COURSE DESCRIPTION CARD - SYLLABUS

Course name
Basics of surveying [N1Bud1>PGD]

Course

Field of study
Civil Engineering

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
20

Laboratory classes
10

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

mgr inż. Michał Moczko
michal.moczko@put.poznan.pl

Lecturers

Prerequisites

Student beginning this course should have basic knowledge on analytical geometry and trigonometry, and should know basic mathematical analysis methods. Student should have an ability to solve basic mathematical tasks from geometry and trigonometry. Student can work in a team.

Course objective

Activities are intended to familiarize the students towards the construction of the large scale trends studies geocartographic and the basic work of the geodesic used in the construction industry, including: Mastering the techniques of surveying in the field to separate the execution of measurement of lengths, angles, the designation of the differences of method of geometric levelling and trigonometric, calculation of the coordinates and the surface. Skills of formulating and solving simple tasks of surveying. The ability to determine the impact of errors in measurements and the accuracy of the measurements. Surveying literacy materials and documentation prepared in the traditional and digital.

Course-related learning outcomes

Knowledge:
1. Know the basic measuring methods used in geodesy and useful means of the processing of

measurement results.
2. Know what are the fundamentals of geometric and technical implementation of the basic maps and other geomapping studies.
3. Know what geodetic works are performed in the construction industry.

Skills:
1. Knows how to correctly measure the angles, distances and differences in height, calculate their most likely values and assess the accuracy of the measurements.
2. It can convert the size observed on the coordinates and their derivatives, and vice versa; know how to use computer software to the public.
3. Can read the map key directly and with the use of CAD programs, as well as to enrich it with new content.

Social competences:
1. Deepens Student knowledge of surveying and verifies it legally.
2. The Student works in team.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Conditions for inclusion of lectures:
Seminar on written on the last classes lasting 45 minutes for a maximum of 20 points.
Rating scale:
The number of points P-max 20
P > 18 - 5,0
16 < P < 18 - 4,5
14 < P < 16 - 4,0
12 < P < 14 - 3,5
10 < P < 12 - 3,0
P < 10 - 2,0
Conditions for inclusion of laboratories:
2 completed surveys (projects) together for a maximum of 8 points (5+3),
4 practical exercises performed, each for a maximum of 2 points (2+2),
seminar on written on the last classes lasting 45 minutes for a maximum of 8 points.
Rating scale:
The number of points P-max 20
P > 18 - 5,0
16 < P < 18 - 4,5
14 < P < 16 - 4,0
12 < P < 14 - 3,5
10 < P < 12 - 3,0
P < 10 - 2,0

Programme content

LECTURES
Legal space geodesy. Tasks of Geodesy and geodetic documentation in construction investment process. Spatial reference System: coordinate systems, mapping. The classification of occupancy: measurements of situational-altitude, implementation, control. Situational-altitude and geodetic warp. Methods of measurement of basic size measured in surveying: direction, length, azimuth, altitude difference. Geodetic measurement techniques: builts, ways of measurement and presentation of results. The principle and application of geometric leveling and trigonometric. Evaluation of the accuracy of the measurements. Source and accidental biases in measurements. Geodetic instruments (rangefinders, Theodolites, tachimetry, levels, satellite receivers): construction, maintenance, control of the correctness of the operation. Map as a source of spatial information. The classification of maps due to the content of the criteria and scales. Map of the main and derivatives, as follows: for the purposes of map design, map standard. The main map in the form of analog and digital. The Bill on the coordinates and the theory of errors (the basics).
LABORATORIES

1. Measurement and calculation of horizontal and vertical angle. Measurement of the length of the geodetic warp side
2. Calculation of coordinates on the plane and surface area.
3. Reading the content of the underground utilities network and elements of land and building records on the fragment of the basic map.
4. Perform the procedure for checking the correct operation of the level. Measurement and calculation of the levelling chain established on both sides.
5. Measurement of a fragment of the area using the tachymetric method.

