University
of Ljubljana
Faculty
of Civil and Geodetic Engineering

Presentation of the study programme

1st CYCLE ACADEMIC STUDY BACHELOR DEGREE PROGRAMME

GEODESY AND GEOINFORMATION (BA)

Valid from the study year 2018/2019

1. Information about the study programme

University Bachelor Degree Program Geodesy and Geoinformation consists of 3 years (6 semesters) and amount to 180 credit points. The study program does not include individual study orientations. The study program is carried out as a regular and a part-time study.

2. Basic goals of the programme

The basic goal of the academic bachelor degree program *Geodesy and Geoinformation* is to train experts to develop professional skills and fundamental theoretical and practical knowledge in the fields of geodesy and geoinformation. Within elective courses, students are given the opportunity to improve their knowledge with related areas according to their interest.

Acquired knowledge:
- a broad insight into the historical development and current status of the profession in Slovenia, Europe and beyond,
- to implement and critically assess procedures related to geodesy and geoinformation,
- to further develop and strengthen professional engineering responsibility and
- comparability of the knowledge acquired to similar programs in the region.

3. General competences

General competences acquired by the graduates of the bachelor study programme of *Geodesy and Geoinformation* include the ability to:

- study new technologies and methodologies independently by acquiring the bases of professional responsibility,
- communicate in oral and written form in the native and in foreign languages with special emphasis on the knowledge of foreign language terminology,
- use information and communication technologies in the fields of geodesy and geoinformation,
- connect with other professionals in working teams of different experts from various professional fields,
- Manage a small surveying firm engaged in solving professional problems.

4. Course-related competences

With the first cycle bachelor, study programme *Geodesy and Geoinformation* the graduate acquires the following course-specific competences:
- knowledge of the role and importance of geodesy and geoinformation in modern society,
- ability to independently solve all kinds of typical surveying tasks in the areas of data capture and quality assessment as well as to make decisions related to the use of spatial information,
- ability to use modern surveying technologies and methodologies to acquire spatial data with appropriate precision or accuracy,
- knowledge of spatial data usage according to their importance, form of records, quality, resources, production and recovery,
- ability to use the measurement results and professional knowledge in:
  - maintenance of basic geodetic systems,
  - less complex building construction,
- administrative procedures to meet the needs of real estate registration,
- participation in planning, design and implementation of interventions in space,
- maintenance of geographic and cartographic systems and preparation of cartographic spatial data and
- cooperation with investors, designers and contractors.

5. Conditions for enrolment

The conditions for the enrolment into professional first cycle bachelor degree program Geodesy and Geoinformation are the agreement with the article 38 and 38b for the Higher Education Act 115 of the Statute of the University of Ljubljana. To enrol to the professional bachelor degree program the candidates are required to:

a) graduate from the secondary technical school of adequate program for the acquisition of secondary technical education from the area of natural sciences or engineering and pass one of the subjects from the grammar school final examination; the selected subject should not be the same as for the graduation from the secondary technical school,
b) finish any of the four-year secondary school programs before 1. 6. 1995
c) finish equivalent education abroad.

The number of places is determined in the Call for enrolment into second cycle study programmes of the University of Ljubljana individually for each academic year.

6. Selection criteria when enrolment is restricted

The candidates from item a) will be selected according to:

- general success in final graduate school examination 60 %
- general success in the 3rd and 4th years of the grammar school 40 %

The candidates from item b) will be selected according to:

- general success in the final technical school examination 40 %
- general success in the 3rd and 4th years of the secondary school 40 %
- success in extra final examination 20 %

The candidates from item c) will be selected according to:

- general success in the 3rd and 4th years of secondary school 50 %
- success from the subjects of natural science (mathematics, physics) in the secondary school 50 %

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

Knowledge conforming in contents and scope to the teaching contents of the courses in the program Geodesy and Geoinformation may be acknowledged. The recognition of knowledge and skills acquired before the enrolment is the subject of the decision by the Study Board of the Department of Geodesy of UL FGG based on student's written application, certificates and other documents that prove successful acquisition of knowledge and the contents of the knowledge, and in accordance with the Rules on procedure and criteria for the recognition of informally acquired knowledge and skills, adopted at the 15th meeting of the Senate of UL, 29.5.2007.

For the acknowledgement of knowledge and skills, the following is considered:

- certificates and other documents evidencing finished courses and other forms of education,
- evaluation of products, services, publications and other works by students,
- evaluation of knowledge acquired by the student self-educational process or empirical learning (possibility of performing study obligations without active participation at lectures, practical, seminars),
- adequate work experiences are taken into account.

