University
of Ljubljana

Faculty
of Civil and Geodetic Engineering

Presentation of the study programme

2st CYCLE ACADEMIC STUDY PROGRAMME
GEODESY AND GEOINFORMATION (MA)

Valid from study year 2018/19

1. Information about the study programme

The second cycle master's study programme *Geodesy and Geoinformation* consists of 2 years (4 semesters) and amounts to 120 ECTS points. The study programme does not include orientations. The study programme is carried out as a regular and a part-time study.

2. Basic goals of the programme

The basic goal of the second cycle master study programme Geodesy and Geoinformation is to educate experts capable of analytical and synthetic thinking, creative, critical, efficient and constructive solving of complex research and development problems and project-applied tasks in the fields of geodesy and geoinformation. The program ensures interdisciplinary integration of the experts and at the same time it provides excellent foundation for further studies at the third cycle of any natural science and technical programmes. At the same time it enables students to obtain a license of Responsible Surveyor by the Slovenian Chamber of Engineers. The study programme provides students comparability of educational attainment also in an international context.

3. General competences

General competences acquired by the graduates of the master's study programme Geodesy and Geoinformation are:

- generally well-informed experts, knowledge about academic areas and scientific work methods,
- critical reading and understanding of texts, independent upgrading of knowledge and search for sources,
- ability to transfer and use theoretic knowledge in practice
- development of high professional and ethical standards and professional, environmental and social responsibility,
- development of scientific literacy, skills of public appearance and communication with clients, transfer and presentation of knowledge and results,
- ability to use domestic and foreign professional language in written and oral communication, communications in international and national scientific circles,
- ability to use and develop geo-information technology,
- capacity to manage professional processes in the surveying companies, public services or agencies in the fields of geodesy or spatial planning.

4. Course-related competences

With the second cycle master's study programme Geodesy and Geoinformation the graduate acquires mainly the following course-specific competences:

- independently solves all kinds of professional and development tasks in the fields of geodesy and geoinformation
- understands, applies and develops modern surveying methodologies and technology and is able to upgrade it,
- plans, organizes, manages and carries out surveying tasks for the establishment, maintenance and restoration of the basic geodetic reference system,
- plans, organizes, executes or leads geodetic works:
  - in the land surveying,
  - in the construction of all types of buildings or generally in all types of infrastructural development in the physical environment,
  - in the procedures of cadastral regulation and registration of real estate,
  - in the fields of topography and cartography,
  - in the fields of photogrammetry and remote sensing,
  - at the establishment, maintenance and upgrading of geographic, cartographic and land information systems
- participates in the preparation of spatial planning documents and
- knows the legal, administrative and economic system, important for the surveyor.

5. Conditions for enrolment

The second cycle master' study programme Geodesy and Geoinformation is available to the graduates from:

a) first cycle University study programme Geodesy and Geoinformation;
b) first cycle higher education professional study Technical Real Estate Management, who pass differential exams from the first cycle University study Geodesy and Geoinformation: Mathematics 2, Physics and Geodesy, totalling 20 credit points; the differential exams may be selected as elective courses during the first cycle study or in additional bridging year;
c) higher education professional study of geodesy before the introduction of Bologna programmes;
d) first cycle university study of other studies; the candidates shall finish additional individual bridging programme consisting of 10 to 60 ECTS. The obligations shall be defined according to the level of deviation of the basic area and the candidates may comply with the demands during the first cycle study or by passing exams before the enrolment to the master study.
e) first cycle higher education professional study of other related programmes (technical and geosciences); the candidates shall finish additional individual bridging programme consisting of 10 to 60 ECTS. The obligations shall be defined according to the level of deviation of the basic area and the candidates may comply with the demands during the first cycle study or by passing exams before the enrolment to the master study.
f) other related (technical and geo sciences) higher educational professional studies before the introduction of the Bologna programmes; the candidates shall finish additional individual bridging programme consisting of 10 to 60 ECTS. The obligations shall be defined according to the level of deviation of the basic area and the candidates may comply with the demands during the first cycle study or by passing exams before the enrolment to the master study.

Obligations of the individual bridging programme shall be defined according to the missing knowledge and the experiences of the candidate from practice acquired before the enrolment.