Course topics

LECTURES
1. The place of geodesy as a science and technology with a discussion of the tasks of geodesy
2. Fields of geodesy and their characteristics: geodetic astronomy, dynamic geodesy, geomatics, cartography, photogrammetry and remote sensing, satellite geodesy, also called cosmic or planetary geodesy, geodetic instrument science, equalization calculus and geodetic calculations, economic geodesy (engineering and industrial geodesy, geodesy urban, mining geodesy, agricultural and forest geodesy).
3. Earth model and the use of reference surfaces divided into horizontal and height: geoid, quasi-geoid, ellipsoid of revolution, sphere, plane.
4. Characteristics of static and kinematic reference systems.
5. National spatial reference systems: PL-ETRF89, PL-ETRF2000, ASG-EUPOS.
6. Division of projections according to: the criterion of the shape of cartographic grids, the criterion of mapping distortions, the location of the developed plane of a cylinder or cone.
7. Types of coordinates and determining the position of a point on the reference surface: spatial systems (global) - GRS80H, GRS80h and X,Y,Z; flat systems - PL-LAEA, PL-LCC, PL-UTM, PL-1992 and PL-2000.
8. Construction of a theodolite.
9. Theodolite axial system and geometric conditions: alid level error, inclination error, collimation error, vertical circle zero error.
10. Types of systematic errors in theodolite, checking and rectification.
11. Definition of horizontal and vertical angle.
12. Angular measurement units and conversion of angular units: radians, degrees, grads.
13. Measurement and calculation of the horizontal angle using the following methods: regular (single angle), directional, repeating
14. Measurement and calculation of vertical angles: zenith, inclination.
15. General rules for performing operations on approximate numbers.
16. Approximate numbers and operations on them: absolute error of an approximate number, certain digits of an approximate number, convention for writing approximate numbers, Geodetic calculations on the plane: topographic azimuth, regarding geometric lines and points, rectangular coordinates based on field orthogonal and polar measurements, surface area . Calculations of angular forward cut, linear cut and back cut.
17. Division of the horizontal geodetic network with characteristics: basic fundamental, basic basic, detailed, measurement.
18. Equipment specifications for situational measurements.
19. Length measurement methods with discussion of the principles using: tape measure, electromagnetic rangefinder, thread rangefinder, measuring structures.
20. Methods of measuring situational details with discussion of technologies: orthogonal, polar, linear, angular and angular-linear indentations, precise positioning using GNSS.
21. Division of field details characterized by varying degrees of identification accuracy and rank into three accuracy groups.
22. Methods, principles of measurement and accuracy in technology: geometric leveling, trigonometric leveling, satellite leveling
23. Discussion of the normal height system: PL-KRON86-NH and PL-EVRF2007-NH in relation to ellipsoidal heights.
24. Specification of equipment in height measurements.
25. Height geodetic network divided into classes.
26. Instruments for geometric leveling: construction of an automatic level, checking the geometric conditions of an automatic level.
27. Sources of systematic errors in geometric leveling and ways to avoid them: curvature of the Earth's surface, vertical refraction, differential refraction, residual non-parallelism of the target axis to the horizon plane, settlement of the instrument, settlement of the staff, non-vertical position of the staff, error of the unit

