GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Satellite geodesy and basics astronomy, PG_00044834		
Field of study	Geodesy and Cartography		
Date of commencement of studies	October 2021	Academic year of realisation of subject	2023/2024
Education level	first-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	3	Language of instruction	Polish
Semester of study	5	ECTS credits	6.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Geodesy -> Faculty of Civil and Environmental Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Mariusz Figurski	
	Teachers	dr inż. Paweł Dąbrowski prof. dr hab. inż. Mariusz Figurski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	45.0	15.0	15.0	0.0	0.0	75

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	75	10.0	65.0	150

Subject objectives

The aim of the course is to teach students issues related to the movement of the Earth in outer space, the transformation of coordinates in celestial and terrestrial reference systems. methods of determining coordinates and azimuths using the motion of celestial bodies and satellites, understanding GPS / GNSS signals, code and phase measurements, practical application of GPS / GNSS and the consequences of their modernization,

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U06] can solve geodetic tasks and select measurement methods for typical engineering tasks including the curvature of the Earth and the impact of gravity	The student is able to determine the coordinates of points using standard static and RTK measurements. Is able to carry out a measurement with auto-registration of points	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
[K6_W03] knows and understands the principles of mathematical statistics described in the examples of the adjustment computations	Is able to perform calculations in the field of astrometry and orbital movements of satellites using the methods of equalization calculation and statistically estimate the calculation results.	[SW1] Assessment of factual knowledge
[K6_U04] can use contemporary geodetic instruments, including automation of measurements, data transmission and processing in a computer-instrument system with the use of computer networks	The student is able to assess the possibility of using the GNSS receiver to determine the coordinates of a given point in the field. He can make basic astronomical measurements with a total station. Can choose the measurement method depending on the required accuracy of the coordinates. Is able to use modern recording devices and programs to develop satellite data.	[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information

Subject contents	1. Introduction. What will we do in the framework of satellite geodesy and astronomy. What is the relationship between astronomy and satellite geodesy? 2. Astronomy in geodesy. Day movement of the celestial sphere, annual movement of the sun in the celestial sphere and astronomical seasons of the year, characteristic points and large circles on the celestial sphere, basic astronomical coordinate systems and geographical coordinates, the appearance of the celestial sphere at different latitudes and climatic zones on the Earth's surface. 3. Time. Local time, universal time, time measurements. 4. Spherical triangle. Basic relationships of spherical trigonometry in spherical astronomy. 5. Determination of geographical coordinates and azimuth of the place of observation. Culminations, latitude, longitude, and azimuth. Azimuth reductions. 6. The shape and size of the Earth, rotation of the Earth, flattening of the Earth, Coriolis force, atmosphere, magnetic field, orbital motion of the Earth in relation to the Sun (heliocentric parallax and 1 hour aberration), phenomena of Earth's rotation, phenomena related to the tidal interaction of the Moon and the Sun 7. Elements of orbital movements. Kepler's laws, analysis of the motion of celestial bodies along conic sections. Satellite perturbations. 8. Reference systems and systems in satellite geodesy, national systems. 9. Satellite leveling. Geometric heights and orthometric heights. Solving the problem of satellite leveling by determining the height of the geoid in relation to the ellipsoid. Simplified methods of determining the geoid in small areas. An approach to the height system in Poland. 10. Principles of satellite positioning before and in the era of GNSS. Technological precursors of GNSS, terrestrial positioning systems, extraterrestrial systems, satellite positioning. Construction of GNSS systems based on GPS. 11. Global positioning satellite systems (GNSS). Operational systems GPS, GLONASS, GALILEO, COMPAS, GNSS signals and errors, satellite messages and ephemeris. Phase and code observations, basic observational equations. 12. Measurement errors and ways to reduce them. Discussion of the budget of errors and their sources. Receiver and satellite clock errors. Ionospheric and tropospheric effects. Classification of positioning methods. 13. Types of receivers and measurement methods. Common features of GPS receivers. Construction of the receiver. Selected methods of GPS measurements. Accuracy of measurement. Types of GNSS receivers. 14. GNSS and geodetic coordinate and height systems. Realization of the satellite reference system in Poland. EURE-POL, POLREF, EUVN, ASG-EUPOS networks. Permanent systems of various scales. 15. Static measurements, DGPS, RTK. 16. GNSS observations and their processing methods. Ways of establishing geodetic networks with the use of GNSS technique. 17. Geodetic and non-geodetic GNSS locating. GNSS meteorology. 18. Modernization of GPS and GNSS, the future of satellite navigation systems.
Prerequisites and co-requisites	Knowledge from subject Geodesy I (GSPKC.5.1.), physics, physics, mathematics

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Practical Exercises	100.0%	30.0%
Midterm colloquiums	50.0%	70.0%

Recommended reading

Basic literature	1. Lamparski J., Świątek K., GPS w praktyce geodezyjnej, Wydawnictwo Gall, Olsztyn 2007. 2. Specht C., System GPS, Biblioteka Nawigacji nr 1, Wydawnictwo Bernardinum, Pelplin, 2007. 3. Zieliński J., i in. System nawigacyjny Galileo, WKiŁ, Warszawa, 2006.Czarnecki K. Geodezja Współczesna w zarysie, Wydawnictwo Gall, 2010. Van Sickle, Jan (2015) *GPS for Land Surveyors*, *4th Ed.* CRC Press. (ISBN: 978-1-4665-8310-8)
Supplementary literature	1. ICD - GPS 200, NAVSTAR GPS Joint Program Office, Navtech, February 1995. 2. ICD-GALILEO, Galileo Open Service Signal In Space, Interface Control Document (OS SIS ICD), Draft 0, European Space Agency / Galileo Joint Undertaking, 2006. 3. ICD-GLONASS, Global Navigation Satellite System GLONASS Interface Control Document, Moscow, 2002. 4. SPS, Global Positioning System (GPS), Standard Positioning Service, Signal Specification, Department of Defence, Positioning/Navigation Executive Commitee, November 5. 1993 5. SPS, Global Positioning System Standard Positioning Service, Performance Standard, Assistant Secretary of Defense, 2001. 6. SPS, Global Positioning System Standard Positioning Service, Performance Standard, 4th edition, September 2008.
eResources addresses	Adresy na platformie eNauczanie: Geodezja Satelitarna z elementami Astronomii 2023/2024 - Moodle ID: 32302 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=32302

Example issues/ example questions/ tasks being completed	ASG-EUPOS network functions and architecture GNSS phase measurements in geodesy RTCM-104 standards and its functions ASG-EUPOS services Formal regulations in GNSS measurements
Work placement	Not applicable