Based on the approval of the acquired knowledge the Study Board of the Department of Geodetic Engineering, UL FGG, will evaluate the knowledge with the same number of ECTS points as the number of ECTS points of the course.

8. Methods of the assessment

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

9. Advancement conditions according to the program

9.1 Conditions for the advancement from one year to another

Conditions for progression according to the study programme are harmonised with the Article 151 of the Statute of the University of Ljubljana.

Students are allowed to enrol to the second study year after completing by the end of the academic year all the obligations foreseen by the study plan and achieving 60 credit points according to ECTS.

Students are allowed to enrol to the third study year after completing by the end of the academic year all the obligations foreseen by the study plan and achieving at least 54 credit points according to ECTS.

Exceptionally, students may enrol to the next year also when failing to complete all obligations defined by the study program for the enrolment to the next study year, by providing justified reasons as defined by Article 153 of the Statute of UL (maternity, longer illness, extreme family and social circumstances, certified status of a person with special needs, active participation in top professional, cultural and sports events, active participation in the university bodies).

Considering the conditions from the above paragraph, students may also enrol to the next year when they accumulate at least 45 credit points according to ECTS. The enrolment according to the above paragraph is the subject of the decision by the Study Board of the Department of Geodesy at FGG.

Faculty of Civil and Geodetic Engineering has been offering tutorship and supervision for its students for several years. From the very first year, students have designated supervisors for the specific year, and smaller groups of students can also have individual tutors consisting of teachers or students from higher years, who help them, select orientation, elective courses, etc.

Students with above-average study results are allowed to advance at a faster rate. An adequate decree thereof shall be adopted by the Senate of FGG based on a candidate's application and on opinion of the Study Board of FGG. The decree also defines the principles of faster advancement.

9.2 Conditions for repeated enrolment in the same year

Failing to meet all the obligations defined by the study program for the advancement in the next year, students may enrol in the same year for the second time. They are entitled to the repeated enrolment only once for the duration of the study, provided that they achieve at least 30 credit points according to ECTS.

10. Transfers between study programs

Transfer between programmes shall mean termination of education in the student's original study programme (first programme) and continuation of education in the first cycle academic 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 first cycle study programmes, and until their expiration also from the undergraduate study programmes adopted after June 11th 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.

The Study Board of the Department of Geodesy will examine applications of candidates for the transfer to the first cycle academic study programme Geodesy and Geoinformation and the scope of acknowledged obligations in the study programme individually. 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 first cycle academic study programme Geodesy and Geoinformation, the candidate may enrol to the higher year of the first cycle academic study programme Geodesy and Geoinformation.

11. Conditions for completion of the study

Students finish the study by the accomplishing the foreseen obligations totalling 180 credit points according to ECTS, including practical training and diploma thesis.

12. Conditions for completion of individual parts of the programme

The Study is uniform.

13. Qualification, professional or academic title

- diplomirani inženir geodezije (UN)
  (first cycle graduate in geodesy)

- diplomirana inženirka geodezije (UN)
  (first cycle graduate in geodesy)

14. Qualification, professional or academic title (abbreviation)

- dipl. inž. geod. (UN)

15. Classifications

- KLASIUS-SRV: Professional higher education (first cycle Bologna)/professional university (first cycle Bologna) (16204)
- ISCED: architecture, urbanism and civil engineering (58)
- KLASIUS-P: Geodesy and cartography (5813)
- Frascati: Technical sciences (2)
- Level SOK: Level SOK 7
- Level EOK: Level EOK 6
- Level EOVK: First cycle

16. Study programme courses, Syllabus

1st YEAR	Contact hours								
	L	S	ST	LT	FW	OW	Σ	Σ	ECTS
1st semester									
Mathematics I	75		75				150	300	10
Physics	75	15	45				135	270	9
Software tools in geodesy		45	30				75	150	5
Introduction to geodetic engineering	45			45			90	180	6
Total 1st semester	**195**	**60**	**150**	**45**	**0**	**0**	**450**	**900**	**30**
2nd semester									
Mathematics II	60		60				120	240	8
Civil engineering and Infrastructure	30		30				60	120	4
Topographic surveying and mapping	75			75			150	300	10
Statistical methods in geodesy	30		30				60	120	4
Adjustment computations I	30		30				60	120	4
Total 2nd semester	**225**	**0**	**150**	**75**	**0**	**0**	**450**	**900**	**30**
Total 1st and 2nd semester	**420**	**60**	**300**	**120**	**0**	**0**	**900**	**1800**	**60**

