidistant, equal-area, conformal, 4 hours) • Important map projections (conic, azimuthal, cylindrical, pseudocylindrical, pseudoconic, polyconic, miscellaneous, 10 hours) • Solving problems in the official map projections (normal aspect Mercator, Gauss-Krüger, HTRS96/TM, HTRS96/LCC, 6 hours) • Mathematical base of topographic maps (2 hours) • Choosing a map projection (2 hours)		
2.6. Format of instruction:	☒ lectures	☐ independent assignments	2.7. Comments:

	☐ seminars and workshops ☒ exercises ☐ on line in entirety ☐ partial e-learning ☐ field work	☐ multimedia and the internet ☒ laboratory ☐ work with mentor ☒ consultations ☒ evaluations of knowledge	Exercises follow lectures in their content. Three students choose seminars that allow them to be exempted of the written exam.
2.8. Student responsibilities	Regular attendance to lectures and exercises, the possibility of taking part in preliminary exams, the possibility of consulting the demonstrator and teachers, written and oral exams, activity through the system of E-learning. Attending lectures and exercises in the amount of 70% and active participation are conditions for signature. Above 30% of absences - loses the right to the signature, and the signature is a prerequisite for the exam registration.		

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	2.4	Research		Practical training	
	Experimental work		Report		Learning and preparation for preliminary and final exams (other)	2.6
	Essay		Seminar essay		(other)	
	Tests		Oral exam		(other)	
	Written exam		Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	During the semester, the two preliminary exams (tests) exist through which students can be exempted from the written part of the exam. In order to be exempted from the written part of the exam student should acquire a minimum of 50% marks at both preliminary exams. Student achieves a rating on every preliminary exam and the mean of these two ratings is equivalent to the grade of the written exam. Actual rating from continuous assessment applies to one of the first two examination periods in which students attend only the oral exam. If they do not pass the exam, the next time they should take part in the written part. Written exam consists of six tasks. It is necessary to solve three tasks, or 50%, to pass the written part of the exam.

2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Frančula, N.: Kartografske projekcije, Geodetski fakultet, Zagreb, 2004.		e-learning
	Lapaine, M., Tutić, D.: New Official Map Projection of Croatia – HTRS96/TM / O novoj službenoj kartografskoj projekciji Hrvatske – HTRS96/TM, Kartografija i Geoinformacije 2007, special issue, 34-53		e-learning

2.12. Optional literature (at the time of submission of study programme proposal)	Borčić, B. (1955): Matematička kartografija; Kartografske projekcije, Tehnička knjiga, Zagreb Borčić, B. (1976): Gauss-Krügerova projekcija meridijanskih zona, Liber, Zagreb Snyder/Stewart (1997): Bibliography of Map Projections, USGS Bulletin 1856 Lapaine, M., Kuveždić, A. (2007): On the Development of Map Projections / O razvoju kartografskih projekcija, Kartografija i Geoinformacije, special issue, 110-147. Lapaine, M. (2014): Kartografske projekcije i njihove deformacije, pozvano predavanje, Peti hrvatski kongres o katastru, Zagreb, 8–9. 5. 2014., Zbornik radova, ISBN 978-953-97081-9-9, ur. D. Medak, M. Rezo i M. Zrinjski, 15–32 Snyder, J. P. (1987): *Map Projections: A Working Manual*, U. S. Geological Survey Professional Paper 1395, Washington. Snyder, J. P. (1993): Flattening the Earth, Two Thousend Years of Map Projections, The University of Chicago Press. Bugayevskiy, L. M., Snyder, J. P. (1995): Map Projections – A Reference Manual, Taylor & Francis, London, Bristol.
2.13. Quality assurance methods that ensure the acquisition of exit competences	Two preliminary exams, written and oral exam. Student evaluation.
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Boško Pribičević Almin Đapo	1.6. Year of the study programme	III.
1.2. Name of the course	Hydrographic survey	1.7. Credits (ECTS)	5
1.3. Associate teachers	Branko Kordić Luka Babić Vanja Miljković	1.8. Type of instruction (number of hours L + S + E + e-learning)	30L + 30E
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	70-90
1.5. Status of the course	obligatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION			
2.1. Course objectives	The driving factor for this curriculum is bringing specifics and methods of survey on and under the water surface closer to students; preparation of students for conducting hydrographic survey projects, with special attention to processing and visualising bathymetric data; introducing students to maritime organisations in Croatia and the world.		
2.2. Course enrolment requirements and entry competences required for the course	Previously taken courses: Satellite positioning		
2.3. Learning outcomes at the level of the programme to which the course contributes	Knowledge and understanding : - Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Applying knowledge and understanding : - Handle geodetic instruments and appropriate measuring equipment properly, and perform geodetic measurements. - Establish geodetic networks needed in surveying and stakeout in order to provide the required quality of the works performed in certain space. Making judgements : - Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. Communication skills :		

<table>
<tr><td></td><td colspan="3">- Prepare official public documents, reports, graphic and cartographic presentations using the surveying results related to objects in space.
Learning and ethical skills :
- Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards.</td></tr>
<tr><td>2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="3">1. Definition of terms Hydrography, bathymetry, oceanography and marine geodesy as well as knowing basics of marine law and maritime domain
2. Knowing basics and specifics of marine cartography and classification of naval navigational maps
3. Explain the role of International Hydrographic organisation and Croatian Hydrographic institute as well as IHO specifications
4. Knowing naval positioning methods
5. Describe clasic and contemporary depth measurement methods and errors occurring during depth measurements
6. Defining the execution plan for hydrographic survey
7. Mastering the use of a singlebeam echosounder in combination with a GNSS receiver
8. Applying modern methods and techniques of hydrographic survey for production of simple analogue and digital plans, maps and similar</td></tr>
<tr><td>2.5. Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="3">Definition and activity of hydrography. Elements of oceanography. Adriatic Sea. Coordinate systems and map projections in hydrography. Positioning methods on water surface. Classical methods of positioning. Astronomical positioning methods. Terrestrial positioning methods. Positioning by means of electromagnetic waves. Underwater positioning. Hydrographic survey standards. Basics of bathymetry. Classic methods of depth measuring. Acoustic methods for depth measurements. Echo sounder. Echosounder resolution. Converter-transmitter beam model. Influence of the seabed on depth measurement. Single beam echosounder. Echosounder measurement corrections. Combined methods of positioning and depth measurement. Bathymetric maps. The organization of hydrographic activities. International Hydrographic Organization. Croatian Hydrographic Institute. Basics of maritime law. Maritime domain. Concessions.</td></tr>
<tr><td>2.6. Format of instruction:</td><td>☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☒ partial e-learning
☒ field work</td><td>☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td>2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="3">Attending more than 70% lectures and practical exercises. Delivery of project in due term. Presenting project results with</td></tr>
</table>

	evaluation of understanding the presented results in no more than 3 questions. Project tasks are: 1. Determination of the speed of sound in water based on given parameters 2. Determination and correction of errors in the measurement of depth 3. Visualization of the characteristic cross-sectional data based on field measurements Taking two written exams pertaining to assessing both theoretical and practical knowledge obtained thus far.

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	1	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	1	Oral exam	1	(other)	
	Written exam	1	Project	1	(other)	

2.10. Grading and evaluating student work in class and at the final exam	Requirements for obtaining the signature: - Presence in 70% of classes, - Timely made three tasks, - A minimum of 11 points (out of 60 possible) from two mid-term exams. Evaluation: Continuous monitoring of students is applied: during the semester two mid-term exams (tests) will be held, on which one can get maximum of 2 x 30 = 60 points. The first mid-term, after seven weeks of classes, and the second after 13 weeks of classes. The requirement for a positive evaluation of the exercises the right of on the signature, and a minimum of 31 points (out of 60 possible) on mid-term. Rating = M1 + M2 M1, M2 - marks achieved on mid-term. The final grade is determined as follows: Points - Rating 31 to 38 is sufficient (2) 39-45 good (3) 46-53 very good (4) 54-60 Excellent (5) Students who do not pass the exam take written and oral exam. The condition for taking the oral exam is 50% of the possible points in the written part of the exam.

2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the**	**Availability via other media**

		library	
	Pribičević, Boško. Pomorska geodezija / Medak, Damir (ur.). Zagreb : Sveučilišni udžbenik. Sveučilište u Zagrebu - Geodetski fakultet. 2005.	10	
	Lectures presentations		e-learning
2.12. Optional literature (at the time of submission of study programme proposal)	Lachapelle, de Jong, Scone, Elema (2002): Hydrography. Delft University Press. Ingham, A.E. (1992): Hydrography for the Surveyor and Engineer. Third Edition. Blackwell Scientific Publications. Oxford.		
2.13. Quality assurance methods that ensure the acquisition of exit competences	Database of presence in class, student activities, assignment, analysis of the student's exam, analysis of student assignments, student evaluation of the course instructor.		
2.14. Other (as the proposer wishes to add)	Students are expected to respect the principles of academic integrity which are regulated by the Code of Ethics of the University (available at: www.unizg.hr). In class is expected that everyone has the right to speak your mind as long as it does not offend the other person. For performing exercises used special measuring equipment: single beam echo sounder (2 pcs) in combination with a dual frequency GNSS receivers (4 pcs) and software package HypackMax for planning and carrying out hydrographic measurements. Exercises are performed on Sports and Recreational Centre (lake) Jarun and on high school playground across the street from the Faculty of Geodesy (fieldwork) in real field conditions requiring the attention of students, which are specifically warned before performing the exercises.		

