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

GLOBAL POSITIONING

Jelgava

Programme

Code of the study course at LLU IS Register**:**
2.0 CP (32 h.): lectures 1.0 CP (16 h), laboratory works 1.0 CP (16 h).
Type of assessment: Formal Test with a grade.
The author: Armands Celms, associated professor of Department of Land Management and Geodesy
Compulsory course of the professional Bachelor's degree level study programme "Land Management and Surveying", 5th semester.

Abstract
Students learn the concept of global positioning, the content of global positioning. Students acquire the knowledge of components and operational principles of global positioning, instruments (devices) used in global positioning, measurement methods, computerized measurement data processing, accuracy assessment, its application in GIS, cartography, construction and other sectors of national economy. The course focus on global navigation satellite systems (GPS, GLONAS, GALILEO).

The aim of the study course:
The aim of the study course is to train future specialists to solve various types of geodetic tasks in geodetic-related fields. Lectures' topics and laboratory works are closely linked with production, the theory of global positioning and latest international innovations in the industry.

***Learning outcomes (knowledge, skills and competence)*:**
After completing the course students will have:

- **knowledge** and critical understanding of global positioning nature and content, Global Navigation Satellite System (GNSS) application possibilities and the know-how of the use of obtained results for performing specific tasks;
- **skills** to independently carry out the condition assessment of a resulting task, apply the acquired solution methods to various types of surveying tasks;
- **competence** to organize global positioning measurements according to the requirements, carry out processing and evaluation of the obtained results, to detect and avoid possible measurement errors.

Relation of the study course with other subjects:

- Students should have the prior knowledge in study courses**:** "Mathematics", "Physics" "Geodetic Networks", "Cadastral Surveying".
- The study course will enhance the effectivity of practical training, elaboration of the diploma project.

Requirements for individual work:

1. One home assignment.
2. Individual studies of the theoretical literature included in the list of bibliography.

***Assessment of knowledge*:**

1. Two tests based on the topics of the study course, completed laboratory works and a home assignment.
2. The type and procedure of the formal test:
   2.1.The formal test takes place in oral form.
   2.2.The grade of the formal test is based on:
      2.2.1. Successful result of the answers to the questions;
      2.2.2. Successful result in the tests;
      2.2.3. At least 85% attendance.

***Procedure and requirements for settling missed lectures*:**

The missed tests and laboratory works should be settled according to the procedure approved by the department at the time scheduled by a lecturer.

Extended content of the programme

1. The notion of global positioning.
2. General overview of global positioning.
   2.1 History and chronological development of global positioning.
   2.2. Space-based artificial Earth satellites.
   2.3 Control system of artificial Earth satellites.
   2.4. Global positioning systems in the world.
   2.5. Satellites, their prototypes and history of development.
   2.6. Coordinate and time systems. Setting the appropriate coordinate system according to the given task in the ArcGIS programme.
3. Components of the global positioning system and the basic principles of its operation.
   3.1. Broadcast on carrier frequencies and their visibility.
   3.2. Broadcasted code signals.
   3.3. Measurement comparison of wavelength of codes and carrier frequencies.
   3.4. Transmitted satellite signals. Measurement accuracy prediction by analysing the "precision figure" of the measurement in the ArcGIS environment.
4. Coordinate detection techniques in geodetic measurements using global positioning.
   4.1. Autonomous measurements.
   4.2. Differential measurements.
   4.3. Static method.
   4.4. Kinematic method.

4.5. Simultaneous differential measurements.

5. Visibility, location and application of satellites.
6. Factors influencing global positioning measurement errors and their reduction techniques.
   6.1. Satellite orbital errors,
   6.2. Inaccuracies in the satellite clock.
   6.3. Ionosphere.
   6.4. Troposphere.
   6.5. Reflected signal errors.
   6.6. Other errors.
   6.7. Deleting measurement errors.
7. Instruments for global positioning.
8. Surveying methods (methods of detecting coordinates) with global positioning systems. Projection of surveying precision and evaluation in ArcGIS environment.
   8.1. Measurement method for working with single-frequency receivers.
   8.2. Measurement method for working with bi-frequency detectors.
   8.3. Comparison of measurement methodology with GPS bi-frequency and single-frequency receiver.
   8.4. Real-time measurements using base stations.
9. Calculation and projection of coordinates in MicroStation and ArcGIS software.
10. Measurement processing, accuracy estimation, analysis and representation of results in the ArcGIS environment.
11. Creation of geodetic network by using global positioning.
12. Application of global positioning in elevation measurements.
13. Application of global positioning in elevation measurements using the geoid model LV-98 and LV-14.
14. Application of global positioning measurements in GIS, cartography, construction, the national economy on the whole.
15. The significance of global positioning systems in LATpos; LITpos; EUPOS and other sub-systems.
16. Future prospects for global positioning.

List of laboratory works:

1. Introduction to LatPos real-time system.
2. Getting to know the TRIMBLE real-time system.
3. Determination of coordinates with single-frequency instruments.
4. Coordinate determination with bi-frequency instruments.
5. Determination of normal and ellipsoidal elevations in the given points.
6. Finding geodetic points from given coordinates.
7. Output of geodetic measurements and preparation for processing.
8. Mathematical processing of geodetic measurements.

Home assignment:

1. In groups write and present an essay on the use and application of global positioning in various sectors of the national economy.

Bibliography

Compulsory reading:

1. U.Zumenta redakcijā. Ģeodēzija. R.: VA LĢIA „Latvijas karte", 2007
2. Hofmann-Wellenhof B., Wasle E., Lichtenegeer H. GNSS-Global Navigation Satelite Systems. Springer Wien New York, 2008.
3. Strang G., Borre K. Linear Algebra,Geodesy, and GPS:/-Wellesley, Cambridge Press. 1997. 624p.

Further reading and sources of information:

Recommended periodicals:

1. žurnāls "Mērnieks"
2. www.lgia.gov.lv
3. www.vzd.gov.lv
4. Websites related to global positioning systems.