

# Semester 7



<b>STUDY MODULE DESCRIPTION FORM</b>		
Name of the module/subject <b>Optical Networks</b>		Code
Field of study <b>Electronics and Telecommunications</b>	Profile of study (general academic, practical) <b>general academic</b>	Year /Semester <b>4 / 7</b>
Elective path/specialty <b>Information and Comm. Technologies</b>	Subject offered in: <b>English</b>	Course (compulsory, elective) <b>elective</b>
Cycle of study: <b>First-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>Other</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. Wojciech Kabaciński email: wojciech.kabacinski@et.put.poznan.pl tel. 061 665 3907 Electronics and Telecommunications ul. Polanka 3, 60-965 Poznań		
<b>Prerequisites in terms of knowledge, skills and social competencies:</b>		
1	<b>Knowledge</b>	Has a basic knowledge in mathematics required to formulate and solve task in the area of electronics and telecommunications. Has knowledge in optoelectronics and optical communication, including knowledge required to understand operation of advanced optical communication systems.
2	<b>Skills</b>	Is able to use bibliography in English (books, scientific and technical journals, application notes, catalogs, instructions, recommendations etc.). Can write research report and prepare presentation (in Polish or/and English) on solving problems in the field of electronics and/or telecommunications, can conduct discussion on the presented problem. Can use optimization methods to solve problems in electronics and telecommunications.
3	<b>Social competencies</b>	Knows the limitations of their own knowledge and skills, he understands the need for further education.
<b>Assumptions and objectives of the course:</b> To get students familiar with architectures and operation of optical networks and devices used in such networks.		
<b>Study outcomes and reference to the educational results for a field of study</b>		
<b>Knowledge:</b>		
1. Has general knowledge about architectures and topologies of optical networks 2. Has general knowledge on devices used in optical networks 3. Has an idea about future evolution of optical networks		
<b>Skills:</b>		
1. Can design logical and physical topologies of optical networks 2. Can evaluate usefulness and chose appropriate network devices 3. Can evaluate the risk of faults in the network and design methods for their localization		
<b>Social competencies:</b>		
1. He is aware of significance of optical networks in telecommunication network evolution 2. He is aware if influence of optical networks on information society 3. Has competences to work in a team to realize projects on optical networks		

<b>Assessment methods of study outcomes</b>		
Forming assessment: In the laboratory: on the basis on activity during projects and the report from the final project Summary assessment: Lectures: the multiple choice test; points for each question: -0,25 p. (wrong answer), 0 p. (no answer), 1 p. (correct answer); test is passed when student receives at least 50% points.		
<b>Course description</b>		
Lectures: What are optical networks. Types of optical networks. Transport networks. WDM networks. Broadcast and Select networks. Elements and devices in optical networks: ROADM, OXC, types, configurations, architectures. Switching elements. switching fabrics: architectures and parameters, comparison. Optical packet and burst switching. Contention resolution. Routing and wavelength assignment. Network topology design methods. Protection and restoration methods. Optical access networks: EPON, GEON, WDM PON.		
Laboratory: Topology design of some networks. Designing of some devices in simulation systems.		
<b>Basic bibliography:</b>		
1. R. Sivarajan, K.r N. Ramaswami: Optical Networks: A Practical Perspective (Morgan Kaufmann Series in Networking) 2002, 2010 2. T. E. Stern, G. Ellinas, K. Bala: Multiwavelength Optical Networks: Architectures, Design, and Control 3. B. Mukherjee: Optical WDM Networks, Springer. 2006		
<b>Additional bibliography:</b>		
1. W. Kabaciński: Nonblocking Electronic and Photonic Switching Fabrics. Springer, 2005		
<b>Result of average student's workload</b>		
Activity	Time (working hours)	
1. Lectures	30	
2. Laboratory	15	
3. Preparation for laboratory	15	
4. Preparation to the final exam	15	
5. Final exam	2	
<b>Student's workload</b>		
Source of workload	hours	ECTS
Total workload	77	3
Contact hours	47	2
Practical activities	30	1

<b>STUDY MODULE DESCRIPTION FORM</b>		
Name of the module/subject <b>Switching Systems</b>		Code
Field of study <b>Electronics and Telecommunications</b>	Profile of study (general academic, practical) <b>general academic</b>	Year /Semester <b>4 / 7</b>
Elective path/specialty <b>Information and Comm. Technologies</b>	Subject offered in: <b>English</b>	Course (compulsory, elective) <b>elective</b>
Cycle of study: <b>First-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>other</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. Wojciech Kabaciński email: wojciech.kabacinski@et.put.poznan.pl tel. 061 665 3907 Electronics and Telecommunications ul. Polanka 3, 60-965 Poznań		
<b>Prerequisites in terms of knowledge, skills and social competencies:</b>		
1	<b>Knowledge</b>	Has a basic knowledge in mathematics required to formulate and solve task in the area of electronics and telecommunications.
2	<b>Skills</b>	Is able to use bibliography in English (books, scientific and technical journals, application notes, catalogs, instructions, recommendations etc.). Can write research report and prepare presentation (in Polish or/and English) on solving problems in the field of electronics and/or telecommunications, can conduct discussion on the presented problem. Can use optimization methods to solve problems in electronics and telecommunications.
3	<b>Social competencies</b>	Knows the limitations of their own knowledge and skills, he understands the need for further education.
<b>Assumptions and objectives of the course:</b> To get students familiar with architectures and operation of different kinds of switching nodes used in telecommunication networks (routers, switches, optical cross-connects, etc.), their control and performance evaluation.		
<b>Study outcomes and reference to the educational results for a field of study</b>		
<b>Knowledge:</b> 1. Has knowledge about the switching nodes role and architecture in communication networks 2. Knows methods for switching nodes evaluation and comparison 3. Knows the way switching systems are controlled		
<b>Skills:</b> 1. Can evaluate and compare selected performance parameters of switching systems 2. Can prepare experiments enabling to evaluate selected parameters 3. Can propose and design control algorithms for controlling switching nodes		
<b>Social competencies:</b> 1. Has competences to work in a team to realize projects on switching systems		
<b>Assessment methods of study outcomes</b>		