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Vicedean for academics and students	1.6. Year of the study programme	3. (summer semester)
1.2. Name of the course	Final exam	1.7. Credits (ECTS)	2
1.3. Associate teachers	All teachers in scientific-academic and academic rank	1.8. Type of instruction (number of hours L + S + E + e-learning)	
1.4. Study programme (undergraduate, graduate, integrated)	bachelor	1.9. Expected enrolment in the course	80
1.5. Status of the course	obligatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	
2. COUSE DESCRIPTION			
2.1. Course objectives	To execute final testing of acqured knowledge and skills during the whole study by solving the written exam.		
2.2. Course enrolment requirements and entry competences required for the course	Passed all exam of obligatory courses of undergraduate study		
2.3. Learning outcomes at the level of the programme to which the course contributes			
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)			
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Students take the final exam in written form. The written exam consists of 40 questions from the fields based on mathematical, physical, geodetic and geoinformation material. The written exam lasts 180' and students need to write the answers to each question. The questions can be theoretical, as well as computational tasks in order to evaluate the knowledge level achieved by the students during the Bachelor study programme in adequate way. The length of the questions is adjusted to that kind of exam and should not be longer than one paragraph, a few formulas with the interpretation of tags, i.e. of problem task that is intended to show the understanding of the problem and its solution and not lengthy calculation. The written exam is conducted by the appointed committee with the vice-dean for academic and students affairs being its chair.		

<table>
<tr><td>2.6. Format of instruction:</td><td>☐ lectures
☐ seminars and workshops
☐ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td>☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☒ Writen exam (other)</td><td>2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="3">To attend the final exam.</td></tr>
</table>

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance		Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests		Oral exam		(other)	
	Written exam	2	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam

Each answer is scored with 5 points and it is possible to earn the total of 200 points. In order to pass the final exam, students must answer correctly 50% of question (earn 100 points). The final exam grade is derived from the number of earned points:

- sufficient: 101 – 125 points
- good: 126 – 1 50 points
- very good: 151 – 175 points
- excellent: 176 – 200 points.

2 ECTS points stand for the Final exam – written exam (basic mathematical, physical, geodetic and geoinformation knowledge)

2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**

2.15. Optional literature (at the time of submission of study programme proposal)	
2.16. Quality assurance methods that ensure the acquisition of exit competences	Exam statistica and students questionares.
2.17. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Mraović, Branka	1.6. Year of the study programme	III.
1.2. Name of the course	Management in Geodesy and Geoinformatics	1.7. Credits (ECTS)	3
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	30 (15 L + 15 S)
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate, sixth semester	1.9. Expected enrolment in the course	50
1.5. Status of the course	optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	level 2 of e-learning

2. COUSE DESCRIPTION	
2.1. Course objectives	The course is aimed at today's students and tomorrow's managers who want to understand the essentials of management as they apply within the contemporary work environment of geodesy and geoinformatics bearing in mind the context of harmonizing the Croatian business and legal environment with those in the European Union.
2.2. Course enrolment requirements and entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. Demonstrate competences in real estate registers and interests in real estates, understand land development measures and methods of land evaluation. Demonstrate competences in regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy right, publishing and exchange of spatial data. Use information technology in solving geodetic and geoinformation tasks.

	Communicate the results obtained by means of geodesy and geoinformation to clients and experts of geodetic and other related professions. Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards. Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Understand which personal competences are needed for managerial success. To acquire a personal perspective on four basic management functions or responsibilities: planning, organizing, leading and controlling. Identify different levels and types of managers in geodetic and geoinformatic company and institution. Understand fundamentals of organizing in geodesy and geoinformatics as an essential managerial responsibility. To use different management structures in geodesy and geoinformatics depending on conditions such as environment, technology and size. To anticipate future needs and managerial responses in geodesy and geoinformatics. Understand managerial agendas and networks in geodesy and geoinformatics. Demonstrate competence in understanding the management functions across cultures. Analyse managers as decision makers and problem solvers in geodesy and geoinformtics.

	To use leading through motivation in geodesy and geoinformatics. Demonstrate competence in making comparative study of how management in geodesy and geoinformatics is practiced in Croatia and aroud the world. Understand steps in the team-building process. Analyse and interpret characteristics of high-performance and poor-performance teams. Use team-building as an ongoing leadership responsibility. Demonstrate competence in distinguishing useful team roles. Demonstrate competence in using critical thinking in team work. Describe and analyse characteristics of team members. Identify skills and types of contribution which may be expected by individual team members. Differentiate high performance teams as they can be applied in various fields of geodesy and geoinformatics. Demonstrate competence in using evaluation research to make sure that actual performance meets or surpasses company/institution objectives. Analyse and interpret phases of evaluation research: 1. needs estimation, 2. program planning, 3. formative evaluation, 4. summative evaluation. Analyse and interpret a concept of the „learning organization“ in geodesy and geoinformatics. Understand the process of harmonizing the Croatian business and legal environment with those in the European Union, and with the international standards of doing business.

	Understand the importance of balance sheet equation for the business subject safety. Analyse and interpret qualitative characteristics of financial reports. Understand the function of financial literacy and its importance for profession of geodetic engineer. To acquire a perspective on various types of financial reports and levels of financial literacy.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	**Course Content – Lectures (by weekly class schedule – 15 hours)** 0. Course Organisation - Basic instructions and guidelines about teaching, e-learning, course content, student responsibilities and rights, grading and evaluating student work in class and the final exam. 1. Major schools on management thought – Historical views on geodetic company as learning organization. Success factors in geodesy and geoinformatics. Pressing problems in the geodetic sector. Geodetic sector and related sectors of the economy. 2. Managers in organizations - The ten roles of managers as identified by Henry Mintzberg: Interpersonal roles; 2. Informational roles; 3. Decisional roles. 3. The management process – Four functions of management: planning, organizing, leading, controlling. 4. Managerial skills and competencies – Top level managers; 2. Middle level managers; 3. Lower level managers. Conceptual skills. 2. Human skills. 3. Technical skills. 5. Personal competencies for managerial success – Leadership. Self-objectivity. Analytic thinking. Behavioral flexibility. Oral communication. Written communication. Personal impact. Resistance to stress. Tolerance for uncertainty. 6. Team-building and team work – Building self-managing work teams. Psychological profiles of team members and their roles in teams. Types of teams. Virtual teams. How can team building increase group effectiveness. What can go right/What can go wrong?

	7. Types of managers - Line managers. Human resource managers. Functional managers. General managers. Administrators. 8. Responsibilities of a supervisor (line-manager) – Examples from geodetic companies and institutions: Plan and schedule work daily, weekly and monthly. Clarify tasks and gather ideas for improvement. Appraise performance. Recommend pay increases. Inform subordinates. Inform high levels. Recruitment and training. Motivation. 9. Stakeholders in company – General manager. Financial stakeholders. Customers, suppliers and competition. Members of government, the press and the public. Superiors. Peers. Immediate subordinates.Subordinates od subordinates. 10. Financial reporting in small, middle sized and large company – Key forms of financial reports: 1. Reports for managers; 2. Reports for shareholders; 3. Reports for tax authorities. 11. Standardized forms of financial reports – Main financial statements: 1. The income statement or profit and loss account; 2. The cash flow statement; 3. The balance sheet statement or statement of financial position. 12. Decision making process – Financial and investment decisions. Sources of funding. Investment opportunities. Savings and profit retained. 13. Fundamentals of organizing – Organization charts and the formal structure. Technology and structure. Functional structures. Divisional structures. Matrix structures. Team-based structures. Network structures. 14. Terminology in financial accounting and reporting – Assets. Liabilities. Shareholders' equity or equity capital. Share capital. Earnings or net income. Stock market exchange. Share. Option. Difference between the American and the European options. 15. Geodesy and geoinformatics and the global economy – Global environment, corporate governance, ongoings inside geospatial domain and geodetic profession. Critical stakeholders in geodetic sector. **Course Content – Seminars and student practical work in the field (by weekly class schedule – 15 hours)** During their seminar work students keep analysing the stakeholders in the geodesy and geoinformatics – companies, institutions in Croatia, international organisations and media. In every moment, it is important to know: Where are you? Who

you are doing business with? The work aims:

9. To learn something useful from practical examples.
10. To hear an interesting geodetic story and use it to compile teaching material.
11. To learn how to follow competitors.
12. The project promotes the values of work and personal engagements towards success.

A CONCEPT OF STUDENT'S HOMEWORK

The profile of a stakeholder should contain:

11. General data about stakeholder and the history.
12. Technical image of the company.
13. Analysis of standardized financial reports of the company.
14. Form of business organisation – organisational design and how it has been changed in certain period.
15. Interview with stakeholders.

The profile consists of two parts :

5. Presentation.
6. Essay – comments and analysis of collected data.

This part of our teaching activity is related to the process of making our students acquainted with the demands of the European Union related to the transparency of business performed by legal and natural persons, as well as with the efforts made in geodesy in the processes of harmonizing the Croatian business and legal environment with those in the European Union, and with the international standards of financial business.

The function of the essay is to turn the data – images, numerical and textual data into a story with figures, plot and action. The students should answer to basic questions:

5. What the companies in geodesy are dealing with?

6. What is the factor of success in geodesy?

The individual approach and creativity are highly valued in writing an essay

Work phases

1. PHASE: Students have selected the stakeholders being the subject of their project research on their own. First, they had to suggest a few stakeholders (up to 5) out of each category – company, institution, international organisation and medium, regardless of the fact whether they already knew something about them or found out the information by searching web pages.

2. PHASE : Students were divided into working teams allowed to group themselves on their own. In this way, there were 41 working teams formed out of 83 students.

3. PHASE: The stakeholders were finally selected. Each student's team could process one stakeholder, so that 41 teams finally made 42 profiles. One team worked comparatively on researching two stakeholders (two geodetic companies).