2nd YEAR	Contact hours								
	L	S	ST	LT	FW	OW	Σ	Σ	ECTS
3rd semester									
Adjustment computations II	30		30				60	120	4
Spatial planning	30			30			60	120	4
Geodesy	30			30			60	120	4
Cartography	60		60				120	240	8
Geoinformatics I	45			45			90	180	6
Introduction to data	30			30			60	120	4
Total 3rd semester	**225**	**0**	**90**	**135**	**0**	**0**	**450**	**900**	**30**
4th semester									
Photogrammetry I	30			45			75	150	5
Precise classical geodetic measurements	60			75			135	270	9
GNSS in geodesy	60			60			120	240	8
Introduction to law	30		30				60	120	4
Elective course I (UL FGG or UL)	30		30				60	120	4
Total 4th semester	**210**	**0**	**60**	**180**	**0**	**0**	**450**	**900**	**30**
Total 3rd and 4th semester	**435**	**0**	**150**	**315**	**0**	**0**	**900**	**1800**	**60**

* student obligations total 60 ECTS/year, which agrees with 1800 hours/year; hours include contact hours + independent work

** the course is intended as an optional for students from other faculties (social sciences,…)

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

3rd YEAR	Contact hours								
	L	S	ST	LT	FW	O	Σ	Σ	ECTS
5th semester									
Rural planning	30			30			60	120	4
Economics and management in geodesy	45		30				75	150	5
Engineering surveying I	45			45			90	180	6
Remote sensing I	30		30				60	120	4
Property law	30		30				60	120	4
Elective course II (UL FGG or UL)	60		45				105	210	7
Total 5th semester	**240**	**0**	**135**	**75**	**0**	**0**	**450**	**900**	**30**

6th semester									
Real property records and cadastres	60			50	10		120	240	8
Real estate management and evaluation	30	15	45				90	180	6
Elective course III (UL FGG or UL)	45		60				105	210	7
Practical training	6					80	34	120	4
Diploma work						75	75	150	5
Total 6th semester	**141**	**15**	**105**	**50**	**10**	**155**	**424**	**900**	**30**

Total 5th and 6th	**381**	**15**	**240**	**125**	**10**	**155**	**874**	**1800**	**60**

ELECTIVE PROFESSIONAL COURSES	Contact hours								
	L	S	ST	LT	FW	O	Σ	Σ	ECTS
Field work					90		90	180	6
Programming	15		45				60	120	4
Standards in surveying and engineering	15	30	15				60	120	4
Hydrography and toponomy	30		30				60	120	4
Measurement and description of space**	30		20		10		60	120	4
Selected topics from geodetic surveying	15			45			60	120	4
Basic computing methods for engineers	15			45			60	120	4
Total elective subjects	**120**	**30**	**110**	**90**	**100**		**450**	**990**	**30**

* student obligations total 60 ECTS/year, which agrees with 1800 hours/year; hours include contact hours + independent work

** the course is intended as an optional for students from other faculties (social sciences,…)

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

17. Possibilities of elective courses and mobility

Elective courses are foreseen: one in the 3rd semester (4 ECTS), two in the 5th semester (4 ECTS each) and one in the 6th semester (6 ECTS). The study program itself proposes only two professional elective courses plus Sports Education, and appropriate selection would be e.g. Field Work in the 6th semester and Computer Programming either in the 3rd or 5th semester, together with other available elective courses. Among elective courses, FGG recommends beside Sports Education also courses from the area of municipal or traffic infrastructure and hydrology. Among elective courses from other members of UL, FGG proposes especially courses from the area of law, economy, administration, communicology, foreign languages, geomorphology, computer science, sensors, etc.

Student may transfer 30 credit points of the program (one study semester, regardless of mandatory and elective units) from any other area of geodesy and geoinformation, provided (if exists) an adequate agreement signed with UL FGG.

18. Presentation of individual courses

18.1 Obligatory courses

MATHEMATICS I (10 ECTS)
Sets and mappings, natural, real and complex numbers, geometric vectors, numerical sequences and series, limits and continuity of a function of one real variable, derivative of a function of one real variable, matrices, systems of linear equations, determinants, eigenvectors and eigenvalues of matrices, integral of a function of one real variable, power series.

