

STUDY MODULE DESCRIPTION FORM		
Name of the module/subject 4G wireless networks		Code 1010812131010812442
Field of study Electronics and Telecommunications	Profile of study (general academic, practical) general academic	Year /Semester 2 / 3
Elective path/specialty Radio Communications	Subject offered in: Polish	Course (compulsory, elective) elective
Cycle of study: Second-cycle studies	Form of study (full-time, part-time) full-time	
No. of hours Lecture: 2 Classes: - Laboratory: - Project/seminars: 1		No. of credits 3
Status of the course in the study program (Basic, major, other) other		(university-wide, from another field) from field
Education areas and fields of science and art technical sciences Technical sciences		ECTS distribution (number and %) 3 100% 3 100%
Responsible for subject / lecturer: prof. dr hab. inż. Krzysztof Wesolowski email: wesolows@et.put.poznan.pl tel. 0616653812 Wydział Elektroniki i Telekomunikacji ul. Piotrowo 3A 60-965 Poznań		Responsible for subject / lecturer: prof. dr hab. inż. Krzysztof Wesolowski email: wesolows@et.put.poznan.pl tel. 0616653812 Wydział Elektroniki i Telekomunikacji ul. Piotrowo 3A 60-965 Poznań
Prerequisites in terms of knowledge, skills and social competencies:		
1	Knowledge	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
2	Skills	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.).
3	Social competencies	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
Assumptions and objectives of the course: Description of the newest achievements and perspectives of the progress in mobile communication systems, in particular LTE, LTE-Advanced as well as HSPA+ and HSPA-Advanced including the newest transmission and system management technologies		
Study outcomes and reference to the educational results for a field of study		
Knowledge:		
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]		
Skills:		

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]
Social competencies:
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]

Assessment methods of study outcomes		
Written examination and evaluation of the developed project (based on demonstration and report)		
Course description		
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		
Basic bibliography:		
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		
Additional bibliography:		
1. E. Dahlman, S. Parkvall, J. Skold 4G: LTE/LTE-Advanced for Mobile Broadband, Academic Press, 2009		
Result of average student's workload		
Activity	Time (working hours)	
1. Literature studies	30	
2. Work on the project - getting acquainted with specific tasks, development and debugging of the simulation model, writing a report	15	
3. Consulting with the exercise instructor	15	
Student's workload		
Source of workload	hours	ECTS
Total workload	90	3
Contact hours	50	2
Practical activities	30	1