4. PHASE: Students had to study by means of web pages the way in which a stakeholder was presented and then periodically report about it at seminar sessions.

5. PHASE: Students had to make a questionnaire for the observed stakeholder. They were allowed to ask the questions first that they found most interesting. The questions from students' questionnaires were continuously discussed at seminar sessions. Based on suggestions given by the colleagues from other teams, some questions were modified, and some supplemented.

6. PHASE: Students had to analyse the financial reports of the observed stakeholders on the web pages of FINA. Those students who had international organisations as the objects of their research, contacted directly their stakeholders. The students who selected the institution in Croatia as their stakeholder collected the data in practical work guided their teacher.

7. PHASE: The analysis of the financial business of stakeholders. After the students had collected the data, they were able to analyse the company's balance sheet alone at the seminar sessions, as well as the financial activities of the stakeholders in the

<table>
<tr><td></td><td colspan="3">budget of the City of Zagreb, the stakeholders in the state budget, and the financing of international organisations.

8. PHASE: Students contacted directly the stakeholders and arranged a meeting at the physical location of the stakeholder, when it was possible. The students contacted the stakeholders at distant locations by phone or e-mail. In this work phase, the interviews with stakeholders were done.

9. PHASE: The teams presented their analyses of collected data in front of their colleagues.

10. PHASE: Two assignments were created in the e-learning environment of the course.

➢ **First assignment**:
The students needed to visit the web page of FINA register of public reports, study the balance sheets of the most successful entrepreneurs in 2012 and compare them with the balances of the business subject whose business they monitored within the scope of the task Stakeholder’s profile in geodesy

➢ **Second assignment**:
During the seminar session, there was a discussion *pro et contra* opened about the public report on financial results of the company. The basic questions were focused on the usage of financial reports, why the financial reports should be read and whether the financial reports should be public.

11. PHASE: The working teams handed their presentations and essays to their teacher in digital and analogous forms. Their work resulted in the creation of 41 teaching materials about 42 stakeholders in geodesy.</td></tr>
<tr><td>2.6. Format of instruction:</td><td>☒ lectures
☒ seminars and workshops
☒ exercises
☐ on line in entirety
☒ partial e-learning
☒ field work</td><td>☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☒ work with mentor
☐ (other)</td><td>2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="3">Create a stakeholder's profile in geodetic sector by student's own choice – company, institution, international organisation,</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">media. The profile ought to be focused on basic functions of management in geodesy and geoinformatics.

Obligatory class attendance of 70% lectures.

Obligatory class attendance of 70% seminars.

Obligatory two Moodle E-tests.</td></tr>
<tr><td rowspan="5">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>0.5</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Essay</td><td>0.5</td><td>Seminar essay</td><td>0.5</td><td>(other)</td><td></td></tr>
<tr><td>Tests</td><td>0.5</td><td>Oral exam</td><td>0.5</td><td>(other)</td><td></td></tr>
<tr><td>Written exam</td><td>0.5</td><td>Project</td><td></td><td>(other)</td><td></td></tr>
<tr><td>2.10. Grading and evaluating student work in class and at the final exam</td><td colspan="6">Written and oral exam, and two E-tests.

Prerequisities for teacher's signature and partial immunity of the final exam

Prerequisities for teacher's signature
- minimum class attendance of 70%
- To make a stakeholder's profile in geodetic sector – seminar presentation and essay
- Two Moodle E-tests.

Immunity of written exam
-Student must pass both Moodle E-tests (2 to 5 rating)
-Presentation
-Essay
-Regular class attendance – lectures and seminars

Immunity of oral exam

- Student must pass both E-tests (4 to 5 rating)</td></tr>
</table>

	-Presentation – rating 4 to 5 -Essay -Regular class attendance – lectures and seminars		
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Books/Textbooks • Mraović, B. (2010.) *Globalni novac, Politička uvjetovanost financijske informacije: socijalna kritika*, SKD Prosvjeta, Zagreb, ISBN 978-953-7611-20-0; CIP 741093. (scientific book, language: Croatian), number of pages: 336. • Mraović, B., (1995.) Pobjednici i gubitnici, Organizacijske implikacije tehnološkoga razvoja, Zagreb: Nakladni Zavod Globus, UDK 65.01, ISBN 953-167-046-3, (scientific book, language: Croatian), number of pages: 383.	Available in the libraries of the city of Zagreb and other Croatian libraries	
	Electronic teching materials available on Moodle: Mraović, B. (2011.) *Uvod u menadžment*, Sveučilište u Zagrebu, Geodetski fakultet		Moodle
		Available in the libraries of the city of Zagreb and other Croatian libraries	

2.12. Optional literature (at the time of submission of study programme proposal)	Analysis of financial reporting • Gulen, D., Spajić, F., Spremić, J., Tadijančević, S., Vašiček, V., Žager, K. Žager, L., Računovodstvo, Ekonomski fakultet Zagreb i Hrvatska zajednica računovodstva i financijskih djelatnika, Udžbenici Sveučilišta u Zagrebu, Zagreb, 2006. • Brković, V. (ur), Hrvatski računovodstveni sustav (službeni tekstovi za Hrvatsku), RRIF, Zagreb, 2008. • Direktive EU, globalizacija odnosno harmonizacija hrvatskog računovodstva • Zakon o računovodstvu • Greuning van H., Bratanović, Brajković, S., Analiza i upravljanje bankovnim rizicima, Pristupi za ovjeru organizacije upravljanja rizicima i izloženosti financijskom riziku, Međunarodna banka za obnovu i razvitak / Svjetska banka i MATEJ Zagrebačka škola ekonomije i menadžmenta, Zagreb, 2006. • Mraović, B., Pobjednici i gubitnici, Globus, Zagreb. • Spajić, F., Gulin, D., Orsag, S., Vašiček, V., Žager, L., Leho, S., Avelini Holjevac, J., Mrša, J., Analiza financijskih izvještaja, Hrvatska zajednica računovodstva i financijskih djelatnika i Računovodstvo i financije, Zagreb, 1994. • Rosenberg, J.M., Dictionary of Business & Management, John Wiley & Sons, Ire., New York • Gulin, D., Idžojtić, J., Novaković, Ž., Konsolidacija financijskih izvještaja, Hrvatska zajednica računovodstva i financijskih djelatnika & časopis Računovodsvo i financije, Zagreb, 1999. • Hrvatsko-engleski ekonomski rječnik, MATE • Žager, K., Žager, L., Analiza financijskih izvještaja, Masmedia, Zagreb • Časopis Ekonomija, časopis za ekonomsku teoriju i politiku • Ekonomski leksikon, Zagreb, Leksikografski zavod Miroslav Krleža i Masmedia, 1995. • Gulin, D., Orsag, S., Vašiček, V., Žager, L., Analiza financijskih izvještaja, poslovanje dionicama, poslovne kombinacije, konsolidacija, Seminarski materijal, Hrvatska zajednica računovodstva i financijskih djelatnika & časopis Računovodstvo i financije, Zagreb, 1996. • Šošić, H., Bilančna i financijska politika najvećih korporacija, Narodne novine, Zagreb, 1991. • Ekonomski leksikon, Zagreb, Leksikografski zavod Miroslav Krleža i Masmedia, 1995. • Gulin, D., Orsag, S., Vašiček, V., Žager, L., Analiza financijskih izvještaja, poslovanje dionicama, poslovne kombinacije, konsolidacija, Seminarski materijal, Hrvatska zajednica računovodstva i financijskih djelatnika & časopis Računovodstvo i financije, Zagreb, 1996. • Šošić, H., Bilančna i financijska politika najvećih korporacija, Narodne novine, Zagreb, 1991. • Parker, R.H., Understandng Company Financial Statements, Penguin Books, 1994. • Natts, J., Accounting in the Business Environment, I., II., Ritman Publishing, London, 1996. • Galbraith, J.K., Novac, Odakle je došao, kamo je otišao, Stvarnost, Zagreb, 1975.

	• Marshall, P., How to Understand Finance at Work, A guide to better managemet and decision-making, How to Books, Plymouth, 1994.
2.13. Quality assurance methods that ensure the acquisition of exit competences	- continuous monitoring of student knowledge **Rating** Continuous via project tasks: *Written* - Writing essays based on prescribed literature - Writing essyas based on itelligent search of websites - Writing critical essays - Making seminar presentations - Written exam *Oral* - Public presentation of seminar work in lecturing room - Oral exam *Electronic media* Analysing websites The final exam is written and oral.
2.14. Other (as the proposer wishes to add)	Student is expected to accept and respect the principles of academic honesty and integrity prescribed and regulated by the Ethical codex of the University of Zagreb (document available at: www.unizg.hr). In a lecturing room student is allowed to express his/her opinion in a tolerant and open minded way.