of length on the staff, error of location zero patch.
28. Leveling of geodetic lines and precision analysis with alignment.
29. Methods, principles of measurement and accuracy in surface leveling according to the purpose: leveling of scattered points, leveling of profiles, grid leveling, total station
30. Terrain relief with description in the form of elevations and contour lines. Cartometric measurements to create a hypsometric profile. Discussion of the principles of creating a digital terrain model (DTM).
31. Characteristics of the National Spatial Information Infrastructure divided into databases.
32. Standard cartographic preparation - Basic Map: map creation process, content of the basic map, cartographic editing. Registration report and cadastral map. Map for design purposes in the investment process
33. Elements of the calculation of measurement errors (measurement uncertainties): Types of measurement errors - gross, systematic and random errors. Normal distribution (Gaussian curve) and random error laws. Measures of measurement accuracy and Gaussian mean errors. Measures of measurement accuracy (average, borderline, average, probable error). The law of transfer of average errors. Planning and assessing the accuracy of measurements, as well as calculations of multivariate functions. Equally accurate and non-equally accurate observations with accuracy weighting factor.
LABORATORIES
1. Exercise No. 1 "Measuring and calculating horizontal and vertical angles." Demonstration of the correct use of a theodolite and discussion of factors affecting the accuracy of angle measurements. Learning to level and center a theodolite. Learning to operate the instrument safely. Aiming and taking readings. Measurement of horizontal directions in two series and calculation with control of the horizontal angle using the usual method. Measurement and calculation of the vertical angle. Entries and calculations made in a paper journal.
2. Exercise No. 2 "Measuring the length of the side of the geodetic network". Preparation and double measurement of the section measured using the direct method. Multiple measurements of the same section using an electro-optical rangefinder. Calculation of errors and comparison of results.
3. Exercise No. 3 "Calculation of the coordinates of the plot boundary points and surface area" Performing coordinate calculations based on given linear and angular quantities (x,y) = f(d,α) and reverse calculations (d,α) = f(x, y) in various configurations. Calculations of azimuths from coordinates. Conversion of coordinates in the polar system to the rectangular system and vice versa. Using observational data to calculate rectangular coordinates using the following methods: from rectangular offsets, from the polar system, from forward angular indentation. An analytical method for calculating surface area using terrain measures and point coordinates.
4. Exercise No. 4 "Identification of the content of the underground utility network and elements of the land and building records on a fragment of the basic map.
Familiarization with the Regulation of the Minister of Development, Labor and Technology of July 23, 2021 regarding the Topographic Objects Database and the basic map. Working with a map for design purposes as a derivative of the basic map in order to select and identify content elements belonging to the databases of the National Spatial Information Infrastructure: EGiB, GESUT, BDOT500.
5. Exercise No. 5 "Performing the procedure for checking the correct operation of the level." Learning to check and rectify an automatic level. Learning to take readings from a leveling staff. Height difference calculations.
6. Exercise No. 6 "Measurement and calculation of a leveling sequence established on both sides." Conducting field measurements of differences in the heights of geodetic control network points in the leveling sequence, with precise analysis and approximate alignment. Calculations in a paper journal or using a geodetic calculation program, e.g. Winkalk.
7. Exercise No. 7 "Measuring a fragment of land using the tachymetric method." Discussion of the principles of measurement technology and demonstration of the use of a total station. Carrying out field measurements of terrain details in terms of situation and altitude. Learning how to select measured points. Making a field sketch and recording measurement data. Calculation of the position and height of the station.

Teaching methods

LECTURES
Educational methods: Information lecture with PPT presentation.
LABORATORIES
Educational methods: Practice method. Demonstration method.
Direct work using measuring instruments;
calculations, presentation and analysis of measurement results.

Bibliography

Basic
1. Geodezja - M. Wójcik, I. Wyczałek, Wydawnictwo Politechniki Poznańskiej 1997
2. Geodezja dla kierunków niegeodezyjnych - Stefan Przewłocki PWN, Warszawa 2002
Additional
1. Geodezja w budownictwie i Inżynierii - Michał Gałda Rzeszów 2001
2. Geodezja 1 - A. Jagielski, Kraków 2005
3. Geodezyjne pomiary inżynieryjne - I. Wyczałek, E. Wyczałek, Poznań 2005
4. Geodezja. Podręcznik dla studiów inżynieryjno-bodowlanych - M.Odlanicki-Poczobutt PPWK, Warszawawa 1989
5. Inne pozycje książkowe z podstaw geodezji lub geodezji dla kierunków niegeodezyjnych.

Breakdown of average student's workload

	Hours	ECTS
Total workload	86	3,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	56	2,00