PHYSICS (9 ECTS)
Physics and measurements, kinematics, forces, torque, dynamics, momentum and rotation, work, power, energy, gravitation (Kepler's laws, Newton's gravity law, potential energy, satellites), oscillations and waves, structure of matter, deformations, liquids, temperature, the first law of thermodynamics, electrostatics, electric current (Ohm's law, work and power, electric instruments), magnetism, induction, electromagnetic waves, radiation, light, light sources (Sun, absorption of light in atmosphere), geometric optics (reflection, refraction, mirrors, lenses, optic instruments), wave optics, photons, special theory of relativity.

SOFTWARE TOOLS IN GEODESY (5 ECTS)
The role and importance of information, engineering information, solving engineering problems with computers, information systems, information pollution and information literacy, communication and communications technology, importance of communication, forms, computer networks, and devices on networks, Internet, computer software and operating systems, desktop and cloud applications, distributed data processing, solving engineering problems with computers – analysis and modelling problems, data structures, creating and using algorithms, standard algorithms, getting to know dedicated computer software - QGIS, ArcGIS, AutoCAD, Excel... programming – the concept of the program, programming languages, types of programs, procedural programming, object-oriented programming. Introduction to programming with the programming language Python – learning development environment, design and construction of simple programs, extension of applications with own functions, getting to know the programs QGIS, ArcGIS, AutoCAD, Excel ... basic functions, the analysis of geodetic data, Python as the programming language – development environment, program development, examples of automation of work with Python, examples in QGIS, PostgreSQL and PostGIS.

INTRODUCTION TO GEODETIC ENGINEERING (6 ECTS)
Definitions of geodesy and geodetic engineer, international organisation of surveying and geodetic engineering, science of geodesy, history of geodesy, geodetic engineering as a profession to provide social and spatial infrastructure – geodetic engineering from the user's standpoint, units of measure, survey calculations, numbers in surveying, errors in numerical calculation, plane and spherical

trigonometry Earth and approximation of the Earth's shapes, coordinate systems in surveying (Cartesian, polar), fundamentals of plane coordinate computations, measurements overview, introduction into geodetic surveying and instrumental techniques, surveying system, surveying procedure, errors, applicability of geodetic surveying, sensitivity of surveying system, properties of surveying instruments, basic concepts and signs, surveying strategy.

MATHEMATICS II (7 ECTS)
Scalar functions of several real variables, double and triple integral, integrals with parameter, differential geometry, curve integral, plane integral, integral theorems, ordinary differential equations.

CIVIL ENGINEERING AND INFRASTRUCTURE (4 ECTS)
Civil engineering, building structures, legal bases, preparation of land and arrangement of building site, construction time plan, building documents, building profiles, geomechanical bases, earth works and foundation engineering, structural elements, protective structures, installations and other equipment, design and construction of high structures, design and construction of roads and railways, infrastructural buildings and devices, technical infrastructures, technical-technological characteristics of traffic structures and devices, energy, urban, water infrastructure, infrastructure for managing other natural resources and structures in public use, basic materials, building materials and binders, structural solutions, construction contract, project management, cadastre of public technical infrastructure.

TOPOGRAPHIC SURVEYING AND MAPPING (10 ECTS)
Coordinate systems in geodesy, geodetic grids as realisation of coordinate system, geodetic tools, theodolite, electrical-optical range finder, methods and errors of measuring horizontal corners, errors and corrections of lengths, trigonometric altimetry, geometric levelling, level meter, detailed geodetic surveying, determining coordinates, GNSS systems, principles position determination in GNSS, detailed terrestrial surveying, detailed geodetic surveying in GNSS systems and grids, combination of classical terrestrial measurements and GNSS measurements in detailed surveying, measuring procedures, planning and performing geodetic surveying, printout, charting, geodetic plans, detail sheets, height presentation of the terrain in geodetic plans, presentation precision, surface calculus, shrinkage of detail sheets, digitalisation of geodetic plans.

STATISTICAL METHODS IN GEODESY (4 ECTS)
Basics of statistics, presentation of data, descriptive statistics (graphic presentations and numerical presentations of spatial and other data), descriptive statistics (percentiles, frequency distribution, data in classes), probability calculus (introduction, event, probability of event), probability variables and probability vectors, moments of probability variables and their functions, probability distributions most frequently encountered in geodetic engineering, normal distribution as the most important distribution in geodetic engineering, sampling (properties of basic statistics, average of sample, variance of sample), evaluation of parameters (point and interval evaluations), assumption testing (basics of the theory of assumption testing frequently used in stability analyses of geodetic points, classic examples of testing assumptions, testing conformity, "hi-square" test), bivariant analysis (testing of statistic dependence, testing of linear connection, linear regression, application of the least square method as one of the basic methods of adjustment computation in geodetic engineering), variance analysis with examples in geodetic practice.