6. Selection criteria when enrolment is restricted

In case of restricted enrolment the following conditions shall be considered: grade obtained in the first cycle study (100%).

7. Criteria for recognising knowledge and skills acquired before enrolment in the programme

The student can be acknowledged the knowledge that matches the contents and scope of the study in the programme Geodesy and Geoinformation. The Study Board of the Department of Geodetic Engineering UL FGG takes decisions regarding the acknowledgement of knowledge and skills acquired before the enrolment, based on the student's written application, the enclosed certificates and other documents evidencing the successfully acquired knowledge and contents of this knowledge, and in accordance with the Rules on the procedure and criteria for the acknowledgement of informally acquired knowledge and skills, adopted on 29 May 2007 at the 15th meeting of the UL Senate.

For the acknowledgement of knowledge and skills the following shall be considered:
- certificates and other documents evidencing finished courses and other forms of education,
- evaluation of finished products, services, publications and other original works of the student,
- evaluation of knowledge acquired by the student based on self-education or learning from experiences (possibility of completing study obligations without participation at lectures, practical work, seminars),
- adequate work experiences.

In case that the Study Board of the department determines that the acquired knowledge may be acknowledged, this is evaluated with the same number of ECTS points as the number of credits in the subject.

8. Methods of assessment

The assessment methods are in accordance with the Statute of University of Ljubljana and listed in the Course Syllabi.

9. Conditions for progression through the programme

9.1 Conditions for progression from one year to another

The student may enrol to subsequent year, if they complete by the end of the study year all the obligations foreseen by the study plan, amounting to at least 45 ECTS.

Exceptionally the student may enrol to subsequent year if he has completed all their obligations in accordance with the study programme and achieved at least 40 ECTS of the current year and if he has justifiable reasons as defined by the UL Statute. The exceptional enrollment is decided by the Study Board of the FGG Department of Geodesy.

Students with above average study results will be allowed faster advancement. Based on the student's application and justified opinion of the Study Board of UL FGG the final decision about such advancement is adopted by the Senate of UL FGG. With its decree the principles of faster progress shall be defined.

9.2 Conditions for repeated enrolment in the same year

Failing to meet all the obligations defined by the study programme for the advancement in the subsequent year, students may enroll in the same year for the second time, provided that they have obtained at least 30 credit points according to ECTS.

10. Transfers between study programmes

Transfer between programmes shall mean termination of education in the student's original study programme (first programme) and continuation of education in the second cycle master study programme of Geodesy and Geoinformation (second programme), in which a part of the completed study requirements from the first study programme are recognised as completed.

Transfers are possible from the second cycle study programmes, and until their expiration also from the undergraduate academic study programmes adopted after June 11 2004, where the competences of the finished studies are comparable and according to the acknowledgement criteria at least half of the obligations according to ECTS from the first study programme related to compulsory courses of the second study programme can be acknowledged. Considering the scope of acknowledged obligations from the first study programme in the Republic of Slovenia or abroad student may enrol to the same or higher year in the second study programme. Transferring students shall fulfil the conditions for the enrolment to the second study programme.

Applications of candidates for the transfer to the second cycle master study programme Geodesy and Geoinformation and the scope of acknowledged obligations in the study programme will be examined individually by the Study Board of the Department of Geodesy. If in the procedure of acknowledging obligations for the purpose of transfer the candidate is approved at least the amount of credit points and those point that are required for the enrolment to a higher year of the second cycle master study programme Geodesy and Geoinformation, the candidate may enrol to the higher year of the second cycle master study programme Geodesy and Geoinformation.

11. Conditions for completion of the study

Students finish the study by accomplishing all the prescribed obligations totalling 120 points according to ECTS.

12. Conditions for completion of individual parts of the programme

The study is uniform.

13. Qualification, professional or academic title

magister inženir geodezije in geoinformatike (MA)
(second cycle graduate in geodesy and geoinformation)

magistrica inženirka geodezije in geoinformatike (MA)
(second cycle graduate in geodesy and geoinformation)

14. Qualification, professional or academic title (abbreviation)

mag. inž. geod. geoinf.

