STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Satellite navigation systems		**1010802111010830864**
Field of study	Profile of study (general academic, practical)	Year /Semester
Electronics and Telecommunications	**general academic**	**1 / 1**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**obligatory**
Cycle of study:	Form of study (full-time,part-time)	
Second-cycle studies	**full-time**	
No. of hours		No. of credits
Lecture: **2** Classes: **-** Laboratory: **-** Project/seminars: **-**		**1**
Status of the course in the study program (Basic, major, other)	(university-wide, from another field)	
major	**from field**	
Education areas and fields of science and art		ECTS distribution (number and %)
technical sciences		**1 100%**
Technical sciences		**1 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	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
2	**Skills**	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.
3	**Social competencies**	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.

Assumptions and objectives of the course:

Recognition and understanding of the principles of operation of the satellite navigation systems and their augmentation systems

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Has a systematic knowledge, with necessary mathematical background, of satellite navigation systems - [K2_W10]
2. Understands basic concepts of global navigation satellite systems. Is able to justify practical implementation of theese concepts - [-]
3. May motivate the needs that navigation satellite constellation must fullfil. - [-]
4. Understands the limitation of the satellite navigation systems and the necessity of using completive systems in order to get everywhere available navigation. - [-]

Skills:

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]
2. Is prepared to use technical literature (also technical periodicals). - [-]
3. Efectively use satellite navigation equipment. - [-]
4. Is able to make course estimation of the GNSS receivers quality - [-]

Social competencies:

1. Stresses the importants of navigation abilities for society - [-]
2. Is able to recognize problem which effective solution involve the GNSS - [-]

Assessment methods of study outcomes

1. Checking questions during the lesson
2. Written credit

Course description

Ubiquitos 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.

Basic bibliography:

1. P. Misra, P. Enge, Global Positioning System. Signals, Measurements, and Performance, Revised Second Edition, Ganga-Jamuna Press, 2011
2. B. Hofmann-Wellenhof, H. Lichtenegger, E. Wasle, GNSS ? Global Navigation Satellite Systems GPS, GLONASS, Galileo and more, Springer Wien New York 2008
3. E. D. Kaplan, Ch. J. Heagarty, Editors, Understanding GPS. Principles and Applications, Second Edition, Artech House 2006

Additional bibliography:

1. S. Gleason, D. Gebre-Egziabher (editors), GNSS Aplications and Methods, Artech House, Boston London 2009
2. R. Prasad, M. Ruggieri, Applied Satellite Navigation Using GPS, GALILEO, and Augmentation Systems, Artech House, Boston London 2005

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures	30
2. Preparation to the credit	10
3. Work with bibliography	10

Student's workload

Source of workload	hours	ECTS
Total workload	50	1
Contact hours	30	0
Practical activities	10	1