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Vlado Cetl	1.6. Year of the study programme	3.
1.2. Name of the course	Geoinformation Infrastructure	1.7. Credits (ECTS)	5.0
1.3. Associate teachers	Radan Vujnović	1.8. Type of instruction (number of hours L + S + E + e-learning)	20L+10S+30E
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	40
1.5. Status of the course	Optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	The objective of the course is to provide teoretical and practical knowledge in Geoinformation infrastructure
2.2. Course enrolment requirements and entry competences required for the course	Passed courses: Cadastre and Geoinformation Modelling
2.3. Learning outcomes at the level of the programme to which the course contributes	Demonstrate competences in regulations and administrative framework important for geodesy and geoinformatics, the regulations related to copy right, publishing and exchange of spatial dana Maintain topographic, cartographic, maritime and navigation, and land information systems, integrate and visualise spatial information Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Describe and use key and utility registers and other databases of economic and public utility infrastructure Distinguish and use geoinformation services Explain Spatial Data Infrastructure and its parts Describe and distinguish levels of spatial data infrastructure Use Geoinformation infrastructure

<table>
<tr><td>2.5. Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">1. Spatial units
2. Utility cadastre
3. Municipality Information Systems (MIS), Data, Tools, Functions. Competencies. Contents
4. Creation of utility cadastre. Docummentation. Searching utilities and searching devices. Methods. Analysis.
5. The new administration tasks. Management = service to citizens. Information place. MIS conditions. Descriptive data. Logical organizationof MIS. Hybrid systems. Network topology
6. Costs/benefits. Optimal dana basis: Adresses, Water supply, Sewerage, Electricity, Gas. Data organisation data. The layers of data. Industrial applications of GIS. Contents. Features. Maintenance. Usage of dana
7. Activities in the world. Download and exchange of data. Maintenance of MIS.
8. Preliminary exam
9. Spatial Data Infrastructure. (Geographic information infrastructure) - local, national and global.
10. EUROPEAN SDI. INSPIRE in general
11. INSPIRE components (data, services, metadata, network services). INSPIRE data specifications
12. National Spatial Data Infrastructure (NSDI) in general. The NSDI development in Croatia
13. Presentation of seminars
14. Presentation of seminars
15. Preliminary exam

Exercises: Work on geoinformatic projects</td></tr>
<tr><td>2.6. Format of instruction:</td><td colspan="2">☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☒ partial e-learning
☒ field work</td><td colspan="2">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td>2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="5">Regular attendance of more than 70% lectures and 70% exercises. Completition of the project on the exercises</td></tr>
<tr><td rowspan="5">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>0.5</td><td>Research</td><td></td><td>Practical training</td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>1.0</td><td>(other)</td></tr>
<tr><td>Tests</td><td>1.0</td><td>Oral exam</td><td>1.0</td><td>(other)</td></tr>
<tr><td>Written exam</td><td>0.5</td><td>Project</td><td>1.0</td><td>(other)</td></tr>
</table>

2.10. Grading and evaluating student work in class and at the final exam	During the semester, two preliminary exams are organized. Students who pass both exams are exempted from the exam		
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Groot, R., McLaughlin, J., (2000): Geospatial data infrastructures, Oxford University press, Oxford.	10	
	Cetl, V.: Geoinformation infrastructure, Internal script		online
	Online course materials on e-learning system		online
2.12. Optional literature (at the time of submission of study programme proposal)	Bernard, L., Fitzke, J., Wagner, R. M. (2005): Geodateninfrastruktur, Wichmann, Heidelberg Bill, R., Seuß, R., Schilcher, M. Kommunale Geo-Informationssysteme Basiswissen, Praxisberichte und Trends, Herbert Wichmann, Heidelberg, 2002 Standards, legislative documments		
2.13. Quality assurance methods that ensure the acquisition of exit competences	In accordance with the Quality Policy and Quality Manual, University of Zagreb and the quality assurance system of the Faculty Survey evaluation of subjects and teachers. Self-evaluation of teachers		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Robert Župan	1.6. Year of the study programme	3
1.2. Name of the course	Web-Cartography	1.7. Credits (ECTS)	3
1.3. Associate teachers	Stanislav Frangeš Vesna Poslončec-Petrić Igor Birin Krunoslav Šoštarić	1.8. Type of instruction (number of hours L + S + E + e-learning)	30 (15L+15E) e-learning = yes
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	40
1.5. Status of the course	Elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	level 2
2. COUSE DESCRIPTION			
2.1. Course objectives	The acquisition of theoretical and practical knowledge about static and dynamic web maps and their application and visualization for navigation, tourism and Government Administration in Emergency Situations.		
2.2. Course enrolment requirements and entry competences required for the course	No conditions		
2.3. Learning outcomes at the level of the programme to which the course contributes	Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. Make plans, maps and related presentations using modern methods and technologies on the basis of measured data and other sources. Maintain topographic, cartographic, maritime and navigation, and land information systems, integrate and visualise spatial information. Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. Prepare official public documents, reports, graphic and cartographic presentations using the surveying results related to objects in space. Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards.		

2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	The students will: - Identify the characteristics of functionality and interactivity of web maps, - Explain the theoretical assumptions web cartography, - Master the complex features, rules and tools to display maps on the web, - Apply the acquired knowledge about static and dynamic web maps, - Carry out the procedures for creating web maps and visualization of spatial data.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	The content of lectures: 1. The functions of web maps. 2. The role of web cartography in today's information society 3. What factors influence the design web map 4. Elements of web maps 5. Analysis of programs and different creation technologies for web map design 6 . Classification, types and subtypes of web maps 7. Midterm exam 1. 8. Atlases on the web 9. GIS and web-maps 10. Web map publishing, copyrights and rights of use 11. Future of web-cartography 12. The use of web maps 13. Users of web maps 14. Cybercartography 15. Midterm exam 2. Exercises: 1. Implementation of the survey among students in order to determine the level of knowledge in the use of different software houses needed for the practical development of web-maps (1 hour). 2. In agreement with the students the most acceptable choice of software (eg. OCAD) (1 hour). 3. Introduce students to the terms of reference, the embodiment, terms and conditions handing over the project. The division of project tasks (1 hour). 4. Discussion of the optimization work on a particular task (1 hour). 5. Collection of data required to work on the set project. Field data collection, available online or other available data.

	Operating instructions of the first part of the task (creating maps) with the selected software (OCAD), with an emphasis on its advantages and disadvantages (1 hour). 6. Presentation of the work in OCAD., Examples of making simple tasks and defining the rules of presentation. 7th Working with files and attribute data on the map (1 hour). 8th Solving and devising specific individual tasks, and web-ticket (1 hour). 9th Georeferencing and supplement the data collected on the concrete tasks (1 hour). 10th visualization of data in relation to the means of expression and control of making maps on the web with a particular individual tasks (1 hour). 11th Submission of project documentation in written or digital form, a presentation on the completion of the project (5 hours).

2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work	☒ independent assignments ☐ multimedia and the internet ☒ laboratory ☐ work with mentor ☒ midterm exams (other)	2.7. Comments:

2.8. Student responsibilities	Compulsory attendance at 70% of teaching - lectures. Compulsory attendance at 70% of classes - exercises. Compulsory submission of projects task.

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	0,3	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	1,0	Oral exam	0,7	(other)	
	Written exam	1,0	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	Preliminary exams during the semester: - 2 tests - Each colloquium has 5 theoretical questions that should write a short response (to the size of a paragraph), - Colloquium is written for 20 minutes - Scoring: - The correct answer is scored with 4 points - Maximum points per exam = 20 - Total maximum points = 100

	- To pass the colloquium need to win 10 points, - The passage of the previous colloquium conditional accession to the following, - Passage at all colloquia allows the release of the written exam and - Depending on the number of points of all the activities that are pointed. Mandatory requirement for entry into the evaluation system is the realization of minimum conditions (the right to the signature). The right to exercise the signature of students who achieve the following conditions: 1. Students with a minimum of 32 points (presence of two points, preliminary exams 20 (10 + 10) points and project 10 points). Evaluated by the points: Points Rating 70 points to 80 points = sufficient (2) 81 points to 88 points = good (3) 89 points to 95 points = very good (4) 96 points to 100 points = excellent (5) Students can accept assessment or take the exam at one of the scheduled exam date. Written part of the final exam: - Consists of six questions that need answering complete more comprehensive response, - The correct answer to each question is scored with one point (maximum 6 points) with gradation evaluating the tenth of a point, - To pass the written part of the exam is necessary to win 4 points, - Score on the written part of the examination shall be determined as follows: 4.0 - 4.5 points: sufficient (2) 4.6 to 5.0 points: Good (3) 5.1 to 5.5 points: very good (4) 5.6 to 6.0 points: excellent (5) The oral part of the final exam: - All students and students are required to take the oral examination, - Students and students answer 3-5 questions - Assessment of oral examination form teacher on the basis of safety and Integrity of the answers to these questions.

	Overall rating is formed from the written (1 share) and oral examination (share 0.7) according to the specified ratios or weights exam		
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Župan, R. – Web Cartography, internal script, Faculty of Geodesy, Zagreb 2013.		e-learning
	Kraak, M.-J., Brown, A.: Web Cartography – developments and prospects. ITC Division of Geoiformatics, Cartography and Visualisation, Taylor & Francis, London, New York 2001	1	http://libgen.org/get.php?md5=7F66198463D74D2002A626FF7EFD4667
	Župan, R. (2014): Lectures in a PPT forms		e-learning
2.12. Optional literature (at the time of submission of study programme proposal)	Gray, N.: Web Server Programming. University of Wollongong, J. Wiley and Sons 2003.Kaufman, J., Staudler, D. (1998): Cadastre 2014, FIG publication. Doyle, S., Dodge, M., Smith, A.: The potential of web-based mapping and virtual reality technologies for modeling urban environments. Centre for Advanced Spatial Analysis, University College London, 1998.		
2.13. Quality assurance methods that ensure the acquisition of exit competences	Periodic testing of the acquired knowledge of students - two midterm exams. Periodic testing adopted practical knowledge of students – submission two tests when submitting the project. Passing the written and oral examination. Self-evaluation of teachers and interviewing participants.		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Drago Špoljarić	1.6. Year of the study programme	III.
1.2. Name of the course	Geodetic Astronomy	1.7. Credits (ECTS)	5
1.3. Associate teachers	-	1.8. Type of instruction (number of hours L + S + E + e-learning)	60 (30L-30E)
1.4. Study programme (undergraduate, graduate, integrated)	study of geodesy and geoinformatics, BSc	1.9. Expected enrolment in the course	60
1.5. Status of the course	optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	e-learning 2