15. Classifications

- KLASIUS-SRV: Master education (second cycle Bologna)/master education (second cycle Bologna) (17003)
- ISCED: architecture, urbanism and civil engineering (58)
- KLASIUS-P: Geodesy and cartography (5813)
- Frascati: Technical sciences (2)
- Level SOK: Level SOK 8
- Level EOK: Level EOK 7
- Level EOVK: Second cycle

16. Study programme courses, Syllabus

1st YEAR	Contact hours								
	L	S	SP	LP	FW	OW	Σ CH*	Σ SO*	ECTS*
1st semester									
Mathematics III	45		30				75	150	5
Geoinformatics II	30		30				60	120	4
Satellite Geodesy and Navigation	45			30			75	150	5
Adjustment computations III	30			30			60	120	4
Urban Planning	30			30			60	120	4
Geodetic Measuring Systems	60			60			120	240	8
Total 1st semester	**240**		**60**	**150**			450	**900**	**30**
2nd semester									
Physical Geodesy	30			30			60	120	4
Spatial Data Analyses	30			30			60	120	4
Remote Sensing and Photogrammetry II	60			60			120	240	8
Multimedia Cartography	45			60			105	210	7
Elective course I (FGG or external)	60		45				105	210	7
Total 2nd semester	**225**		**45**	**180**			450	**900**	**30**
Total 1st and 2nd semester	**465**		**105**	**330**			**900**	**1800**	**60**

2nd YEAR	Contact hours								
	L	S	SP	LP	FW	OW	Σ CH*	Σ SO*	ECTS*
3rd semester									
Engineering Surveying II	45			45			90	180	6
Spatial Statistics	30		30				60	120	4
Land consolidation and rearrangement	30			30			60	120	4
Mass Real Estate Valuation	30		30				60	120	4
Elective courses II (FGG or external)	90		90				180	360	12
Total 3rd semester	**225**		**150**	**75**			**450**	**900**	**30**

4th semester									
Project task						300	300	600	20
Master thesis						150	150	300	10
Total 4th semester						**450**	**450**	**900**	**30**
Total 3rd and 4th semester	**225**		**150**	**75**		**450**	**900**	**1800**	**60**

ELECTIVE PROFESSIONAL COURSES	Contact hours								
	L	**S**	**SP**	**LP**	**FW**	**OW**	**Σ CH***	**Σ SO***	**ECTS***
Physical Education					45		45	90	3
Field Project Work					60		60	120	4
Selected Chapters from Spatial Planning	45		45				90	180	6
Geoinformatics III	30		30				60	120	4
Selected Chapters from Cartography	30		15				45	90	3
Geophysics	30			15			45	90	3
Close-Range Photogrammetry	15			30			45	90	3
Optimisation of Geodetic Technical Tasks	15			45			60	120	4
Total elective courses	**165**		**90**	**90**	**105**		**450**	**900**	**30**

L – lectures; S – seminar; SP – seminar practicals; LP – laboratory practicals; FW – field work; OW – other work; CH – contact hours; SO – study obligations

* student workload amounts to 60 ECTS/year, which comes to 1800 hours/year; the hours include contact hours and independent work

17. Possibilities of elective courses and mobility

Elective courses are foreseen for the 2nd semester in the scope of 7 ECTS and in the 3rd semester in the scope of 12 ECTS. The study programme itself proposes 8 elective courses, which cover different areas of geodesy and geoinformation, and including physical education. To complete practical knowledge, in the third semester it is appropriate to select Field Project Work. Apart from the selection of elective subjects in the existing study, students may also choose among elective subjects at UL FGG. Recommendable subjects are from the areas of municipal engineering, traffic infrastructure as well as hydrology. They may also select any elective subjects from other faculties that are members of UL, and from other universities and higher education institutions in Slovenia or abroad, dealing with law, economics, administration and business administration, computer science, language, geology, agronomy, forestry, architecture and urbanism, etc.

Student may transfer 30 ECTS points of the programme (one study semester, regardless of compulsory and elective units) from any other area of civil engineering, provided that there is available an adequate agreement signed with UL FGG.