ADJUSTMENT COMPUTATIONS I (4 ECTS)
Concept of adjustment, mathematical, functional and stochastic model, statistic properties of observations, measures of precision, accuracy and reliability of observations, standard deviation, variance, cofactor, inclusion of observations in a model, linearization of nonlinear problems, the least square method, weight, weight matrix, variance-covariance matrix, cofactor matrix, adjustment of indirect observations according to the least square method, iterative solving of linearized problems, conditional adjustment according to the least square method, law of variance covariance propagation, variance covariance propagation in an indirect and in conditional adjustment.

ADJUSTMENT COMPUTATIONS II (4 ECTS)
General model of adjustment according to the least square method, variance covariance propagation in general model of adjustment, bivariate normal distribution, error ellipses, absolute and relative ellipses of errors, selection of appropriate adjustment technique, computational and numerical evaluation of adjustment procedure, input data for the adjustment, test of consistency of repeated observations, redundancy matrix and redundancy number, output results of the adjustment, global test model, application of a-posteriori reference variance, »data snooping« and »tau test«, detection of gross errors in observations, valuation of adjustment results.

SPATIAL PLANNING (4 ECTS)
Meaning and role of spatial planning, spatial management at the municipality, regional and state levels, strategic spatial planning, teamwork and interdisciplinary work in spatial planning, professional code of conduct and ethics in spatial planning, implementation of plans and control; illegal spatial interventions, permission of spatial interventions, coordination of territorial interests, public inclusion, spatial inventory, spatial potential, urban and rural land use, spatial concepts of land use distribution for agriculture, forestry, mining, housing, production, tourism and recreation; spatial distribution of traffic, municipal and energy infrastructure, environmental protection, environmental infrastructure.

GEODESY (4 ECTS)
Shape and size of the Earth, Earth as a sphere, rotation ellipsoid, relations between rotation e llipsoid parameters, meridian, prime vertical and parallel of rotation ellipsoid, geographic geodetic and astronomic coordinates, relations between rectangular and geodetic coordinates of rotation ellipsoid, normal sections of rotation ellipsoid, radii of curvature of normal sections of rotation ellipsoid, mean radius of rotation ellipsoid curvature, geodesic, determination of geodetic coordinates, Gauβ-Krüger projection of meridian zones, transverse Mercator projection, geoid, geoid height, deflection of the vertical, reduction of observations to the rotation ellipsoid due to geoidal height and deflection of the vertical, reductions of the observations to the Gauβ-Krüger and Transverse Mercator projection, coordinate systems in geodesy, astro-geodetic datum, local astronomical and local geodetic coordinate systems, geodetic and global geodetic coordinate systems in geodesy, rotation and reflection matrix, transformations of coordinate systems in geodesy.

CARTOGRAPHY (8 ECTS)
Cartography, cartographic communication, history of cartography, mathematic cartography, cartographic projections, copies and projection types, systemic maps, cartographic design, graphic elements and variables, map design, cartographic generalisation, recording of spatial information, modelling of reality, topology, topographic and cartographic bases, cartographic sources, quality of sources, national and European spatial database infrastructure and legislation, standardisation, national topographic cartographic system, cartographic editing, map elaboration, map media, automation of procedures, software and tools, application of maps, cartometry, interpretation of contents, aids and orientation in the field, application of maps on screen, location services.

GEOINFORMATICS I (6 ECTS)
Overview of the content, ontology and literature, the role of spatial (geographic) data and information in decision making process; system, information system (IS) and geographic information system (GIS); geoinformation, technology GIS and its role and components; strategic planning, modelling and development of information system models, system engineering, cybernetics, UML and geoinformatics; models and concepts of reality, time and its role and abstraction, modelling of spatial problem domain (cartographic and object-oriented) in relational databases; analog and digital spatial data, sources and characteristics, temporal data; standardization, international, regional and national, types of standards, legal aspects of standardization, industrial standardization, de facto standards; the role of formal and open standards for geoinformation domain; presentation of standards for spatial data - CEN/TC 287 and ISO/TC 211, standards for coding and data transfer,

interoperability, language Express, standardized metadata and examples of standardized metadata; technology OpenGIS and OGC open standards, OGC specifications and standardized web services, data transfer with GML; object catalogues and their standardization spatial data infrastructure and its national and international importance.