2. COUSE DESCRIPTION	
2.1. Course objectives	The acquisition of basic theoretical knowledge in spherical and geodetic astronomy required for understanding and mastering the practical astrogeodetic tasks in engineering geodetic practice. Understand the theoretical assumptions necessary for mastering of the other courses in which students require such specific knowledge.
2.2. Course enrolment requirements and entry competences required for the course	no
2.3. Learning outcomes at the level of the programme to which the course contributes	**Knowledge and understanding** Understand the role of geodesy, geoinformatics and spatial data in modern world, demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. **Applying knowledge and understanding** Handle geodetic instruments and appropriate measuring equipment properly, and perform geodetic measurements. **Making judgements** Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. **Learning and ethical skills** Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning	Differentiate and define the celestial coordinate systems and phenomena that change the coordinates of celestial bodies, describe celestial coordinate reference systems and frames.

outcomes)	Compare and recalculate the coordinates in different celestial coordinate systems. Differentiate and define time systems and scales, calendars, epochs and dates and describe modern measuring time (quartz and atomic clocks). Compare and recalculate the basic timescales. Differentiate and describe the procedures (methods) for determining the astronomical coordinates of the station and astronomical azimuth. Apply determining the astronomical coordinates and azimuth in specific tasks of surveying engineering profession and analyze topical measurements
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Lectures: 1. Content and organization of the course. The importance and application of astronomy. Subject and division. 2. Object in the celestial sphere, their magnitude and real and apparent motion. 3. Celestial sphere. Celestial coordinate systems. Mean and apparent places. 4. Phenomena that change the coordinates of celestial bodies: refraction, aberration and parallax. 5. Phenomena that change the coordinates of celestial bodies: the precession and nutation. 6. Motion of the Earth's poles and non-uniformity of the Earth's rotation. 7. Time. Historical review of the measuring of time (processes or devices). Calendars. Epochs and dates. Julian Date (JD, MJD). 8. Time systems and scales (apparent and time solar and sidereal time). 9. Time systems and scales (UT0, UT1, ET, TDT, TT, BDT, TCG, TCB, UTC, TAI, GPST, GLONASST). 10. Modern devices for measurnig of time, synchronization and time distribution. 11. Methods of determining the astronomical azimuth (direct method). 12. Methods of determining the astronomical azimuth (indirect methods: hour angle and zenith distance). 13. Individual and simultaneous determination methods of astronomic latitude and longitude (Horebow-Talcott method, a meridian passing star, method of equal height). 14. Automation, testing and application of determining the astronomical azimuth in engineering surveying profession. 15. Celestial reference systems and frames (the basics). Exercises: 1. Introducing students to the project, the embodiment, terms and conditions handing over the project. 2. Computer animation celestial sphere, the stars and constellations. 3. Computer animation astronomical phenomena, apparent and true movement of the celestial bodies. 4. Visit Planetarium at the Tehnical Museum. 5. Online recalculate the coordinates between the celestial coordinate systems. Visualization of the celestial sphere and the

	calculated positions of the heavenly bodies. 6. The first project task: Conversion time scales. 7. The design of the project task (exercise repetitions). 8. The first partial exam. 9. The second project task: Determination of astronomical azimuth with Polar star observation. 10. The design of the project task (exercise repetitions). 11. Determination of astronomical azimuth with the Sun observation (practical exercises). 12. Simultaneous determination methods of astronomic latitude and longitude (practical exercises). 13. The second partial exam. 14. The partial exam repetitions. 15. The visit to the Astronomical Observatory Zagreb with thematic lecture and observation of the night sky.				
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)		2.7. Comments: 6h of 30h exercises performed in the open (field exercises - azimuth determination and astr. coordinate observation of the Sun and stars)	
2.8. Student responsibilities	Mandatory attendance at 70% of teaching - lectures Mandatory attendance at 70% of classes - exercises Required delivery of two project tasks				

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	1.5	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	1.0	Oral exam	1.5	(other)	
	Written exam	1.0	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	Accessing two partial exam in which students respond to theoretical issues, while at the exercises show practical skills. Preliminary exams are conducted in writing by circling the correct answer or a short essay. Each partial exam content corresponds to the previously processed teaching units. The final exam knowledge is written and oral. If a student does not collect sufficient number of points at partial exams, he is required to pass the regular written / oral examination. Minimum 50% (or 50 points) achieved by each partial exam is a condition for the release of the written exam by tests. List of points and score written exam achieved on the basis of assessment by a written test: 100-130 points is sufficient (2)

	131-160 points good (3) 161-185 points very good (4) 186-200 points excellent (5) Oral examination at the regular examination periods. The final grade is determined based on the total score of written and oral examination.		
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Špoljarić D.: Materijali s predavanja i vježbi		
	Terzić P.: Sferna astronomija, Geodetski fakultet Sveučilišta u Zagrebu, 1990.	5	
	Terzić P.: Geodetska astronomija II, Sveučilište u Zagrebu Geodetski fakultet, Zagreb 1988.	5	
	Roša, D. (2011): Elementarna astronomija I dio. Zvjezdarnica Zagreb, Zagrebački astronomski savez, Zagreb.		
	Roša, D. (2014): Elementarna astronomija II dio. Zvjezdarnica Zagreb, Zagrebački astronomski savez, Zagreb.		
2.12. Optional literature (at the time of submission of study programme proposal)	Schödlbauer, A. (2000): Geodätische Astronomie, Grundlagen und Konzepte. Walter de Gruyter, Berlin, New York. Mueller, I., Eichhorn, H. (1968): Spherical and practical astronomy as applied to geodesy. Frederick Ungar Publishing Co., New York.		
2.13. Quality assurance methods that ensure the acquisition of exit competences	Periodic testing of the adopted theoretical knowledge of students - 2 partial exams. Periodic testing adopted practical knowledge of students - two tests when submitting tasks. Passing a written and oral examination. Self-evaluation of teachers and interviewing participants.		
2.14. Other (as the proposer wishes to add)			

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Jelka Beban Brkić	1.6. Year of the study programme	Third, 6th semester
1.2. Name of the course	Discrete mathematics	1.7. Credits (ECTS)	5
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	30(P)+20(V)+10(S)+e-learning
1.4. Study programme (undergraduate, graduate, integrated)	Bachelor Study	1.9. Expected enrolment in the course	some fifty
1.5. Status of the course	elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	e-learning level: 2

2. COUSE DESCRIPTION	
2.1. Course objectives	Renew and expand the knowledge of basic mathematical concepts and methods used in computer engineering / informatics science. Develop a sense of different degrees of mathematical rigor and formalism and learn to use them in problem solving tasks. Distinguish parts of mathematics that studies finite systems, i.e. deals with objects that can assume only a specific value. Argue the reasons why the characteristics of the computer are described within the framework of finite mathematical systems. Become familiar with the language of computer science.
2.2. Course enrolment requirements and entry competences required for the course	Passed exams: Basics of Geoinformatics, Programming Competencies required: basics of mathematical logic, elementary functions, understanding of algorithms and programming
2.3. Learning outcomes at the level of the programme to which the course contributes	• Understand mathematical methods and physical laws applied in geodesy and geoinformatics. • Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of problems in the field of geodesy and geoinformatics. • Use information technology in solving geodetic and geoinformation tasks • Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. • Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.

<table>
<tr><td>2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="3">• recognize and apply basic types of mathematical reasoning;
• define and classify binary relations on sets knowing their properties and typical examples;
• pronounce and apply the properties of relations in systems for data processing and for the development of functional algorithms;
• adopt basic combinatorial concepts and counting rules and recognize them when counting the elements of a finite set;
• determine the generating function of the starting sequence and identify and solve simple recurrence relations;
• apply the theory of Boolean algebra to design logic circuits and networks;
• distinguish the basic concepts of graph theory;
• Compare and model certain combinatorial problems using graph theory (shortest path algorithm, nearest neighbor algorithm,...).</td></tr>
<tr><td>2.5. Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="3">Mathematical logic 2h
Sets and relations 2h
Ordered sets and mashes 2h
Applications in informatics 2h
Introduction to combinatorics (counting techniques) 4h
Recursive functions 1h
Applications in informatics 2h
1st preliminary exam 1h
Dirichlet principle; Generating functions; Ramsey's theorem 2h
Boolean algebra (definition and properties, Boolean functions) 2h
Graphs (paths and cycles) 2h
Directed graphs 2h
Graph colourings 2h
Applications in informatics 2h
Film: Mashes (mashes/graphs) 1h
2nd preliminary exam /The final exam. 1h</td></tr>
<tr><td>2.6. Format of instruction:</td><td>☒ lectures
☒ seminars and workshops
☒ exercises
☐ on line in entirety
☒ partial e-learning</td><td>☒ independent assignments
☒ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td>2.7. Comments:</td></tr>
</table>

	☐ field work					
2.8. Student responsibilities	Regular school attendance. Monitoring of e-learning. Writing tasks. Consultations (teacher / student assistant)					
2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	Requirement for the signature	Research		Practical training	
	Experimental work		Report		independent assignments	10%
	Essay		Seminar essay	20%	(other)	
	Tests	70%	Oral exam	optional	(other)	
	Written exam	70%	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	50-61 credits	sufficient (2)
	62-74 credits	good (3)
	75-87 credits	very good (4)
	88-100 credits	excellent (5)

