

<b>STUDY MODULE DESCRIPTION FORM</b>		
Name of the module/subject <b>Satellite Navigation Systems</b>		Code <b>1010802111010832882</b>
Field of study <b>Electronics and Telecommunications</b>	Profile of study (general academic, practical) <b>general academic</b>	Year /Semester <b>1 / 1</b>
Elective path/specialty <b>Information and Communication</b>	Subject offered in: <b>Polish / English</b>	Course (compulsory, elective) <b>obligatory</b>
Cycle of study: <b>Second-cycle studies</b>	Form of study (full-time, part-time) <b>full-time</b>	
No. of hours Lecture: <b>2</b> Classes: <b>-</b> Laboratory: <b>-</b> Project/seminars: <b>-</b>		No. of credits <b>2</b>
Status of the course in the study program (Basic, major, other) <b>major</b>		(university-wide, from another field) <b>from field</b>
Education areas and fields of science and art <b>technical sciences</b> <b>Technical sciences</b>		ECTS distribution (number and %) <b>2 100%</b> <b>2 100%</b>
<b>Responsible for subject / lecturer:</b>  prof. dr hab. inż. Andrzej Dobrogowski email: dobrog@et.put.poznan.pl tel. +4861 665 3857 Wydział Elektroniki i Telekomunikacji ul. Piotrowo 3A 60-965 Poznań		
<b>Prerequisites in terms of knowledge, skills and social competencies:</b>		
<b>1</b>	<b>Knowledge</b>	K1_W01 Has a systematic knowledge of mathematical analysis, algebra and theory of probability K1_W02 Has a basic, systematic knowledge of physics K1_W05 Has a detailed, systematic knowledge of the fundamentals of circuit theory K1_W06 Has a systematic knowledge of 1D signal theory K1-W07 Has a systematic knowledge of the theory of EM field, EM waves propagation, and of construction and properties of antennae K1_W15 Knows the principle of operation of digital transmission systems K1_W17 Has a detailed, systematic knowledge, of the fundamentals of the telecommunication theory
<b>2</b>	<b>Skills</b>	K1_U01 Is able to extract information from Polish or English language literature, databases and other sources. Is able to synthesize gathered information, draw conclusions, and justify opinions. K1_U06 Is competent in a foreign language at a minimum of CEFR level B1, knows the electronics and telecommunication terminology in this language. K1_U07 Is able to use known mathematical analysis, algebra and theory of probability concepts to solve basic problems in electronics and telecommunication. K1_U10 Demonstrates the ability to solve problems related to signal analysis in time domain and frequency.
<b>3</b>	<b>Social competencies</b>	K1_K01 Is aware of the limitations of his/her current knowledge and skills; is committed to further self-study. K1_K02 Demonstrates responsibility and professionalism in solving technical problems. Is able to participate in collaborative projects.
<b>Assumptions and objectives of the course:</b> Recognition and understanding of the principles of operation of the satellite navigation systems and their augmentation systems		
<b>Study outcomes and reference to the educational results for a field of study</b>		
<b>Knowledge:</b>		

<p>1. Has a systematic knowledge, with necessary mathematical background, of satellite navigation systems - [K2_W10]</p> <p>2. Understands basic concepts of global navigation satellite systems. Is able to justify practical implementation of these concepts - [-]</p> <p>3. May motivate the needs that navigation satellite constellation must fulfill. - [-]</p> <p>4. Understands the limitation of the satellite navigation systems and the necessity of using complete systems in order to get everywhere available navigation. - [-]</p>
<p><b>Skills:</b></p> <p>1. Is able to evaluate the parameters of telecommunication satellite systems. Is able to evaluate the parameters which determine the positioning accuracy of a satellite navigation system. Is able to measure the parameters of signals and components of satellite navigation systems. - [K2_U10]</p> <p>2. Is prepared to use technical literature (also technical periodicals). - [-]</p> <p>3. Effectively use satellite navigation equipment. - [-]</p> <p>4. Is able to make course estimation of the GNSS receivers quality - [-]</p>
<p><b>Social competencies:</b></p> <p>1. Stresses the importance of navigation abilities for society - [K2_W07]</p> <p>2. Is able to recognize problem which effective solution involve the GNSS - [-]</p>

<b>Assessment methods of study outcomes</b>		
<p>1. Checking questions during the lesson</p> <p>2. Written credit</p>		
<b>Course description</b>		
<p>Ubiquitous positioning and navigation. Navigation methods. Basic characteristics of the navigation systems. Time scales - GNSS system time. Coordinate systems and reference frames. Models of the Earth. World geodetic system WGS-84. Kepler's laws. Equation of satellite motion, satellite orbits. Keplerian elements (parameters). Navigation satellite constellation. Orbital ephemerides. GNSS signals and modulation schemes. navigation message and its content. Navigation equations and their solving methods. GNSS user's velocity determination. Relativistic effects. GNSS navigation performance. PVT services. Architecture of GNSS receivers. GPS, GLONASS, Galileo and Compass. Differential and augmentation systems: DGPS, WASS, EGNOS, SBAS, GBAS, and ABAS.</p>		
<b>Basic bibliography:</b>		
<p>1. P. Misra, P. Enge, Global Positioning System. Signals, Measurements, and Performance, Revised Second Edition, Ganga-Jamuna Press, 2011</p> <p>2. B. Hofmann-Wellenhof, H. Lichtenegger, E. Wasle, GNSS ? Global Navigation Satellite Systems GPS, GLONASS, Galileo and more, Springer Wien New York 2008</p> <p>3. E. D. Kaplan, Ch. J. Heagarty, Editors, Understanding GPS. Principles and Applications, Second Edition, Artech House 2006</p>		
<b>Additional bibliography:</b>		
<p>1. S. Gleason, D. Gebre-Egziabher (editors), GNSS Applications and Methods, Artech House, Boston London 2009</p> <p>2. R. Prasad, M. Ruggieri, Applied Satellite Navigation Using GPS, GALILEO, and Augmentation Systems, Artech House, Boston London 2005</p>		
<b>Result of average student's workload</b>		
<b>Activity</b>	<b>Time (working hours)</b>	
1. Participation in lectures	30	
2. Preparation to the credit	10	
3. Work with bibliography	10	
4. participation in the credit test	2	
5. Consulting with the lecturer	3	
<b>Student's workload</b>		
<b>Source of workload</b>	<b>hours</b>	<b>ECTS</b>
Total workload	55	2
Contact hours	35	1
Practical activities	10	1