INTRODUCTION TO DATA PROCESSING (6 ECTS)
Overview of course content, terminology and literature; introduction to programming; software development methodology; programming language Python (introduction, mathematical libraries, graphing); basics of databases, relational technology, characteristics and use of the standard SQL language; standard data formats (text files, XML, JSON); QGIS and use of the programming language Python to automate processes; modern information systems, computing environment (high-performance and high-permeable); creating simple programs (data transfer, reading, converting, plotting, analysis); Introduction to data analysis with QGIS and Python.

PHOTOGRAMMETRY I (4 ECTS)
Definitions and terminology of photogrammetry, historic development, physical bases of photogrammetric image, mathematical bases of photogrammetry, digital photogrammetry and digital processing of images, image matching and application, digital photogrammetric recording systems, recording plan, orientation of stereopair (natural and artificial stereoscopic view, normal stereopair, one-level procedure, two-level procedure, relative and absolute orientation), photogrammetric equipment for data acquisition, massive recording of topographic data (national topographic system, legal bases, role of photogrammetry, national products, topology and photogrammetric acquisition of vector data, homogenisation of acquired data, examples), ortophoto (elaboration, quality, application).

PRECISE CLASSICAL GEODETIC MEASUREMENTS (9 ECTS)
Classical geodetic grids, triangulation – reductions of surveying values and calculation of coordinates with adjustment, trilateration – reductions of surveying values and calculation of coordinates with adjustment, link between triangulation and trilateration – TPS systems, combined grids, trigonometric altimetry, precise geometric level, precise levelling, precise levelling boards, height calculation with adjustment, geodetic grid project – demands, description of the task, outline scheme, stabilisation of points, assurance of quality geodetic surveying, a priori evaluation of surveying precision and searched quantities, optimisation of geodetic surveying, time plan, financial valuation, implementation of the geodetic grid project – measurements, calculation, interpretations of results, elaboration of geodetic grid, examples from practice.

GNSS IN GEODESY (8 ECTS)
Historic development of global satellite navigation systems (GNSS), segments of GNSS, concept of position determination in GNSS, reference coordinate and time systems of GNSS, normal orbit of GNSS satellite, representation of real orbit of GNSS satellite, impact on satellite orbits, satellite signal: content, preparation, transmission, reception and tracking of GNSS signal, GNSS receiver, types of observations in GNSS, code observations, phase observations, phase ambiguity, combinations of observations in GNSS, determination of absolute and relative position on the basis of code and phase observations, determination of baseline vector in GNSS, sources of influences on observations in GNSS: satellite, atmosphere, receiver and surrounding area of GNSS receiver, methods of GNSS surveying, GNSS geodetic networks, processing of GNSS measurements, quality evaluation of GNSS observations and obtained point coordinates, active GNSS networks, concepts of point coordinates determination in active GNSS networks, data flow in active GNSS networks, connection of coordinates, determined with the aim of GNSS with other data in a coordinate system, practical usage of GNSS technology in geodetic surveying and surveying engineering, GNSS stakeout, combinations of GNSS surveying with terrestrial geodetic surveying.

INTRODUCTION TO LAW (4 ECTS)
The concept of a state, the outline of state authorities in the Republic of Slovenia, the organization of the Executive, local self-government, basic types of legal procedures, the rule of law by development and concept of the rule of law, importance of procedural safeguards in court and administrative procedures,

the concept of Law, the systematization of law, the hierarchy of legal act; basic legal sources (of Slovenian Law): Constitution, Acts of Parliament, regulations and the principle of legality, the use of legal sources in administrative procedure; interpretation of law; open public administration; administrative decisions; the outline of administrative law; the appeal; judicial review of administrative decisions.

RURAL PLANNING (4 ECTS)
The notion of the countryside, functions of the countryside, functions of agricultural landscape, urban–rural continuum, rural settlements and their functions, agricultural production and its tendencies in Slovenia and abroad, natural setting and social conditions in agricultural areas of the Republic of Slovenia, goals of countryside development, management and development of rural settlements (databases, agriculture and its requirements in village development, reconciliation of land uses in villages, public utilities in villages, village renovation, remediation and reconstruction plans, village expansion, acquisition of building land), rural planning using agricultural operations, stages of realisation of these projects, taking into account the overall spatial needs.

ECONOMICS AND MANAGEMENT IN GEODESY (5 ECTS)
Business economics, basics of financial mathematics, analyses of transaction costs, business organisation, organisation theory, strategic management, coordination and business strategy, coordination of plans and activities, economics of information and coordination, effective initiatives and decision making in risk circumstances, management of human resources, technological and organisational development of business systems, problem analyses and solutions, analyses and optimisation of workflow, information systems for organisation management and control, system theory in engineering, project management, project planning and scheduling, project management in geodesy and geoinformatics (coordination and motivation, conflict solutions, negotiations), organisation of surveying in EU and Slovenia, regulation and control of surveying business units, public surveying services, professional codex.