18. Presentation of individual courses

18.1 Obligatory courses

MATHEMATICS III (5 ECTS)
Linear and euclidean spaces: linear independence, basis, linear mappings, nullspace and range, matrix representation, transitional matrix, rank, eigenvalues and eigenvectors, scalar product, norm, orthogonality, Gram-Schmidt orthogonalisation, orthogonal projection (vector of best approximation), Fourier coefficients, least squares method, overdetermined systems, normal system, regression line. Numerical linear algebra: numerical computation and errors, linear systems, matrix decompositions: LU, QR, SVD. Graph theory: matrix presentation, isomorphism, path, cycle, walk, spanning tree, Hamiltonian and Eulerian cycle, the shortest path problem, weighted graph, algorithms of Kruskal and Dijkstra. Ordinary differential equations: linear DE of order n, LDE with constant coefficients, linear systems of DE of first order, matrix solution of initial problem, boundary value problem. Basics on partial differential equations: equations of mathematical physics, vibrating string, d'Alembert solutions.

GEOINFORMATICS II (4 ECTS)
Quality of spatial data and information (terminology, the importance of data quality and standardization, standardized data quality models, elements of data quality). Internet and web-GIS, their relation to GIS technology (data servers and users, open standards and services, data transfer supply, history and development of web GIS, communication for data transfer). Mobile GIS and required tools for the support, hardware and software, field computers, wireless data transfer and communication. Cost and benefit analysis and its application in the domain of geoinformation, marketing and distribution of spatial data, effectiveness and efficiency issues of data services. Vector and raster data models for graphical recognition and presentation of spatial data, 3D- and 4D spatial data model, comparison of the approaches, database issues, special requirements: dtat stes, topology, data compression, visualization, etc. The historical overview, the role, importance and main application fields of spatial data analyses, the possible classification of methods and approaches, etc.

SATELLITE GEODESY AND NAVIGATION (9 ECTS)
Reference systems and reference frames, geodetic datum. Inertial (celestial) and terrestrial reference systems and frames. The hierarchy of celestial and terrestrial reference systems. Artificial Earth satellites for surveying; methods of satellite geodesy. Fundamentals of the theory of time; sidereal time, solar time (universal time), dynamic time, atomic time, coordinated time, own specific time. Methods of global geodesy: VLBI, SLR, LLR, DORIS, GNSS.
Interdisciplinary tasks that can be solved using modern satellite techniques. Basis of kinematic and dynamic motion of satellites. Object (point) movement in the central field of force, conservation laws. Movement of artificial Earth satellites, Kepler's laws, derivation, orbits. Undisturbed and disturbed movement of satellites. Keplerian elements. Perturbing forces. Effects on satellite observations, modelling impacts, use of models by solving inverse problems: GNSS meteorology, GNSS reflectometry, GNSS for monitoring the Earth's atmosphere.

ADJUSTMENT COMPUTATION (4 ECTS)
Concept of internal and external observations in the least squares adjustment. The concept of geodetic datum, datum information of the observables in geodesy and surveying. Definition of the geodetic datum with minimum and inner constraints. Geodetic datum defect adjustment, quality measures of estimated quantities. Sequential least squares adjustment, quality measures of estimated quantities. Concept and measures reliability and sensitivity of observations. Adjustment of transformations of coordinate systems. Concept of least squares collocation. Covariance function, correlation function. Use of collocation in geodetic and surveying tasks. Kalman filter, basic form and extended Kalman filter, quality evaluation of Kalman filtering. Application of the Kalman filtering in kinematic surveying and kinematic geodesy.

URBAN PLANNING (4 ECTS)
Basic notions and terminology in urban spatial planning; sustainable principles of urban development, development of settlements, settlement, typology, urban system, urbanisation and urban land use, planning documentation and administrative services; inspection, development of urban areas: land allotment for building development, land acquisition, urban planning, implementation of urban planning documents, and their application, urban ecology, environmental impact assessment in urban areas, urban renovation. Lectures on housing, production and central land uses; green, transport and municipal areas, and infrastructure systems. Visits to urban planning institutions and the Urban Planning Department of the City Administration. Tutorials: Design of the implementation plan (municipal detailed spatial plan or renovation plan), based on the town plan or other regulations; analysis of land ownership; land allotment and urban infrastructure (textual and graphical report). To analyse and work on evidence bases for the project in question; data acquisition, land acquisition, plan implementation, and marketing.

