LATVIA UNIVERSITY OF LIFE SCIENCES AND TECHNOLOGIES
FACULTY OF ENVIRONMENT AND CIVIL ENGINEERING

APPROVED
by the academic staff meeting of
Department of Land Management and Geodesy
February 6, 2018

GEODESY

Jelgava

P r o g r a m m e

Code of the study course at LLU IS Register**: BūvZ1041**
4 CP (64 h): lectures 2 CP (32 h), laboratory works 2 CP (32 h)
Type of assessment: Examination.
The authors: Vita Cintina, a lecturer of of Department of Land Management and Geodesy,
Jānis Domburs, a lecturer of of Department of Land Management and Geodesy.
Compulsory course of the professional Bachelor's degree level study programme "Land Management and Surveying", full-time and part-time studies.

***Abstract*:**

Students acquire knowledge of the shape and size of the Earth, the coordinate systems used in geodesy, geodetic measurement types, the mathematical processing of measurements and evaluation of measurement accuracy, the surface display in plans and maps and point identification. Students acquire knowledge of surveying methods and tools; practically learn the horizontal, slope angle and magnetic azimuth measurements, acquire a variety of surveying types - horizontal, vertical and topographic surveying, and they know how to display measurement results graphically.

***The aim of the study course*:**

To acquire the necessary theoretical knowledge and practical skills in measuring land parcels, drawing up plans, maps, profiles and other graphic materials necessary for the work of an engineer - land surveyor.

***Learning outcomes (knowledge, skills and competence)*:**

After completing the course students will have:

- **knowledge** of geodetic measurement types and their implementation, surveying methods and mathematical processing of geodetic measurements;
- **skills** to use the acquired theoretical knowledge in practice (install and measure the horizontal, vertical and topographic surveying network, take measurements of the situation and relief using various methods, to evaluate the accuracy of the measurement data, process measurement results and to draw up the situation, relief and topographic plans), work carefully and accurately, work independently as well as in a team, design measurement journals, plans, profiles and other documents as required;
- **competence** to access, select and analyze information independently necessary for the geodetic work and use it to make decisions accordingly; to address problems related to their competence,

understand professional ethics; students are able to assess the impact of their professional activities on the environment and society, critically evaluate their knowledge and skills and understand the need of further education; students are responsible for their work quality.

Relation of the study course with other subjects:

The prior knowledge of mathematics, physics and geography of the secondary school level is necessary. The acquired knowledge, skills and competence in the study course **Geodesy** will be required during traineeship and in the other study courses related to geodesy.

Requirements for individual work:

Studying materials from the resources of the list of bibliography, studying for the tests and examination, doing individual home assignments.

Procedure of assessment of knowledge:

1. Two tests for checking theoretical knowledge (One test for part-time students);
2. Completion of planned laboratory works;
3. Examination at the end of the semester.

Procedure and requirements for settling missed lectures:

According to the procedure approved by the department.

Extended content of the programme

1.INTRODUCTION

The subject of geodesy, its tasks, historical development and the role in the national economy. Relation of geodesy with other sciences. Institutions that plan and perform geodetic works

2. GENERAL INFORMATION

2.1. The concept of the shape and size of the Earth. Level surface. Reference ellipsoid. The concept of projection of lines on the ellipsoid surface.

2.2. Horizontal plane. Horizontal distances and angles and their insertion in the MicroStation programme. Absolute and relative heights of the Earth's surface. Elevations.

2.3. Distortions that occur when representing the entire surface of the Earth or its individual parts in the plane. Map, plan and profile. Scale of plans: numeric and linear. Cross scale. Tools for drawing lines and angles in plans and maps. Content of topographical plans and maps. Symbols and their arrangement and possibilities for generalization on the digital plan in the MicroStation and ArcGIS environment.

2.4. Identification of vertical and horizontal direction in the area. Cylindrical and spherical levels, their interval value.

2.5. Absolute and relative errors in measurements. Calculations with approximate numbers. Mathematical calculations of geodetic measurements and evaluation of measurement accuracy.

2.6. Relief of an area. Basic shapes of the relief. General information on relief representation in plans and maps. Horizontal method. The gradient or slope of a line. Expression of a slope in tangents, degrees and per cents. Methods of determining a slope. Graphs of slopes and angles of slopes. Determination of point heights from horizontals in the ArcGIS programme. Designing the profile on the basis of calculations performed in the MicroStation programme.

3. ORIENTATION OF COORDINATE SYSTEM AND LINES

3.1. Geographic and rectangular coordinate systems. Latvian coordinate system LKS 92. Coordinate networks. Determining rectangular points and geographic coordinates on the map. Correct selection of coordinate system and understanding how to use it when working on the project in ArcGIS environment.

3.2. The concept of a geographic and magnetic meridian. Magnetic declination. Azimuths, rhumbs, their correlation. Calculation of horizontal angles according to azimuths and rhumbs of their edges.

3.3. Directional angles. The notion of meridian distance approximation. Forward and back azimuths, rhumbs and directional angles. Correlation between the right angle in polygons and the direction angles of the sides. Increase of coordinates. A geodetic task in the plane: direct and opposite. Geodetic intersection. Direct intersection.

4.SIMPLE MEASUREMENT METHODS OF HORIZONTAL DISTANCES

4.1. Notion of measuring horizontal distances. Types of measurements in an area. Marking points. Fixing straight lines.

4.2. Tools for direct measurement of distances in the area. Measurement of distances, accuracy of measurements. Corrections for line gradients. An inclinometre. Calculation of inaccessible distances for direct measurement

4.3. Linear measurement method. An outline and a sketch of a situation (*in Latvian: abriss*) and its compilation in MicroStation programme. Measurement using the right angle coordinate method. A right-angle mirror *(in Latvian: ekers)*, its use. The method of opening.

