



MODULE SPECIFICATION

Module code	
Module title in Polish	Systemy pozycjonowania i nawigacji
Module title in English	Positioning and Navigation Systems
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	Tomasz Owerko, PhD, Eng.
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 5
Semester in the academic year in which the module is taught	winter semester (winter semester/summer semester)
Pre-requisites	No requirements (module code/module title, where appropriate)
Examination required	No (Yes/No)
ECTS credits	4

* 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		



C. LEARNING OUTCOMES AND ASSESSMENT METHODS

Module aims	The aim of the module is to prepare students (both substantially and practically) to work with the use of modern and future navigation and positioning systems.
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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 about currently available GNSS positioning and navigation systems.	l/l	GiK-W15	T1A_W03 T1A_W04 T1A_W05 T1A_W07
W_02	A student has detailed knowledge connected with the possibilities of various positioning systems as well as their operation modes.	l	GiK_W13	T1A_W03
W_03	A student knows configuration methods of GNSS receivers (together with the accuracies possible to achieve).	l/l	GiK_W20	T1A_W03 T1A_W06.
W_04	A student is familiar with the methods of conducting surveys with the use of GNSS methods (including works connected with establishing control networks and considering integrated control networks with the use of ASG-EUPOS network stations, inventory and realisation works).	l/l	GiK_W13 GiK_W21	T1A_W03, T1A_W04
U_01	A student has substantial background for effective utilisation of positioning and navigation methods depending on economic needs.	l/l	GiK_U20 GiK_U26	T1A_U11
U_02	A student can make simple surveying works with the use of GNSS techniques (including the needs of establishing satellite networks) and use services concerning supporting GNSS measurements; moreover, a student is able to complete satellite levelling on small areas.	l/l	GiK_U23 GiK_U28	T1A_U15
U_03	A student is able to assess the accuracy of measurements realised with satellite methods.	l/l	GiK_U25	T1A_U16
K_01	A student is aware of limitations of GNSS techniques.	l	GiK_K06	T1A_K03
K_02	A student can plan measurements with numerous receivers; a student can also co-operate in a team.	l	GiK_K07	T1A_K03

Module content:

1. Topics to be covered in the lectures

No.	Topics	Module outcome code
1	Introduction: positioning techniques and their developments; determining the position and navigating with the use of satellites.	W_01
2	Coordinate systems as well as time systems: the definition of global and local	W_01



	coordinate systems; satellite systems in relation to traditional surveying systems.	
2	Satellite orbits: the description of motion, motion interferences, determining position, and ephemeris.	W_01 W_02
3	Satellite signals and observed data: physical fundamentals, wave propagation, and the structure of surveying receivers; pseudo-distances (a code, a phase, and a Doppler); RINEX, RTCM, NMEA, ANTEX, SINEX, IONEX, and NTRIP.	W_02 W_03
3	Wave propagation in a centre: ionosphere, troposphere, and signal multi-tracking.	W_03
4	Mathematical fundamentals of determining position: SPP as well as a theoretical fundamental as regards obtaining surveying accuracies; differential method; relative positioning (RTN/RTK, and VRS).	W_02 W_03 W_04
5	Processing data in GNSS: software; computational techniques (determining phase inhomogeneity)	W_02 W_03 W_04
6	GNSS systems (a comparison): GPS, Galileo, regional systems as well as regulations concerning work completion with GNSS techniques and preparing results.	W_02 W_03 W_04
7	Civil and military navigation systems (sea, land, and air).	W_02 W_03 W_04

2. Topics to be covered in the laboratories

No.	Topics	Module outcome code
1,2	The structure and configuration of satellite receivers.	U_1, K_1
3,4	The work with GNSS in RTK/RTN mode on the basis of ASG-Eupos.	U_2
5,6	The work with GNSS in RTK/RTN mode on the basis of own reference station.	U_2
7,8	GNSS measurements with the static method (computations).	K_2, U_3
9,10,11	Measurements and planning them with the static method (computations).	K_2, U_3
12,13	Observation analysis, communication formats (NTRIP and RTCM) as well as data exchange formats (RINEX).	K_1
14,15	Checking the accuracy of the RTK GNSS receiver on the basis of the ISO 17 123 norm.	U_3

Assessment methods



Module outcome code	Assessment methods <i>(Method of assessment; for module skills – reference to specific project, laboratory and similar tasks)</i>
U_01 U_02 U_03	Tests
W_01 W_02 W_03 W_04	Obtaining a credit for the lectures on the basis of oral presentations.
K_01 K_02	Observing a student's involvement during laboratory classes.



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	
3	Contact hours: participation in laboratories	30
4	Contact hours: attendance at office hours (2-3 appointments per semester)	
5	Contact hours: participation in project-based classes	
6	Contact hours: meetings with a project module leader	
7	Contact hours: attendance at an examination	
8		
9	Number of contact hours	45 <i>(total)</i>
10	Number of ECTS credits for contact hours <i>(1 ECTS credit = 25-30 hours of study time)</i>	1.8
11	Private study hours: background reading for lectures	10
12	Private study hours: preparation for classes	
13	Private study hours: preparation for tests	13
14	Private study hours: preparation for laboratories	12
15	Private study hours: writing reports	20
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	
19		
20	Number of private study hours	55 <i>(total)</i>
21	Number of ECTS credits for private study hours <i>(1 ECTS credit = 25-30 hours of study time)</i>	2.2
22	Total study time	100
23	Total ECTS credits for the module <i>(1 ECTS credit = 25-30 hours of study time)</i>	4
24	Number of practice-based hours <i>Total practice-based hours</i>	60
25	Number of ECTS credits for practice-based hours <i>(1 ECTS credit = 25-30 hours of study time)</i>	2.4

E. READING LIST

References	
Module website	