GEODETIC MEASURING SYSTEMS (8 ECTS)
Introduction: importance of measuring technique, classification of geodetic measuring sensors
Levels: development, digital level, working principles, calibration, use – static and kinematic measurements.
Tachometers: development, structure, technical fundamentals of automatic tacheometers. Theodolite: instrumental errors, instrumental controls, sighting – accuracy, efficiency, calibration, tests of APT, AST

systems. Distancemeters: errors, accuracy, calibration (frequency control, resolution, zero point); non prism measurements.
Tachometer: static measurements (principles, examples: metal constructions, geomechanical researches, high buildings, crane rails, TPS in athletics); kinematic measurements. TPS and GNSS combinations: Leica, Trimble, Topcon. TLS – Terrestrial laser scanners: technology classification and technical limitations, measuring strategy. Basic measuring principle, laser scanner as multisensor system – structure, laser beam as touch, distance measurement, direction deflection, measuring of geometrical values, targets. Categorization of terrestrial laser scanners: Field measurements: instrumentation and equipment, assuring of registration, georeferencing. Scanogram processing: visualisation, data organisation, segmentation, registration. Calibration: component calibration, system calibration. Applicability. IFM – Interferometry: Michelson interferometer, two-frequency interferometer IFM, absolute interferometry ADM, spherical reflector. Linear and angle measurements with interferometer: interferometer as length etalon, distortion measurements, kinematic measurements. Laser Tracker: working principles, instruments on the market with main technical characteristics, application examples, multisensor systems: Laser Tracker + TLS + robot + videogrammetry

PHYSICAL GEODESY (4 ECTS)
Planet Earth, geodynamicla processes on Earth: plate tectonics. Euler's poles of rotation; geophysical and geodetic models of plates motion. Rotation of the Earth, precession and nutation, polar motion. Earth's orientation parameters (EOP). The gravity field of the Earth. Gravitational force and potential, Gravity force and potential. Geometry of the Earth's gravity field: level surfaces, plumb line. Spherical harmonic representation of the gravitational potential; global geopotential models. Figure of the Earth, geoid, level ellipsoid; normal gravity field. Anomaly gravity field of the Earth: deflection of the vertical, gravity anomaly, (quasi)geoid height. Height system: geopotential heights, orthometric, dynamical, normal heights. Mean se level, tide gauge, sea surface topograhy. Levelling networks in Slovenia, vertical datums; European height networks: UELN, EUVN, EVRS. (Quasi)geoid determination, methods and data. GNSS-levelling. Interpolation of geoid heights from the model. Gravimetry, absolute and relative gravity measurements. Gravimetric survey, gravimetric networks.

SPATIAL DATA ANALYSES (4 ECTS)
Overview of course content, terminology and literature. Vector and raster data – comparison, strengths, weaknesses. Overview spatial analysis – development and characterization of spatial analysis. Implementation of spatial analysis in GIS. Operators in spatial analysis. Overview spatial analysis methods. Introduction to geostatistical analysis and spatial statistics. Processing of raster layers – logical operations, mathematical algebra. Analysis of vector data – topology, algebra, data overlay. Analysis of density, distance and direction. Neighbourhood analysis, network analysis. Values extraction and inquiries. Generalization of values. Surface modelling – overview of methods, features of interpolation methods. Kriging. Creating contours. Triangulation with optimization. Visualisation of spatial data
Three-dimensional representation of the terrain and of spatial objects. Animated displays spatial plane.

REMOTE SENSING AND PHOTOGRAMMETRY II (8 ECTS)
Methods of camera calibration: calibration in a test field, self-calibration; different mathematical models: collinear model, direct linear transformation, projective model; practical examples. Advanced procedures of aerial triangulation (AT): automated AT, GNSS supported AT, integrated sensor orientation; direct orientation; phases of aerial triangulation: project planning, input data, processing and analysis of the results. Photogrammetric acquisition of topographic data for building up topographic data sets. Quality assurance and quality control in photogrammetric projects. Planning photogrammetric project. Current satellite system for data collection of the Earth’s surface and image ordering, with the emphasis on the high and very high resolution satellite images. Aerial laser scanning: physical characteristics of laser beam, system components, main phases of data collection and processing, products and their use. Generation of digital terrain models from remote sensing and photogrammetric sources: technologies for generating the models, production procedures, quality of products; available national sources. Object based classification and its applications: comparison with the pixel classification, segmentation, quality of classification. Mobile mapping systems: characteristics, components, workflow, products and their use. Terrestrial laser scanning in connection to photogrammetric applications. Selected practical examples..