	Title	**Number of copies in the library**	**Availability via other media**
2.11. Required literature (available in the library and via other media)	Beban Brkic, J.: *Discrete Mathematics*, Textbook for students (on the web), Faculty of Geodesy, Zagreb		http://e-ucenje.geof.unizg.hr/
	Lipschutz, S., Lipson M.: *Discrete Mathematics*, Schaum's Outline Series, McGraw-Hill, New York, 1997.	2	
	Lipschutz, S.: 2000 *Solved Problems in Discrete Mathematics*, Schaum's Solved Problems Series, McGraw-Hill, New York, 1994.	2	
2.12. Optional literature (at the time	Žubrinić D.: *Introduction to Discrete Mathematics*, Element, Zagreb, 2006		

of submission of study programme proposal)	Pavčević, M-O.: *Introduction to the Theory of Graphs*, Element, Zagreb, 2006.
2.13. Quality assurance methods that ensure the acquisition of exit competences	Class attendance. In revising during lectures. Solving tasks during exercises. Activity on the system for e-learning. Individual assignment. Interactive assignments and Seminar essays. Consultations attendance. Preliminary exams. Exams. The implementation of a single university Questionnaire for evaluating teachers prescribed by the Senate.
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Stanislav Frangeš	1.6. Year of the study programme	3 years; 6th semester of undergraduate study
1.2. Name of the course	Spatial orientation and perception of the environment	1.7. Credits (ECTS)	2
1.3. Associate teachers	Vesna Poslončec-Petrić Igor Birin	1.8. Type of instruction (number of hours L + S + E + e-learning)	30 (10L+5S+15E +e-learning)
1.4. Study programme (undergraduate, graduate, integrated)	Undergraduate	1.9. Expected enrolment in the course	40-50
1.5. Status of the course	Elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	Adoption of basic knowledge of cartography, its development and methods of producing maps, cartographic visualization and generalization with a focus on achieving the ability to distinguish objects viewed at different cartographic representations and the application of the elements of cartography in order to develop simple maps and map related representations.
2.2. Course enrolment requirements and entry competences required for the course	Passed subject: "Cartography" Undergraduate subject: "Map projections"
2.3. Learning outcomes at the level of the programme to which the course contributes	**Applying knowledge and understanding:** Apply knowledge of mathematics and physics for the purpose of recognizing, formulating and solving of problems in the field of geodesy and geoinformatics Solve practical tasks in surveying, spatial data collection, real estate evaluation and management. Make plans, maps and related presentations using modern methods and technologies on the basis of measured data and other sources Determine and interpret the size, properties and relations of objects in space on the basis of measured data, spatial databases, plans and maps. Use information technology in solving geodetic and geoinformation tasks. **Making judgements:** Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by

	means of surveying and its results.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	The students will: ✓ Describe the purpose and applied topographic, marine and other maps in orientation. ✓ Qualitative and a quantitative interpretation of spatial data and evaluate their suitability for use. ✓ To plan methods of surveying and integrate spatial data from different sources for the purpose of orientation. ✓ Implement reambulation of space. ✓ Master orientation in space using classic and modern navigation devices.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	1. Orientation and Navigation (geographic, topographic, astronomy, nautical, satellite, ...) 2. Terrain: concept, characteristics, types of terrain, cartographic representation of the terrain. 3. Applying of maps in orientation (topographic, mountain, excursion). Applying topographic map, types of topographic maps, map elements, scale, projection, a division of maps into sheets, coordinate grid, content maps and cartographic key. 4. Devices for orientation and navigation: compass, radar, GPS (type, use, measurement and positioning). Measurement on a map: length, azimuth, altitude. Measurement and evaluation: methods of measurement and determination of distances on land, determining the distance according to the degree of visibility of the observed object, determining distance hearing, determine the distance based on the speed of sound, measuring the angle of the observed object. 5. Navigate with a compass and a map: map orientation, positioning. Navigating the terrain. Additional sources of topographic orientation: guides, maps, charts without cartographic basis (landscapes, panoramas, drawings, etc.); charts, special atlases, cartographic and topographic signs; astronomical maps. 6. Orientation in difficult conditions: karstic terrain, low visibility, snow, night navigation, ... Disorientation and loss of the field: danger, caution, waste, decision-making, call for help. Organizations and associations related to orientation: national and international. Task no. 1 (5 hours): Geographical and topographical orientation in unfamiliar territory. Orientation and Navigate using topographic maps. Content analysis of maps in the field. Task no. 2 (5 hours): Positioning on unfamiliar territory using a map and compass. Measurement and evaluation. Analysis of field exercises.

<table>
<tr><td></td><td colspan="6">Task no. 2 (5 hours): GPS and navigation in unknown terrain or low visibility (default point in different projections, and the corresponding dates. Task: enter the GPS device in accordance with the received data and find the set point (the hidden objects on the ground). Analysis of exercise.</td></tr>
<tr><td>2.6. Format of instruction:</td><td colspan="2">☒ lectures
☒ seminars and workshops
☒ exercises
☐ on line in entirety
☒ partial e-learning
☒ field work</td><td colspan="2">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:

The exercises are being held on the ground (near the Faculty, Maksimir Jarun, Medvednica)</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="6">Conditions for successful conduct of obligations in the course include:
- Regular attendance at least 70% of wages for lectures and exercises,
- Preparation and presentation of a seminar paper on a given topic,
- Preparation and submission of project tasks during the exercises.</td></tr>
<tr><td rowspan="5">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>0,25</td><td>Research</td><td></td><td>Practical training</td><td>1,0</td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>0,25</td><td>(other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Written exam</td><td>0,25</td><td>Project</td><td>0,25</td><td>(other)</td><td></td></tr>
<tr><td>2.10. Grading and evaluating student work in class and at the final exam</td><td colspan="6">During the semester will be held – two preliminary exams. The written part, which evaluated the theoretical knowledge and practical, which are, evaluated skills.
Preliminary exams are not mandatory. The average rating of the – two preliminary exams shall be deemed the final score on the exam the first two examination periods. The examination period consists of written / practical part.</td></tr>
<tr><td rowspan="3">2.11. Required literature (available in the library and via other media)</td><td colspan="4">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="4">Pahernik, M. (2012): Vojna topografija II - orijentacija i topografske karte, Hrvatsko vojno učilište "Petar Zrinski", Zagreb.</td><td>2</td><td></td></tr>
<tr><td colspan="4">Lovrić, P., Frangeš, S., Babić, B. (1992): Orijentacija na zemljištu kartom i kompasom, Geodetski fakultet, Interna skripta, Zagreb.</td><td>20</td><td></td></tr>
</table>

	Lovrić, P. (1992): Topografija, Geodetski fakultet, Interna skripta, Zagreb.	5	
2.12. Optional literature (at the time of submission of study programme proposal)	Meilinge, T. (2008): Strategies of Orientation in Environmental Space, Logos Verlag Berlin GmbH, Germany. Darken, R.P., & Peterson, B. (2001). Spatial Orientation, Wayfinding, and Representation. Handbook of Virtual Environment Technology. Stanney, K. Ed. Gobec, I., Gobec, D. (2013): Orijentacija – Priručnik uz školu orijentacije. Orijentacijski klub Vihor, Zagreb. Pahernik, M. (2012): Vojna topografija I - topografski objekti zemljišta, Hrvatsko vojno učilište "Petar Zrinski", Zagreb. Buzjak, N. (1998.): Satelitski sustavi za orijentaciju i navigaciju, Geografski horizont, br. 2, Zagreb. Ćosić, S.; Alilović, M.; Frangeš, S.; Landek, I. (2012): *Topografske karte na području Hrvatske,* Državna geodetska uprava, Zagreb. Frangeš, S. (2003): Topografska kartografija, Geodetski fakultet, Zagreb, predavanja.		
2.13. Quality assurance methods that ensure the acquisition of exit competences	Records of attendance. Publication of accepted project tasks a student group. Survey to assess the work of teachers. Analysis of the success of students in different components teaching performance (preliminary exams and delivery of projects).		
2.14. Other (as the proposer wishes to add)	The classes will include expert associates, external associates, and visiting lecturers (second colleges, universities, members of non-governmental organizations (GSS, mountaineers, scouts) and staff from the industry. It is recommended that students prior to registration subjects we listen topographic mapping in (fifth semester of undergraduate studies). Auditory and planning exercises are held in the classroom, which is equipped with modern computers, commercial and free software to create maps. The case can be heard and the first and second year of graduate studies. The subject with the requirements as one connected module will be offered to all students at the University of Zagreb.		

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Siniša Mastelić Ivić	1.6. Year of the study programme	3
1.2. Name of the course	Spatial development plans	1.7. Credits (ECTS)	3
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	15L+15S
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	20
1.5. Status of the course	optional	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	Course objective is to introduce students with the complete system of spatial development planning and methods of implementation of planned activities in the space. Course content includes an overview of the different levels of planning, geodetic and geoinformation databases and analysis, implementation instruments, zoning requirements, projects and building permits and the role of geodetic experts in the whole process. Practical work will include collecting of spatial data and information related to the planning, implementation of spatial analysis, interpretation of specific urban conditions and preparation of geodetic works in the plan implementation.
2.2. Course enrolment requirements and entry competences required for the course	Passed exams Cadastre and Modeling of geoinformation
2.3. Learning outcomes at the level of the programme to which the course contributes	Demonstrate competences in real estate registers and interests in real estates, understand land development measures and methods of land evaluation. Solve practical tasks in surveying, spatial data collection, real estate evaluation and management. Determine and interpret the size, properties and relations of objects in space on the basis of measured data, spatial databases, plans and maps. Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper

	procedures for their solution.		
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Identify the types and levels of planning: strategic, spatial, urban planning, implementation Explain the types of conditions in physical planning Read the terms of spatial development in accordance with the physical planning documents for individual project Link system of spatial development planning and real estate registers Apply geoinformation knowledge in the development of spatial development plans		
2.5. Course content broken down in detail by weekly class schedule (syllabus)	Introduction to the system of spatial development planning Strategic planning and development strategies State and regional spatial plans Spatial plans on municipal level Geodetic maps and data as a basis for spatial planning Spatial dana infrastructure for spatial planning GIS analysis to support decision making in planning Colloquium Implementation plans Type of urban conditions Projects and building permits Approaches to implementation of spatial development plans Geodetic works in the implementation of spatial development plans The role of geodetic experts in the process of planning and implementation of spatial development plans Colloquium		
2.6. Format of instruction:	☒ lectures ☐ seminars and workshops ☒ exercises ☐ on line in entirety ☒ partial e-learning ☐ field work	☐ independent assignments ☒ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:
2.8. Student responsibilities	The presence of more than 70% of lectures and exercises.		

