GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mathematical methods of geodetic observation processing, PG_00065126		
Field of study	Geodesy and Cartography		
Date of commencement of studies	February 2026	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	1	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Geodesy -> Faculty of Civil and Environmental Engineering -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Marek Zienkiewicz	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	20.0	25.0	0.0	0.0	0.0	45

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	45	5.0	25.0	75

Subject objectives

Acquainting and discussing issues related to standard and unconventional methods of developing geodetic observations

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U02] can perform and elaborate 3D models based on laser scaninng data; can apply methodologies in advanced geodetic observation	The student correctly uses the algorithms of the least squares method and non-standard estimation methods to develop geodetic observations. He analyzes the obtained results and correctly draws conclusions about the tested measurement structure	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools
[K7_W04] has knowledge of the digital image processing basics; knows advanced models of geodetic surveying, theoretical foundations of non-standard estimation methods, free and multi-step equations (sequential) adjustment methods	The student has a well-established knowledge of the theory of the least squares method and non-standard estimation methods. He knows the methods of developing geodetic data in both classical and free observation systems. The student also has knowledge of the diagnosis of observational material in the context of gross errors in measurements	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture
Lecture topics:
1. Fundamental functional, probabilistic and statistical models used in geodesy,
2. Classic methods of developing geodetic observations,
3. Free adjustment performed by the principles of the least squares method,
4. Theoretical foundations of non-standard methods of developing geodetic observations - M-estimation, Baarda's method.
5. Sequential processing of geodetic observations,
6. Geodetic data filtration using the Kalman method
Exercises:
Least squares observations adjustments. An example of free adjustment of geodetic networks. Detection and localization of outliers in the observation material by using the Baarda's approach. Robust adjustment of geodetic network. Object position prediction using the Kalman filter.

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="3">Basics in the field of matrix calculus</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="3"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Practical exercises</td><td>100.0%</td><td>20.0%</td></tr>
<tr><td>Final test</td><td>50.0%</td><td>80.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">Wiśniewski Z. 2016. Rachunek wyrównawczy w geodezji z przykładami,
Wiśniewski Z. 2013. Zaawansowane metody opracowania obserwacji geodezyjnych z przykładami</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">Koch K.R. 1999. Parameter estimation and hypothesis testing in linear models,
Caspary W. 2000. Concepts of network and deformation analysis. The University of New South Wales, Kensington
Zienkiewicz M.H. 2024. Wybrane teoretyczne i aplikacyjne własności Msplit estymacji, Wydawnictwo Politechniki Gdańskiej</td></tr>
<tr><td>eResources addresses</td><td colspan="2"></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3">Free adjustment of geodetic networks,
Robust adjustment of the geodetic network by using the Huber method,
Detection and localization of gross errors in the observation material by using the Baardy method</td></tr>
<tr><td>Practical activites within the subject</td><td colspan="3">Not applicable</td></tr>
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