

<b>STUDY MODULE DESCRIPTION FORM</b>		
Name of the module/subject <b>4G Wireless Networks</b>		Code <b>1010802131010812921</b>
Field of study <b>Electronics and Telecommunications</b>	Profile of study (general academic, practical) <b>general academic</b>	Year /Semester <b>2 / 3</b>
Elective path/specialty <b>Information and Communication</b>	Subject offered in: <b>English</b>	Course (compulsory, elective) <b>elective</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>1</b> Project/seminars: <b>-</b>		No. of credits <b>3</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>3 100%</b> <b>3 100%</b>
<b>Responsible for subject / lecturer:</b> prof. dr hab. inż. Krzysztof Wesolowski email: wesolows@et.put.poznan.pl tel. 0616653812 Wydział Elektroniki i Telekomunikacji ul. Piotrowo 3A 60-965 Poznań		<b>Responsible for subject / lecturer:</b> prof. dr hab. inż. Krzysztof Wesolowski email: wesolows@et.put.poznan.pl tel. 0616653812 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>	K2_W06: Has a systematic, advanced knowledge of contemporary mobile communication systems and state-of-the-art techniques applied in these systems K2_W05: Has a systematic knowledge, together with the necessary mathematical background, related to information and coding theory K2_W00: Has extended, in-depth knowledge of those branches of mathematics which are used in formulating and solving problems in electronic and telecommunications
<b>2</b>	<b>Skills</b>	K2_U01: Is able to communicate English, to discuss professional matters and to use knowledgeably English language professional sources. K2_U02: Is able to write a short paper, in Polish or English, on a technical subject from his/her field of study. Is able to present a problem from his/her field of study and a solution to this problem, and participate in the discussion to follow K2_U08: Is oriented in rules of activities in the area of standardization, knows Polish and international standardization bodies (ITU, ISO, ETSI, CISPR, 3GPP, etc.).
<b>3</b>	<b>Social competencies</b>	K2_K06: Demonstrates responsibility for designed electronic and telecommunication systems. Is aware of the hazards they pose for individuals and communities if they are improperly designed or produced K2_K03: Understands the legal framework of Polish and international standards in electronics and telecommunication
<b>Assumptions and objectives of the course:</b> Description of the newest achievements and perspectives of the progres in mobile communication systems, in particular LTE, LTE-Advanced as well as HSPA+ and HSPA-Advanced including the newest transmission and system management technologies		
<b>Study outcomes and reference to the educational results for a field of study</b>		
<b>Knowledge:</b>		
1. Has a systematic, advanced knowledge of contemporary mobile communication systems and state-of-the-art techniques applied in these systems - [K2_W06]		
2. Has a knowledge of new techniques applied in the newest mobile communication systems, e.g. coordinated multi-point transmission (CoMP), application of relay stations, etc. - [K2_W06]		
3. Has a detailed knowledge of functioning of 3G system enhancements such as HSPA+ - [K2_W06]		
<b>Skills:</b>		

1. Has ability of study standardization documents produced by standardization bodies, in particular 3GPP - [K2_U08] 2. Has ability to evaluate the 3GPP LTE system and its enhancements as well as HSPA and its enhancements - [K2_U16] 3. Is able to model basic 4G mobile system communication blocks using C++ programming language and IT++ library - [K2_U18]
<b>Social competencies:</b>
1. Demonstrates responsibility and professionalism in solving technical problems - [K2_K05] 2. Is aware of the limitations of his/her current knowledge and skills - [K2_K04] 3. Is aware of the main challenges facing electronics and telecommunication in the 21st century. Is aware of the impact electronics and ICT systems and networks will have on the development of the information society. - [K2_K04]

<b>Assessment methods of study outcomes</b>		
Written examination and evaluation of the developed project (based on demonstration and report)		
<b>Course description</b>		
Lectures - contents: 1. Multiple access methods in 4G systems: OFDMA, SC-FDMA 2. 3GPP LTE system architecture and rules of operation of up-link and down-link in the physical layer. 3. Description of logical and transport channels in the LTE system 4. Establishing a connection, registering in the network, demanding network resources and paging 5. MIMO technology in the LTE system 6. Description of LTE system enhancements introduced in LTE-Advanced 7. Coordination of base station transmission (CoMP) 8. Application of relay stations 9. Optimization of network resources by application of scheduling algorithms 10. Description of further enhancements introduced after LTE-Advanced 11. Evolution of competing HSPA+ technology Exercises: Modeling of selected LTE system blocks using C++ programming and IT++ library		
<b>Basic bibliography:</b>		
1. H. Holma, A. Toskala, WCDMA for UMTS ? HSPA Evolution and LTE, Wiley, 2010 2. S. Sesia, I. Toufik, M. Baker (eds.), LTE: The UMTS Long Term Evolution: From Theory to Practice, Chichester, 2010		
<b>Additional bibliography:</b>		
1. E. Dahlman, S. Parkvall, J. Skold 4G: LTE/LTE-Advanced for Mobile Broadband, Academic Press, 2009		
<b>Result of average student's workload</b>		
Activity	Time (working hours)	
1. Participation in lectures	30	
2. Participation in project/exercises	15	
3. Work on the project - development and debugging of the simulation model, writing a report	10	
4. Literature studies	10	
5. Preparation to examination	10	
6. Consulting with teachers	3	
7. Participation in examination	2	
<b>Student's workload</b>		
Source of workload	hours	ECTS
Total workload	80	3
Contact hours	50	2
Practical activities	25	1