2.9. Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	0.5	Research		Practical training	
	Experimental work		Report		(other)	
	Essay		Seminar essay		(other)	
	Tests	0.5	Oral exam	1	(other)	
	Written exam	1	Project		(other)	

2.10. Grading and evaluating student work in class and at the final exam	

	Title	Number of copies in the library	Availability via other media
2.11. Required literature (available in the library and via other media)	Krtalić, V. (2004): Sustavi planiranja korištenja zemljišta. Novi informator, Zagreb.		
	Marinović-Uzelac, A. (2001): Prostorno planiranje. Dom i svijet, Zagreb.		
	Larsson, G. (1997): Land management – Public Policy, Control and Participation. The Swedish Council for Building Research, Stockholm.		

2.12. Optional literature (at the time of submission of study programme proposal)	FIG (2010): Rapid Urbanization and Mega Cities: The Need for Spatial Information Management. The International Federation of Surveyors (FIG). Copenhagen
2.13. Quality assurance methods that ensure the acquisition of exit competences	
2.14. Other (as the proposer wishes to add)	

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Almin Đapo	1.6. Year of the study programme	III.
1.2. Name of the course	Three dimensional laser scanning in geodesy and geoinformatics	1.7. Credits (ECTS)	3
1.3. Associate teachers	Branko Kordić Luka Babić	1.8. Type of instruction (number of hours L + S + E + e-learning)	L 15 + 30 E
1.4. Study programme (undergraduate, graduate, integrated)	undergraduate	1.9. Expected enrolment in the course	75-85
1.5. Status of the course	obligatory	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2

2. COUSE DESCRIPTION	
2.1. Course objectives	Theoretical and practical knowledge of basic spatial data collection methods using lasers practiced in geodesy and geoinformatics.
2.2. Course enrolment requirements and entry competences required for the course	
2.3. Learning outcomes at the level of the programme to which the course contributes	Knowledge and understanding • Understand the role of geodesy, geoinformatics and spatial data in modern world; demonstrate competences in measuring systems, methods and technologies of measurement and spatial data collection. • Demonstrate competences in theoretical principles, procedures of computing and visualising the surveying data. • Understand mathematical methods and physical laws applied in geodesy and geoinformatics. Applying knowledge and understanding • Handle geodetic instruments and appropriate measuring equipment properly, and perform geodetic measurements. • Prepare geodetic documents needed to establish and maintain cadastral records and land registry, as well as the documents for engineering works. • Make plans, maps and related presentations using modern methods and technologies on the basis of measured data and other sources. • Determine and interpret the size, properties and relations of objects in space on the basis of measured data, spatial databases, plans and maps.

	• Use information technology in solving geodetic and geoinformation tasks. Making judgements • Recognise problems and tasks in the application of geodetic and geoinformation principles and methods, and select proper procedures for their solution. • Exercise appropriate judgements on the basis of performed calculation processing and interpretation of data obtained by means of surveying and its results. Communication skills • Prepare official public documents, reports, graphic and cartographic presentations using the surveying results related to objects in space. • Communicate the results obtained by means of geodesy and geoinformation to clients and experts of geodetic and other related professions Learning and ethical skills • Keep pace with and adopt new technological achievements in the field of surveying, geoinformation systems and services based on the position, and the changes in regulations, norms and standards. • Take responsibility for continuing academic development in the field of geodesy and geoinformatics, or related disciplines, and for the development of interest in lifelong learning and further professional education.
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	• Knowing the basis of laser technology and describing the types of laser systems • Defining accuracy and precision of different LiDAR systems and explaining sources of errors when measuring using laser scanners • Mastering the use of terrestrial laser scanners • Applying methods of point cloud georeferencing and registration • Utilizing spatial data collected using terrestrial laser scanning for visualisation purposes • Utilizing spatial data collected using space and airborne laser scanning for digital terrain model, surface and digital relief model
2.5. Course content broken down in detail by weekly class schedule (syllabus)	1. Introduction 2. Laser technology in geodesy and geoinformatics 3. Laser scanning principles of operation 4. Development of laser scanning 5. Categorisation of laser scanners 6. Accuracy and precision of LiDAR systems 7. Point cloud georeferencing and registration 8. Point cloud filtering

<table>
<tr><td></td><td colspan="6">9. Terrestrial laser systems
10. Terrestrial stationary laser scanning
11. Terrestrial mobile laser scanning (road, railway, water)
12. Space and airborne laser systems
13. Laser scanning from airplane/helicopter
14. Laser scanning from space
15. Laser scanning using unmanned aerial vehicle
Applied theoretical knowledge
1. Collecting and processing data using stationary terrestrial laser scanners
2. Processing data collected using mobile terrestrial laser scanner
3. Analysis of laser scanning data collected from space/air</td></tr>
<tr><td>2.6. Format of instruction:</td><td colspan="2">☒ lectures
☒ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="2">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="6">Attending more than 70% lectures and practical exercises. Delivery of project in due term. Presenting project results with evaluation of understanding the presented results in no more than 3 questions.
Taking two written exams pertaining to assessing both theoretical and practical knowledge obtained thus far..</td></tr>
<tr><td rowspan="5">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical training</td><td>0.5</td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Tests</td><td>0.5</td><td>Oral exam</td><td>0.5</td><td>(other)</td><td></td></tr>
<tr><td>Written exam</td><td>0.5</td><td>Project</td><td></td><td>(other)</td><td></td></tr>
<tr><td>2.10. Grading and evaluating student work in class and at the final exam</td><td colspan="6">Requirements for obtaining the signature:
- Presence in 70% of classes,
- Timely made three tasks,
- A minimum of 11 points (out of 60 possible) from two mid-term exams.
Evaluation:
Continuous monitoring of students is applied: during the semester two mid-term exams (tests) will be held, on which one can get maximum of 2 x 30 = 60 points. The first mid-term, after seven weeks of classes, and the second after 13 weeks of classes.</td></tr>
</table>

	The requirement for a positive evaluation of the exercises the right of on the signature, and a minimum of 31 points (out of 60 possible) on mid-term. Rating = M1 + M2 M1, M2 - marks achieved on mid-term. The final grade is determined as follows: Points - Rating 31 to 38 is sufficient (2) 39-45 good (3) 46-53 very good (4) 54-60 Excellent (5) Students who do not pass the exam take written and oral exam. The condition for taking the oral exam is 50% of the possible points in the written part of the exam.		
2.11. Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Laser scanning – internal script		moodle
	Lectures and excercise presentations		moodle
	Principles of Lasers (Orazio Svelto)	1	
	Theory and practice on Terrestrial Laser Scanning (Lerma García, J.L., Van Genechten, B., Heine, E., Santana Quintero, M.)		
2.12. Optional literature (at the time of submission of study programme proposal)	Fundamentals of Satellite Remote Sensing (Emilio Chuvieco, Alfredo Huete) Airborne and Terrestrial Laser Scanning (George Vosselman, Hans-Gerd Maas)		
2.13. Quality assurance methods that ensure the acquisition of exit competences	Database of presence in class, student activities, assignment, analysis of the student's exam, analysis of student assignments, student evaluation of the course instructor.		
2.14. Other (as the proposer wishes to add)	Students are expected to respect the principles of academic integrity which are regulated by the Code of Ethics of the University (available at: www.unizg.hr). In class is expected that everyone has the right to speak your mind as long as it does not offend the other person. For performing the exercises special measuring equipment is used: 3D terrestrial laser scanners (2 pcs) in combination with		

	the total station (2 pcs) and dual frequency GNSS receivers (2 pcs) and software tools for the execution and processing of measurement by laser scanner. Exercises are performed on high school playground and the streets and squares around the building of the Faculty in realistic field conditions requiring the attention of students, which are specifically warned before performing the exercises.

DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION			
1.1. Course teacher	Dalibor Vračan	1.6. Year of the study programme	Third, 5th semester 6th semester
1.2. Name of the course	Physical and health culture	1.7. Credits (ECTS)	1
1.3. Associate teachers		1.8. Type of instruction (number of hours L + S + E + e-learning)	30 (E)
1.4. Study programme (undergraduate, graduate, integrated)	Bachelor Study	1.9. Expected enrolment in the course	90
1.5. Status of the course	elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	

2. COUSE DESCRIPTION	
2.1. Course objectives	Transfer of information and knowledge about kinesiology and physiology of sport about influence of corporal activity on total psychophysical and social status of human. Adopting new and improvement of existing motility knowledge's and skill's and specialization of students in kinesiological activities appropriate for daily sport-recreational exercise.
2.2. Course enrolment requirements and entry competences required for the course	No
2.3. Learning outcomes at the level of the programme to which the course contributes	
2.4. Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	
2.5. Course content broken down in detail by weekly class schedule (syllabus)	1. Sport games – football - technique. Handball - technique. 2. Sport games – football - technique. Handball - technique. 3. Sport games – football - technique. Handball - technique. 4. Sport games – basketball - technique.