MULTIMEDIA CARTOGRAPHY (7 ECTS)
Importance and meaning of cartography, map media, multimedia, meaning and development, elements of multimedia cartography, design of multimedia maps, map presentation in multimedia environment, interactivity, 3D presentations, symbolic and realistic visualizations, presentation of abstract and dynamic phenomena, dynamic maps, cartographic animation, standards and protocols, digital globes, atlases, electronic atlases, national atlases, virtual reality, augmented reality, spatial games, e-learning, time – space cube, design of maps for transportable devices, navigation maps, location based services and telecartography, fantasy maps, virtual models, mind maps, mapping of non-geographical spaces, multi-presentation possibilities, cybercartography, future of cartography.

ENGINEERING SURVEYING (6 ECTS)
General background of local road design and earthwork volume calculation. Measurement techniques and methods in engineering surveying (plumbing, photogrammetry, use of laser and laser scanning). Geodetic work for complex object construction: bridging objects: type of bridging objects, geodetic plan and hydrographic measurements for bridge design, geodetic network for setting out, control measurements on bridging objects, tunnels: type of tunnels, surface and underground geodetic network for setting out, tunnel breakthrough accuracy assessment, tunnel boring machine (TBM) guidance, control measurement, measurements for quality control of prefabricated elements: quality measures, measured data processing, acceptance criteria, modular prefabricated buildings and steel structure: setting out procedures and control measurements, geodetic measurements mounting production line, structural deformation surveying: stabilization of geodetic reference point, stabilization point on buildings, geodetic network for structural deformation surveying.

SPATIAL STATISTICS (4 ECTS)
Meaning and application of spatial statistics, types of spatial data. Some descriptive examples of spatial data. Basics of theory of probability, definition of random variables, vectors and random functions. Random sampling of random variables and vectors, the inverse method, acceptance- rejection method. Random sampling of random vector, dependent random variables. Monte Carlo method, variance reduction techniques. The definition of moments of random vectors (mean, variance, covariance) and the corresponding moments for random functions (covariance function, variogram). The definition of stationary random fields and processes. The definitions of the distance between points: Euclidian, Mahalanobis, Manhattan, cost distance, resources, number of neighbors. Geostatistical data: definition and examples. Analyses of geostatistical data, the definition and use of scatter plots or crossplots. The definition and meaning of sample variogram, covariance function, correlation function, cross- correlation function, Moran's index, Geary's ration, hypothesis testing for spatial independence. Kriging, idea and different types. Simple kriging. Ordinary kriging, kriging with trend. Differences and advantages of different methods. Spatial patterns, data types, examples. The definitions of central element, spatial distribution, mean linear direction. Quadrat analysis, nearest neighbour analysis. Spatial regression, linear regression, least-squares method, the meaning of spatial, geographically weighted regression. The basics of random field and random process generation, based on kriging and autocorrelation functions.

LAND CONSOLIDATION AND REARRANGEMENT (4 ECTS)
Land management, sustainable paradigm, active land policy, modern guidelines. Historical background, legal frame, administrative and contract land consolidations (procedures, actors, responsible institutions); problem analyses; land valuation; public hearing of surveying documentation (current situation, consolidation plan, land valuation); arrangement of legal regimes at consolidation; implementation of the consolidation plan up to the final realization (entry into legal evidences). Legal restrictions of land consolidation (land rights and their changes during realization of spatial planning acts, real property rights, easements). Historical background in Slovenia (agrarian reform, nationalization/restitution); land policy in Slovenia; land rearrangements (of real property units, land plots) for the purpose of construction: subdivision plan; land rearrangements (of real property units, land plots) at agrarian operations: land exchange, rounding of; agro- and hydro-melioration. Actors and institutions in charge in the field of land rearrangement; motivation of participants; legal restrictions. Systems of land structuring, spatial and land databases; Directive INSPIRE; land information system (LIS) as support for spatial decisions, multi-criteria and multi-attribute decisions; computer assisted land management; public infrastructure arrangements using LIS; cadaster of land consolidation; regulation by

real property legislation. Optimization of processes and transaction costs; system of land use control based on spatial databases; land/real property rights and their changes by realization of spatial planning acts in Slovenia (real property rights, easements).