5. MESUREMENT OF HORIZONTAL ANGLES

5.1. Measurement of horizontal angles. Theodolite.

5.2. Measurement of horizontal angles. Positioning of a theodolite in the working condition. Sighting. Angle measurement in full measure. Angle measurement accuracy.

5.3. Orientation of directions. A surveyor compass *(in Latvian: busole*). Measurement of magnetic azimuth and rhumbs with an azimuth compass. Map orientation with azimuth compass.

6. SURVEY TRAVERSES

6.1. Survey traverses and polygons, their attraction to the points of the geodetic support network points. Selection and fixation of locations of points. Boundary markers. Measurement of angles and side length of traverses.

6.2. Mathematical calculations of traverses. Angle adjustment. Calculation of directional angles and rhumbs. Calculation and adjustment of coordinate increase. Calculation of coordinate points.

6.3. Traverse measurement between stations with given coordinates and its mathematical calculation.

6.4. Determination of survey bearings with direct, sideways and opposite intersections. Measurement control. Calculation of point coordinates and their designing a plan in the MicroStation programme.

7. DESIGN OF TOPOGRAPHIC PLANS AND MAPS

7.1. Design of traverse in the plan from rhumbs and horizontal distances of the sides. Rectangular coordinate network, its design, constructing and testing. Projection of traverse points from coordinates. Correct insertion of traverse points from coordinates in the MicroStation programme.

7.2. Projection of the situation in the plan according to the outline and a sketch of a situation (*in Latvian: abriss*). Layout of the plan in the MicroStation or ArcGIS programme.

8. AREA DETERMINATION

8.1. The significance of area determination for land use and land cadastre. Area determination methods, their comparative evaluation. Area determination in the MicroStation programme.

8.2. Graphical method of area determination. Design and application of squares and parallel line pallets.

8.3. Mechanic method of area determination. Planimeters. Components of a polar planimeter, its testing and use. Determination of the value of the planimeter's unit of measurement. Determination of land use and the type of land use by planimeter for the given area. Legend. Digital planimeters.

9. GEOMETRIC LEVELLING

9.1. Types of levelling. Geometric levelling "forward" and "from the middle". The concept of the effect of surface curve on geometric levelling. Atmospheric refraction and its effect on geometric levelling results. Benchmarks. Line of levels. Levels with a cylindrical level and levels with a compensator. Digital levels. Level rods. Technical levelling and its methodology. Mathematical calculation of levelling results.

9.2. The principle of connected dishes and its use in hydrostatic levelling.

9.3. Surface levelling methods. Surface levelling in squares. Surveying a square grid. Levelling the vertices of the squares and designing a relief plan in the MicroStation or ArcGIS environment.

10. TRIGONOMETRIC LEVELLING

11. TACHEOMETRIC SURVEYING

11.1. Measurement of slopes' angles of the theodolite. The zero point determination of a vertical array.

11.2. Measurement of horizontal distances and elevations.

11.3. Tacheometry with a theodolite. A tacheometric journal and an outline and a sketch of a situation (*in Latvian: abriss*). Processing of a tacheometric journal. Development of a topographic plan.

11.4. Tacheometry with an electric tachometer. Computerized processing and graphic representation of measurement results.

12.SURVEYING BY SIGHT AND BAROMETER LEVELLING

Surveying by sight and its application. Step scale. Atmospheric pressure. Notion of barometer levelling and its application.

List of laboratory works

1. Equalization of closed line of polygons and calculation of directional angles of sides.
2. Calculation of coordinate increase of closed line of polygons and vertices' coordinates.
3. Calculation of traverse between two given points.
4. Constructing cross scale 1:2000.
5. Opposite geodetic task.
6. Constructing coordinate network and insertion of a polygon's vertices in it from rectangular coordinates. Insertion of coordinates in MicroStation programme.
7. Mapping of a polygon's situation in the plan using an outline and a sketch of a situation (*in Latvian: abriss*).
8. Drawing of topographic symbols in the plan in MicroStation programme.

9. Direct intersection.
10. Measurement of horizontal angles and magnetic azimuths.
11. Determination of the planimeter's unit value.
12. Area determination with a mechanical and digital planimeter or area determination using MicroStation vai ArcGIS programme.
13. Area determination with a palette and calculation of adjusted areas for the polygon's land use types.
14. Calculation of a track's levelling journal.
15. Designing longitudinal profile in the MicroStation programme.
16. Designing in the longitudinal profile.
17. Calculation of the surface levelling journal.
18. Designing a relief plan.
19. Tasks in the relief plan.
20. Determination of the zero point in the vertical array, measurement of slope's angle, determination of tachoemetric elevation and horizontal distance.
21. Calculation of tacheometric line.
22. Calculation of tacheometric journal.
23. Development of tacheometric journal plan.
24. Geometric levelling.

Bibliography

Compulsory reading:

1. Helfriča B., Bīmane I., Kronbergs M., Zuments U. Ģeodēzija. Latvijas Ģeotelpiskās informācijas aģentūra, 2007.
2. Helfriča B.Mērniecība I; Mērniecība II.-Jelgava,2004.Mācību līdzeklis.
3. Helfriča B.Mērniecība III.-Jelgava, 2005. Mācību līdzeklis.
4. Freijs V., Jakubovskis O., Kronbergs M., Zuments U. Ģeodēzija. – R.: Zvaigzne, 1993.
5. Biķis J., Freijs V., Jakubovskis O. Ģeodēzija. – R.: Zvaigzne, 1974.

Further reading:

1. Horizontālā uzmērīšana. – Metodiskie norādījumi, Jelgava, 2012.
2. Nivelēšana. – Metodiskie norādījumi., Jelgava, 1995.