<table>
<tr><td></td><td colspan="6">5. Sport games – basketball - technique.
6. Sport games – basketball - technique.
7. Parter gymnastics.
8. Partner gymnastics.
9. Swimming - tehnique.
10. Swimming - tehnique.
11. Swimming - tehnique.
12. Aerobic – motion in space in rythmical cycles.
13. Aerobic – motion in space in rythmical cycles.
14. Stretching – creating small excersising systems in accordance to specific sport.
15. Endurance of motion in nature.</td></tr>
<tr><td>2.6. Format of instruction:</td><td colspan="2">☐ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="2">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td>2.8. Student responsibilities</td><td colspan="6">Presence on 80% (24/30) hours of exercise</td></tr>
<tr><td rowspan="5">2.9. Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>independent assignments</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>interactive tasks</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(other)</td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td>(other)</td><td></td></tr>
<tr><td>2.10. Grading and evaluating student work in class and at the final exam</td><td colspan="6">Course is not assessed</td></tr>
<tr><td rowspan="3">2.11. Required literature (available in the library and via other media)</td><td colspan="4">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="4">Mišigoj-Duraković M. i sur. (1999.) Tjelesno vježbanje i zdravlje, Zagreb: Grafos</td><td></td><td>Knjižnice grada, Kineziološki fakultet.</td></tr>
<tr><td colspan="4"></td><td></td><td></td></tr>
</table>

2.12. Optional literature (at the time of submission of study programme proposal)	Volčanšek, B. (1996.) *Plivanje*, Zagreb: Fakultet za fizičku kulturu Sveučilišta u Zagrebu Trninić, S. (1996.) *Analiza i učenje košarke*, Zagreb: Fakultet za fizičku kulturu Sveučilišta u Zagrebu Janković, V. (1966.) *Odbojka*, Zagreb: Fakultet za fizičku kulturu Sveučilišta u Zagrebu Šnajder, V.; Milanović, D. (1991.) *Atletika hodanja i trčanja*, Zagreb: Fakultet za fizičku kulturu Sveučilišta u Zagrebu, 1991.		
2.13. Quality assurance methods that ensure the acquisition of exit competences	The implementation of a single university Questionnaire for evaluating teachers prescribed by the Senate.		
2.14. Other (as the proposer wishes to add)			

Table 3. List of required and elective courses and/or modules with class hours and ECTS credits

LIST OF COURSES/MODULES								
Year of study: **1.**								
Semester: **I.**								
MODULE	COURSE	COURSE TEACHER	L	S	E	e-learning	ECTS	Required/ elective
	Analytical Geometry and Linear Algebra	Jelka Beban-Brkić	30	0	30	0	5	Required
	Mathematical Analysis	Vida Zadelj-Martić	30	3	25	2	5	Required
	Physics	Mario Brkić	30	0	30	0	5	Required
	Basics of Geoinformatics	Đuro Barković / Nada Vučetić	30	0	30	0	5	Required
	Geodetic Instruments	Đuro Barković	30	0	30	0	5	Required
	Engineering Graphics in Geodesy and Geoinformatics	Dražen Tutić / Vlado Cetl / Almin Đapo / Robert Župan	15	0	30	0	3	Required
	Physical and health culture	Dalibor Vračan	0	0	30	0	0	Required
	Engineering Informatics	Drago Špoljarić	15	0	15	0	2	Elective
	Introduction to Geodesy	Rinaldo Paar	30	0	0	0	2	Elective
	Mathematics on Computers	Željka Tutek	0	0	15	0	1	Elective

LIST OF COURSES/MODULES								
Year of study: **1.**								
Semester: **II.**								
MODULE	COURSE	COURSE TEACHER	L	S	E	e-learning	ECTS	Required /elective
	Computer geometry	Nikol Radović	30	0	30	0	5	Required
	Vector Analysis	Vida Zadelj-Martić	30	0	15	0	3	Required

	Programming	Nada Vučetić	30	0	30	0	5	Required
	Land Surveying	Vlado Cetl	30	0	60	0	5	Required
	Field Measurement	Đuro Barković / Mladen Zrinjski	30	0	30	0	5	Required
	Basics of Statistics	Miljenko Lapaine	30	0	15	0	4	Required
	Physical and health culture	Dalibor Vračan	0	0	30	0	0	Required
	Basics of English for Special Purposes	Biserka Fučkan-Držić	15	15	0	0	3	Elective
	Basics of German for Special Purposes	Biserka Fučkan-Držić	15	15	0	0	3	Elective
	Spherical trigonometry	Nikol Radović	15	8	7	0	3	Elective
	Mathematical Laboratory for Engineers	Željka Tutek	0	0	15	0	1	Elective

LIST OF COURSES/MODULES								
Year of study: **2.**								
Semester: **III.**								
MODULE	COURSE	COURSE TEACHER	L	S	E	e-learning	ECTS	Required /elective
	Analysis and processing of geodetic measurements	Nevio Rožić	30	0	45	0	5	Required
	Databases	Damir Medak	30	0	30	0	5	Required
	Differential Geometry	Jelka Beban Brkić	30	0	30	0	5	Required
	Geodetic Plans	Vlado Cetl	30	0	30	0	5	Required
	Information Society	Branka Mraović	15	15	0	0	3	Required
	Foundations of Land Registration Law	Tatjana Josipović	30	0	0	0	2	Required
	Physical and health culture	Dalibor Vračan	0	0	30	0	0	Required
	English in Geodesy	Biserka Fučkan-Držić	15	15	0	0	3	Elective
	German in Geodesy	Biserka Fučkan-Držić	15	15	0	0	3	Elective
	Business Communication	Branka Mraović	15	15	0	0	3	Elective
	Topography	Brankica Cigrovski-Detelić	15	0	15	0	3	Elective

	Object Oriented Modelling and Programming	Dražen Tutić / Nada Vučetić	15	0	30	0	3	Elective
	Transformation of Coordinates	Miljenko Lapaine	15	0	30	0	3	Elective
	Space visualization	Nikol Radović	15	0	30	0	3	Elective
	Professional Practice						3	Elective

LIST OF COURSES/MODULES								
Year of study: **2.**								
Semester: **IV.**								
MODULE	COURSE	COURSE TEACHER	L	S	E	e-learning	ECTS	Required /elective
	Cartography	Stanislav Frangeš	30	0	30	0	5	Required
	Photogrammetry	Dubravko Gajski	30	0	30	0	5	Required
	Geodetic Reference Frame	Tomislav Bašić / Željko Hećimović	30	0	30	0	5	Required
	Modeling of Geoinformation	Damir Medak / Vlado Cetl	30	0	30	0	5	Required
	Cadastre	Roić Miodrag	30	0	45	0	5	Required
	Physical and health culture	Dalibor Vračan	0	0	30	0	0	Required
	Geoinformation Manipulation	Miljenko Lapaine / Ivka Kljajić	30	0	30	0	5	Elective
	Quality of Geoinformations	Nevio Rožić	30	0	30	0	5	Elective
	Open Geoinformation	Miljenko Lapaine / Dražen Tutić	15	0	15	0	2	Elective

LIST OF COURSES/MODULES								
Year of study: **3.**								
Semester: **V.**								
MODULE	COURSE	COURSE TEACHER	L	S	E	e-learning	ECTS	Required /elective
	Engineering geodetic control	Gorana Novaković	30	0	30	0	5	Required

	Satellite positioning	Željko Bačić	30	0	30	0	5	Required
	Remote Sensing	Dubravko Gajski	30	0	30	0	5	Required
	Land Management	Siniša Mastelić-Ivić	30	0	30	0	5	Required
	Professional Project	Mladen Zrinjski /Brankica Cigrovski-Detelić	0	0	45	0	3	Required
	Practical Work with Geodetic Instruments	Mladen Zrinjski	15	0	15	0	4	Elective
	Land Information Services	Miodrag Roić	30	0	30	0	5	Elective
	Topographic Cartography	Stanislav Frangeš	30	0	15	0	4	Elective
	Franciscan cadastre	Miodrag Roić	15	30	0	0	3	Elective
	Algorithms in Geoinformation Systems	Miljenko Lapaine / Dražen Tutić	0	10	30	5	3	Elective
	Scripting languages in geodesy and geoinformatics	Damir Medak	15	0	30	0	3	Elective
	Evolution of Physics	Mario Brkić	0	30	0	0	2	Elective
	Physical and health culture	Dalibor Vračan	0	0	30	0	1	Elective

LIST OF COURSES/MODULES								
Year of study: **3.**								
Semester: **VI.**								
MODULE	COURSE	COURSE TEACHER	L	S	E	e-learning	ECTS	Required /elective
	State Survey	Tomislav Bašić	30	0	30	0	5	Required
	Engineering geodesy	Rinaldo Paar	30	0	30	0	5	Required
	Map Projections	Miljenko Lapaine	30	0	30	0	5	Required
	Hydrographic survey	Boško Pribičević /Almin Đapo	30	0	30	0	5	Required
	Final exam	Vicedean for academics and students	0	0	0	0	2	Required
	Managemenet in Geodetic Company and Institution	Branka Mraović	15	15	0	0	3	Elective
	Geoinformation Infrastructure	Vlado Cetl	20	10	30	0	5	Elective

	Web-Cartography	Robert Župan	15	0	15	0	3	Elective
	Geodetic Astronomy	Drago Špoljarić	30	0	30	0	5	Elective
	Discrete mathematics	Jelka Beban-Brkić	30	10	20	0	5	Elective
	Spatial orientation and perception of the environment	Stanislav Frangeš	10	5	15	0	2	Elective
	Spatial development plans	Siniša Mastelić-Ivić	15	0	15	0	3	Elective
	Three-dimensional laser scanning in geodesy and geoinformatics	Almin Đapo	15	0	30	0	3	Elective
	Physical and health culture	Dalibor Vračan	0	0	30	0	1	Elective