MASS REAL ESTATE VALUATION (4 ECTS)
Theory of real estate valuation and general principles (introduction into mass valuation of real properties, individual and mass valuation of real properties, rural and urban areas, buildings and other constructions). Monitoring of real estate market, characteristics of real estate market, types of transactions, transaction procedures, legal requirements and limitations. Historical development of real estate mass valuation, computer assisted systems. System of real estate mass valuation – organisation of real estate mass valuation, market data on transactions of real estates and analyses of transactions, geodetic and other data on objects of valuations, general procedures of mass valuation. Concepts of individual models for mass valuation, development of mass valuation model, model calibration, model analyses, determination of general market data of real estate. Software solutions and suitable databases for real estate mass valuation, interpretation of data and their availability (intranet, internet), legislation and regulations, standardization of the field. Valuation of agricultural land and forests, cadastral classification, production capacity of the soil. Real estate mass valuation in Slovenia, legislation and standards. Mass valuation of real estates in GIS, spatial analyses, interpolation methods, deterministic and geo-statistic methods.

PROJECT TASK (20 ECTS)
The course consists of different parts
1. Field work represents the practical implementation of specific geodetic task and can refer to: - geodetic work for the planning activities and the placement of construction objects in space. This includes preparation of conceptual design of the change in the environment, cadastral arrangements, cartographic visualization of the proposed change based on existing databases, planning and implementation of the geodetic network, topographic measurement, staking out the projected object etc. - Using the latest and modern technologies in the field of geodesy and geoinformation in specific surveying tasks (use of drones, combinations tchimetry and lidar, lidar with RGB sensor fusion for positioning, location based services, open source GIS, open source database, etc.). Student can be with the practical task substantively guided to the topic of the thesis.
2.Introduction to research work, methods of research work, representation of bibliographic sources, strategy and practical use of bibliographic sources, searching and finding; writing and styling of research papers, presentation of research work.
3. Independent work of student for the preparation of s draft of master thesis topic; students have to: select relevant sources for the master thesis topic, prepare the overview of the situation in the research scope; prepare possible ways of solving the research task and draw up a work schedule. Student concludes his work with the preparation of a written product - master thesis application; it contains the presentation of the master thesis topic, time line and work schedule and a list of bibliographic sources. After the oral presentation student may supplement the original proposal topic of the master thesis and finally submit the written master thesis application.
4. Field trip consists of visiting professional, research or educational institutions, ministries, municipalities, companies abroad. Field trip lasts for three or four days. Afterwards, students are obliged to prepare field trip reports.

MSC THESIS (10 ECTS)
MSc thesis is made under the supervision of a selected teacher. The work is publically presented at the end of the study. It shall contain introduction,working hypothesis, overview of sources, material and methods, results, discussion and summary. As a rule, the work shall deal with practical problems from geodetic profession practice and should provide further solutions which come out from the study and from the results of students' own work.

18.2 Elective courses

PHYSICAL EDUCATION (3 ECTS)
General theoretical part contains lectures, which are common to all sports programs made collectively for all students (basic function of the human body, movement of the body and cardiovascular system, psychomotor

and functional abilities, prevention and curative activity for developing health, basic nutrition and healthy diet, regulation of body weight and other medical aspects of sports, checking methods and assessment of psychomotor and functional abilities); Special theoretical part is linked to the selected sport (specificity of sport, human development through sport, technique, tactics and rules, fundamentals of physical and technical preparation) and is implemented through practical exercises; Practical work: students choose between the offered sport branches. For each sport have a program of learning and skill training.

