MODULE SPECIFICATION

Module code	
Module title in Polish	**Rachunek wyrównawczy i modele statystyczne w geomatyce**
Module title in English	**Adjustment Calculus and Statistical Models in Geomatics**
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
Programme type	academic
Mode of study	full-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
Module status	Elective field-of-study modules
Language of module delivery	English
Semester in the programme of study in which the module is taught	Semester 4
Semester in the academic year in which the module is taught	summer 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	30	30			

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C. LEARNING OUTCOMES AND ASSESSMENT METHODS

Module aims	The aim of the module is to prepare students for conscious application of analytical and statistical tools to analyse survey results.

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 knows statistical fundamentals of preparing observation (including advanced methods); moreover, a student is knowledgeable about the methodology of agreeing on survey results in angular and linear networks (together with accuracy analysis).	l	GiK_W03 GiK_W13 GiK_W27	T1A_W03 T1A_W04 T1A_W07
W_02	A student knows the analysis of statistical data; a student also has knowledge on point and interval estimation; furthermore, a student is familiar with the principles of estimating linear models according to the method of least squares.	l	GiK_W03	T1A_W01 T1A_W04 T1A_W07
W_03	A student knows the principles of the concatenation variances for both uncorrelated and correlated values.	l	GiK_W03	T1A_W01 T1A_W04 T1A_W07
U_01	A student is able to independently adjust survey results in diverse types of geodetic control network as well as the analysis of the obtained results.	c	GiK_U14 GiK_U15 GiK_U18	T1A_U08 T1A_U09
U_02	A student can consciously apply mathematical statistics tools to prepare observations as regards geomatics.	c	GiK_U15	T1A_U08 T1A_U09
U_03	A student can consciously apply variance concatenation law of both uncorrelated and correlated values.	c	GiK_U15	T1A_U08 T1A_U09
K_01	A student understands the necessity and knows the possibilities of continuous education as well as raising his/her professional competences.	l/c	GiK_K01	T1A_K01

Module content:

No.	Topics to be covered in the lectures	Module outcome code
1-3	Observation equations for surveying measurements: length, vertical and horizontal angles. Agreeing measurement results in angular and linear networks. Parametric procedure of the least squares method. The problem of initial approximation in adjustment task.	W_01 W_02 K_01
4-5	Accuracy analysis of point coordinates as regards surveying networks. Covariance matrix. Calculating half-axes of error ellipsis.	W_01 W_02 W_03 K_01
6-7	The law of variance summing (the law of transferring mean errors) as regards uncorrelated and correlated values in surveying measurements.	W_01 W_02 W_03
8-9	The conditional method. Formulating the adjustment problem. Accuracy analysis. The applications of the conditional method.	W_01 W_02

10-12	Measurement result analysis. The identification of gross errors.	W_01 W_02
13-15	The elements of mathematical statistics. Their applications in geomatics. Point estimation of observation results occurring in geomatics. Continuous random variables. The diagram of probability density as well as its geometrical interpretation. The selected distributions of step random variables: chi-square and Student's. Two-dimensional standard distribution. Interval estimation of measurement results occurring in geomatics.	W_02
.	**Topics to be covered in the classes**	
1-4	Observation equations for surveying measurements: length, vertical and horizontal angles. The problem of initial approximation in an adjusting assignment. Adjusting an observation system (an angular and linear network).	U_01 U_02 W_01 W_02 K_01
5-8	The analysis of measurement accuracy. The application of the law of variance summation. Calculating half-axes of error ellipsis.	U_02 U_03
9-12	Solving observation systems with the conditional method. Formulating the levelling problem. Accuracy analysis.	W_01 W_02
13-15	Calculating based on the examples of continuous random variables applicable in geomatics. Examples of point and interval estimation concerning observation results occurring in geomatics.	U_02 W_02

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	Computational assignments and a test
K_01	Observing a student's involvement during the classes. A discussion during the classes. Project tutorials.

D. STUDENT LEARNING ACTIVITIES

ECTS summary		
	Type of learning activity	**Study time/ credits**
1	Contact hours: participation in lectures	30
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)	11
5	Contact hours: participation in project-based classes	
6	Contact hours: meetings with a project module leader	
7	Contact hours: attendance at an examination	4
8		
9	**Number of contact hours**	75 *(total)*
10	**Number of ECTS credits for contact hours** *(1 ECTS credit =25-30 hours of study time)*	3
11	Private study hours: background reading for lectures	10
12	Private study hours: preparation for classes	10
13	Private study hours: preparation for tests	10
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	10
19		
20	**Number of private study hours**	50 *(total)*
21	**Number of ECTS credits for private study hours** *(1 ECTS credit =25-30 hours of study time)*	2
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

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Semester in the academic year in which the module is taught	summer semester
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ECTS credits	5

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Module content:

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9-12	Solving observation systems with the conditional method. Formulating the levelling problem. Accuracy analysis.	W_01 W_02
13-15	Calculating based on the examples of continuous random variables applicable in geomatics. Examples of point and interval estimation concerning observation results occurring in geomatics.	U_02 W_02

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