ENGINEERING SURVEYING I (6 ECTS)
Trigonometric levelling and precise levelling for engineering surveying, hydrostatic levelling, geodetic measurements for construction of buildings, use of standards in engineering surveying, geodetic network for setting out and acceptance criteria, measurement accuracy and tolerance – connection between geodetic and construction accuracy, measurements/setting out off horizontal angels, measurements/setting out of distance, setting out procedures and accuracy assessment, alignment of points on the axis, extension of axis, engineering surveying for design and construction of roads, geometry of circular curve and clothoid, setting out curve, setting out height of points, volumes, controlling of prefabricated elements, setting out of modular prefabricated building.

REMOTE SENSING I (4 ECTS)
Introduction to remote sensing, historic development, physical bases of remote sensing, electromagnetic waves, electromagnetic spectrum, interaction with the atmosphere, interaction with the surface, passive and active sensors, images, sensors of remote sensing (on the ground, in the air and in the universe, characteristics of satellites, rails and belts, spatial, spectral, radiometric and time separability), techniques of remote sensing (optic recording, multispectral scanning, thermal recording), most important satellites and sensors, radar systems, reception, data transfer and processing, elements for photointerpretation, digital processing of images – basics (pre- processing, improvement, transformation and classification of images), examples of use.

PROPERTY LAW (4 ECTS)
Introduction to property law, fundamental concepts, the term of property, public good, the terms of property and real property, divisible and compact properties, properties in the market, components and accessories, possession, acquisition and loss of possession, types of possession, ownership right, introduction, historical development of contents and meaning of ownership right, neighbourhood law, ownership right of several persons, acquisition of ownership right, loss of ownership right, legal security of ownership right, easements (property easements, personal easements, mandatory pathway),

mortgage and land charge, real-estate right, ownership, limitations of ownership rights for public interest, obligation rights, land registry, historical development, internal organisation, types of entries and entry procedures, basic principles of land registry system, border dispute and arrangement of border in legal procedure.

REAL PROPERTY RECORDS AND CADASTRES (8 ECTS)
Land and soil, land management, geographic information system (GIS), land information system (LIS), LIS as an crucial part of spatial data infrastructure (SDI), land administration system, real property evidences and registries, parcel- based system of real property evidencing, historic development of land cadastre, methods of cadastral observations and maintenance of land cadastral data in Slovenia, graphic and attribute subsystems of land cadastre, cadastral index map, cadastral land and soil valuation, land cadastre procedures, building cadastre – contents and procedures, cadastre of public infrastructure – contents and procedures, land surveying services, land surveying at detailed planning, construction and recording of public infrastructure devices, concepts and case studies of real property evidences and registrations in EU, registration of acts and titles, European and other international directives in real property recording, field work (complete elaboration with expert reports).

REAL ESTATE MANAGEMENT AND EVALUATION (6 ECTS)
Basic definitions in the field of real estate valuation and management, statistic bases of real estate valuation, real estate development and life cycle, characteristics of real estate market, transparency of real estate market, system of real estate market valuation: valuation subject, value and approaches: direct sales comparison approach, income approach and cost approach; principles of value valuation, other specific valuation approaches, international, European and Slovenian valuation standards, mass valuation of real estates, legal bases, data acquisition, valuation models, organization of individual and mass real estate valuation, real estate brokerage organization, real estate valuation ethics, acquisition and development of building land, from building permit to registration in official records, state and municipalities real estate management, renting, housing management, economic and financial aspects of building land development and use, fees, taxes and compensation linked to real estate, private-public partnership in the field of building land development, real estate development and facility management.

PRACTICAL WORK (4 ECTS)
Elaboration of a surveying drawing, carrying out surveying-technical works within the construction of less demanding structures, carrying out less demanding land- cadastral surveying-technical works, carrying out less demanding surveying-technical works in the framework of the basic surveying system, maintenance of surveying databases, elaboration of cartographic bases and their presentations for the needs of planning interventions into space.

DIPLOMA WORK (8 ECTS)
Diploma work under supervision of the selected teacher. The work is publicly presented at the end of the study. It has to include introduction, working hypothesis, overview of resources, materials and methods, results, discussion and conclusion. As a rule, the work deals with practical problems of managing land and real estates, and gives solutions resulting from the study and outcomes of own research work.