FIELD PROJECT WORK (4 ECTS)
Course demand realization of real professional projects, as they are in real professional life on the market. New tiles of the projects are defined every year repeatedly. The projects are from the fields of geodesy, surveying, engineering surveying, photogrammetry and cartography and also from the other fields of geodetic engineering. Students are occupied with the realisation of geodetic nets for different purposes (topographic measurements, deformation measurements, stake out etc.) planning of geodetic survey, evaluation of the quality of final results on the base of terrestrial and GNSS measurements, photogrammetric and cartographic methods all in tasks of managing of real property. They solve problems from the field of engineering surveying.
Work starts with tender of adequate number of projects, than follow: - application on the call with the offer of project realization including time plan and financial evaluation, - selection and project realisation (pre-measurement inspection of the object of the project, field measurements, computations, working out of expert's detailed report), - public presentation of the results of the project, - preparation of the project poster.

SELECTED CHAPTERS FROM SPATIAL PLANNING (6 ECTS)
Advanced and thorough examination of selected topics of spatial planning with a special emphasis on: understanding of different land uses, legal regimes, land statuses, etc., significance of legal regimes from spatial planning documents for spatial developments, understanding and coordination of data from different sectors for efficient spatial planning, impact of contents of spatial planning documents (local level) on spatial development and activities, significance of databases for spatial management, understanding and interpretation of spatial planning documents in surveying work, based on surveying groundwork, transfer of information on intended land use to land plot.

GEOINFORMATICS III (4 ECTS)
Overview of the course content (introduction, purpose, terminology, literature, etc.), spatial data quality, standardized quality model and basic elements of quality. Spatial sampling techniques, quality evaluation methods. Standardized metadata report elaboration. Vector data structure, topology and various topology rules, relational model for vector topology implementation, organization and storage considerations. Detailed elaboration and application of selected important spatial data standards (formal and open coded), overview of some related information technology standards. Spatial and temporal models of space, spatial data and temporal analysis and simulations. Elaboration of some specialized spatial analysis for selected application in geodesy. Overview and approaches to the 3D modelling of objects, methods, technology and formats, users and applications.

SELECTED CHAPTERS FROM CARTOGRAPHY (3 ECTS)
Cartographic projections, importance of cartographic projections for cartography and geodesy, theory of planes, projection types according to deformations and mapping planes, projections of nomenclature maps, national coordinate system, selection of projection, calculations among projections, special types of projections, military cartography, importance of spatial data for military purposes, STANAGs, military maps, spatial analyses, map use in the terrain conditions, crisis cartography (natural disasters), geological mapping, special maps (for orientation and navigation). Other actual cartographic themes.

CLOSE-RANGE PHOTOGRAMMETRY (3 ECTS)
Introduction to close range applications. Planning and execution of field measurements. Preprocessing of close range data: sorting of a photo archive, computation of spatial coordinates of control and check points. Photogrammetric acquisition and products. Calibration of non-metric cameras. Procedures of monoscopic

restitution. Data collection for the generation of 3D models. Documenting objects of cultural heritage. Examples of different applications. Accomplishment of a practical example.

GEOPHYSICS (3 ECTS)
Planet Earth. The Dynamic Earth. The Earth's figure and gravity, gravity anomalies; interpretation of gravity anomalies. Gravimetry, absolute and relative gravity measurements. Gravimetric survey. Seismic waves, seizmograph. Earthquake seismology. Internal structure of the Earth. Earth's age, thermal and electrical properties. Geoelectricity. Magnetic field of the Earth. Paleomagnetism. Spatial and temporal variations of the geomagnetic field. Magnetic surveying. Geodynamical processes on the Earth: plate tectonics, Isostasy, rheology.

OPTIMISATION OF GEODETIC TECHNICAL WORKS (4 ECTS)
Optimization of geodetic technical tasks in terms of orders: zero, first, second and third order. Optimization methods: ordinary (trial and error) and analytical (target and multi-target methods). Definition of target functions of the analytical method optimization of the geodetic technical tasks in the sense of accuracy, reliability and price performance of the specific geodetic task. Defining quality criteria of geodetic tasks in terms of: scalar matrix criteria, modifications of existing quality criteria, economic optimization of geodetic technical work simulation as a tool in the optimization of geodetic technical work. Practical implementation of the simple practical optimization results. Practical analytical optimization of geodetic technical task in a challenging project of movement monitoring and deformation of the natural and built environment.