MODULE SPECIFICATION

Module code	
Module title in Polish	**Podstawy rachunku wyrównawczego i obliczeń geodezyjnych**
Module title in English	**Principles of Adjustment Calculus and Surveying Calculations**
Module running from the academic year	**2016/2017**

A. MODULE IN THE CONTEXT OF THE PROGRAMME OF STUDY

Field of study	Surveying and Cartography
Level of qualification	first cycle (first cycle, second cycle)
Programme type	academic (academic/practical)
Mode of study	full-time (full-time/part-time)
Specialism	all
Organisational unit responsible for module delivery	The Department of Geotechnical Engineering. Geomatics and Waste Management
Module co-ordinator	Małgorzata Sokała, PhD
Approved by:	Ryszard Florek-Paszkowski, PhD, Eng.

B. MODULE OVERVIEW

Module type	core module (core/programme-specific/elective HES*)
Module status	compulsory module (compulsory/optional)
Language of module delivery	English
Semester in the programme of study in which the module is taught	semester 3
Semester in the academic year in which the module is taught	winter semester
Pre-requisites	None
Examination required	Yes
ECTS credits	5

* elective HES – elective modules in the Humanities and Economic and Social Sciences

Mode of instruction	lectures	classes	laboratories	project	others

Total hours per semester	15	30			

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C. LEARNING OUTCOMES AND ASSESSMENT METHODS

Module aims	The aim of the module is to prepare students for conscious utilisation of analytical and statistical tools in order to prepare the results of surveying measurements.

Module outcome code	Module learning outcomes	Mode of instruction *(l/c/lab/p/ others)*	Corresponding programme outcome code	Corresponding discipline-specific outcome code
W_01	A student is knowledgeable as regards matrix algebra useful to formulate and solve basic surveying and cartography tasks.	l	GiK_W01	T1A_W01
W_02	A student has knowledge on statistics which enables him/her to independently process data (including basic surveying observations).	l	GiK_W03	T1A_W01 T1A_W04 T1A_W07
W_03	A student has knowledge on the methodology of agreeing on measurement results in levelling networks together with accuracy analysis.	l	GiK_W13 GiK_W27	T1A_W03 T1A_W04 T1A_W07
U_01	A student is able to consciously apply analytical methods (including matrix calculus to solve basic issues as regards surveying and cartography).	l	GiK_U18	T1A_U09
U_02	A student can consciously apply mathematical statistics tools to prepare observations as regards surveying and cartography.	l	GiK_U15	T1A_U08 T1A_U09
U_03	A student is able to independently adjust measurement results in levelling networks as well as the analysis of the obtained results.	l	GiK_U14 GiK_U15 GiK_U18	T1A_U08 T1A_U09
K_01	A student understands the necessity (and knows the possibility) of continuously raising his/her professional qualifications.	l/l	GiK_K01	T1A_K01

Module content:

1. Topics to be covered in the lectures
2. Topics to be covered in the classes

No.	Topics to be covered in the lectures	Module outcome code
1-3	The application of the matrix calculus to solve systems of equations. Operations on matrices.	W_01
4-5	The tasks of the adjustment calculus. The types of observation errors. Measurement result as a random variable. The distribution of a random variable representing the results of surveying measurements. Numerical characteristics of a random variable. A normal distribution and its parameters. Point and interval estimation.	W_02
6-7	Levelling direct homogeneously and variably accurate observations.	W_03
8-9	Error propagation. Error propagation law. Utilising error propagation law during the optimisation of measurement procedures. The method of least squares.	W_02 W_03 K_01
10-12	Agreeing on (levelling) measurement results in levelling networks with the parametric method. The algorithm of calculations. The interpretation of covariance matrix. Determining parameter errors of the levelling issue model and levelled observations. The identification of gross errors.	W_02 W_03 K_01

13-15	Adjustment issues in geomatics and engineering practice. Practical issues of formulating and solving adjustment issues. Engineering applications of the method of least squares. Sample adjustments solved with the parametric method.	W_02 W_03 K_01
.	**Topics to be covered in the classes**	
1-2	Basic calculations (adding, subtracting, multiplying, determinants, and matrix distributions). Solving systems of linear equations.	U_01 W_01
3-4	Levelling direct homogeneously and variably accurate observations. Examples of interval estimation in geomatics.	U_02
5-6	Sample application of the error propagation law in measurement issues.	U_02 W_02
7-10	Equalizing the levelling variably accurate network with the parametric method (together with the accuracy analysis). Paper 1.	U_02 U_03 W_03 K_01
11-15	Engineering applications of the least squares method. The approximation of the set of observation results; the equations of a straight line, plane, and parabola. Paper 2.	U_02 U_03 W_02 W_03 K_01

Assessment methods

Module outcome code	**Assessment methods** *(Method of assessment; for module skills – reference to specific project, laboratory and similar tasks)*
U_01 U_02 U_03 W_01 W_02 W_03	An examination.
U_01 U_02 U_03	Completing computational tasks. Preparing papers on surveying results. A test.
K_01	Observing a student's involvement during the classes. Discussing the results during the classes. Tutorial concerning papers.

D. STUDENT LEARNING ACTIVITIES

ECTS summary		
	Type of learning activity	**Study time/ credits**
1	Contact hours: participation in lectures	15
2	Contact hours: participation in classes	30
3	Contact hours: participation in laboratories	
4	Contact hours: attendance at office hours (2-3 appointments per semester)	7
5	Contact hours: participation in project-based classes	
6	Contact hours: meetings with a project module leader	
7	Contact hours: attendance at an examination	3
8		

9	**Number of contact hours**	55 *(total)*
10	**Number of ECTS credits for contact hours** *(1 ECTS credit =25-30 hours of study time)*	2.2
11	Private study hours: background reading for lectures	15
12	Private study hours: preparation for classes	15
13	Private study hours: preparation for tests	15
14	Private study hours: preparation for laboratories	
15	Private study hours: writing reports	10
16	Private study hours: preparation for a final test in laboratories	
17	Private study hours: preparation of a project/a design specification	
18	Private study hours: preparation for an examination	15
19		
20	**Number of private study hours**	70 *(total)*
21	**Number of ECTS credits for private study hours** *(1 ECTS credit =25-30 hours of study time)*	2.8
22	**Total study time**	125
23	**Total ECTS credits for the module** *(1 ECTS credit =25-30 hours of study time)*	5
24	**Number of practice-based hours** *Total practice-based hours*	0
25	**Number of ECTS credits for practice-based hours** *(1 ECTS credit =25-30 hours of study time)*	0

E. READING LIST

References	1. Harvey, Bruce R., "Practical least squares and statistics for surveyors", Monograph 13, Third Edition, School of Surveying and Spatial Information Systems, University of New South Wales, 2006 2. Huaan Fan, "Theory of Errors and Least Squares Adjustment", Royal Institute of Technology (KTH), Division of Geodesy and Geoinformatics, Stockholm, Sweden, 2010 3. Charles D. Ghilani, "Adjustment Computations: Spatial Data Analysis", John Wiley & Sons, 2011