18.2 Elective courses

FIELD WORK (6 ECTS)
Practical exercises in typical tasks of real estate management, establishment of coordinate reference frame at the working area, field recognition, planning of field measurements, practical terrestrial and satellite supported measurements, processing of measured data, representation and practical usage of obtained results in real estate management, engineering survey and spatial planning.

COMPUTER PROGRAMMING (4 ECTS)

Introduction to the software design, introduction to program coding, use of data and variables, use of logics in program, introduction to the use of algorithms, application of functions and procedures, introduction to the development of user interface, file programming, introduction to data programming, programming principles, introduction to the process of software development, development of Windows programs, development of web programs.

STANDARDS IN GEODESY AND ENGINNERING (4 ETS)
International standards (ISO), European standards (CEN), German standards (DIN), Slovenian Institute for standardization (SIST), Slovenian Institute of Quality and Metrology (SIQ), Metrology Institute of the Republic of Slovenia, standardization system in Slovenia (terminology, identification, legal basis), development of standards, calibration and test laboratories (legal identity, accreditation), national legal bases, ISO and DIN standards for geodetic instruments - development, type, purpose, IAG/IUGG standard as a part of conventions, IERS standards, GNSS specifications and standards for instruments, regularization of GNSS spectrum, industrial standards for exchangeability of data between GNSS and other devices (NMEA 0183 and NMEA 2000), standards for real-time data flow (RTCM SC 104), NTRIP protocol for RTCM data streaming over the Internet.

HYDROGRAPHY AND TOPONOMY (4 ECTS)
Importance of hydrography and marine cartography, international standardization and rules, IHO and IMO, topographic and hydrographic survey and measuring systems, sea levels, managing hydrographic data, reduction, generalization and hydrographic base map, navigation objects, nautical charts, geodetic elements, methods and design, nautical chart production and use, nautical guides and other publications, ENC and ECDIS; importance of toponomy, UN guidelines, basic terms, multilingual, exonyms, endonyms, categorization od geographical names, standardization and national gazetteers, use and presentation of geographical names on maps.

MEASUREMENT AND DESCRIPTION OF THE SPACE (4 ECTS)
Role and importance of space: what is space, types of land use, activities in the space, public and private space, the public good, limitations in space, legal regimes and protection zones, protection of space, space evaluation, spatial planning. Spatial data: description of the space, the type of spatial data (geometric, descriptive, raster, vector), the role and importance of the coordinate system, coordinate systems in Slovenia, the methods of spatial data capture: terrestrial geodetic measurement, GNSS measurements, mass capture of spatial data with the remote sensing, importance of photogrammetry, surveying plan, topographic data: aerial photographs, orthophotos, topographic database (DEM,...); geodetic data: land cadastre, the building cadastre; data on land use and GERK, data of legal regimes, environmental atlas, spatial information systems of municipalities, online atlases and globes (Google Earth), the data quality. The role of surveyors and geodetic surveying in society: the importance of property boundaries, planning the activities in space, real estate evaluation, land management, monitoring and determination of displacements and movements of objects in space, determination of the shape and the size of the Earth, location based services, preparation/production of maps, creation of 3D models of Earth surface and 3D models of buildings.

SELECTED TOPICS FROM GEODETIC SURVEING (4 ECTS)
Specific condition determination with the focus on measurement technology as well as method restrictions for the specific geodetic task. Selection of the appropriate measuring instrumentation with the emphasis on its limitations. Prior quality assessment of measurement achievement in specific conditions. Quality assessment of measurements acquired at the field. Coordinate system establishment further used for the reference or control base of measurements. Establishment of appropriate conditions for the transition between different coordinate systems. Defining impacts/influences on observation in specific measurement conditions. Measurement performance in specific conditions by requiring positioning in local and/or global coordinate system. Surveying problems under different conditions: steep terrain work, areas, overgrown by vegetation, urban area and various combinations of the above-mentioned conditions. Processing of data acquired at the field with final goal of point position determination and visualizing on the selected geodetic topographic basis. Data manipulation and exporting into different databases for further usage.

BASIC COMPUTING METHODS FOR ENGINEERS (4 ECTS)

Basic symbolical computing in Mathematica. Use of tools for symbolical differentiation, integration, solving of ordinary differential equations. Error theory. Basics of numerical computing in Matlab. Usage of numerical methods for solving systems of linear equations, nonlinear equations and systems, numerical interpolation, numerical integration, numerical solution of ordinary differential equations. Data manipulation, export of results and visualisation. Illustration of methods on practical applications.