<p>Forming assessment:                  In the laboratory: on the basis on activity during projects and the report from the final project                  Summary assessment:                  Lectures: the multiple choice test; points for each question: -0,25 p. (wrong answer), 0 p. (no answer), 1 p. (correct answer);                  test is passed when student receives at least 50% points.</p>		
<b>Course description</b>		
<p>Lectures: What are switching systems. Types and functions of switching systems. Switching networks ? terminology, characteristics, topologies. Circuit switching networks - crossbar, Clos, Benes. Circuit switching networks ? control algorithms. Packet switching networks ? router architectures. Buffering in packet switching networks. Buffering in packet switching networks ? scheduling algorithms. Multistage switching networks and packet scheduling algorithms. Optical switching elements. Optical crossconnect systems (OXC) and optical add/drop multiplexers (OADM). Optical switching networks. Energy efficiency in switching networks.</p> <p>Practical exercises:                  Designing of switching fabric topologies (crossbar, Benes, Clos).                  Capacity dimensioning of switching networks.                  Control algorithms ? the shortest connecting path - exercises.                  Control algorithms ? the cheapest connecting path- exercises.                  Control algorithms ? the shortest connecting path - programming.                  Control algorithms ? the cheapest connecting path- programming.                  Control algorithms ? rearrangements and repacking - exercises.                  Control algorithms ? rearrangements and repacking - programming.                  Configuration of switching nodes ? IP routers, software routers, routing.                  Optical switching fabrics ? designing and programming.</p>		
<p><b>Basic bibliography:</b>                  1. A. Pattavina, Switching Theory. John Wiley &amp; Sons, Inc., 1998.                  2. H. J. Chao and B. Liu, High Performance Switches and Routers. John Wiley &amp; Sons, Inc., 2007                  3. W. Kabaciński: Nonblocking Electronic and Photonic Switching Fabrics. Springer, 2005</p>		
<p><b>Additional bibliography:</b>                  1. A. Jajszczyk, Wstęp do telekomutacji, WNT, 2000                  2. W. Kabaciński, M. Żal: Sieci Telekomunikacyjne, WKŁ, 2008</p>		
<b>Result of average student's workload</b>		
<b>Activity</b>	<b>Time (working hours)</b>	
1. Lectures	30	
2. Laboratory exercises	15	
3. Preparation for laboratory ecercises	15	
4. Preparation to the final exam	15	
5. Final exam	2	
6. Discussion of exam otucomes	2	
<b>Student's workload</b>		
<b>Source of workload</b>	<b>hours</b>	<b>ECTS</b>
Total workload	79	3
Contact hours	49	2
Practical activities	30	1

<b>STUDY MODULE DESCRIPTION FORM</b>		
Name of the module/subject <b>Programming of mobile terminals for Android</b>		Code
Field of study <b>Electronics and Telecommunications</b>	Profile of study (general academic, practical) <b>general academic</b>	Year /Semester <b>3 / 7</b>
Elective path/specialty <b>Information and Comm. Technologies</b>	Subject offered in: <b>English</b>	Course (compulsory, elective) <b>elective</b>
Cycle of study: <b>First-cycle studies</b>	Form of study (full-time, part-time) <b>full-time</b>	
No. of hours Lecture: <b>1</b> Classes: <b>0</b> Laboratory: <b>2</b> Project/seminars: <b>-</b>		No. of credits <b>4</b>
Status of the course in the study program (Basic, major, other) <b>other</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>4 100%</b> <b>4 100%</b>
<b>Responsible for subject / lecturer:</b>  dr inż. Adrian Kliks email: akliks@et.put.poznan.pl tel. +48 61 665 3913 Faculty of Electronics and Telecommunications ul. Piotrowo 3A 60-965 Poznań		
<b>Prerequisites in terms of knowledge, skills and social competencies:</b>		
<b>1</b>	<b>Knowledge</b>	K1_W09 ? Knows the rules of preparing the computer programs, has the grounded knowledge in computer science and programming, knows the syntax of various programming languages, such as C, C++, C#, Matlab K1_W23 ? Knows the fundamentals of the functioning of the operating systems and databases. K2_W02 ? Has the basic knowledge in the area of creating and architecture of the programmable chips and of the potential of their practical application K2_W06 ? has the grounded and advanced knowledge on current wireless communications systems
<b>2</b>	<b>Skills</b>	K1-U01 ? Can find necessary information in the literature and various resources, prepared in Polish and English; can integrate and interpret the possessed information, and draw conclusions based on them K1_U05 ? Can make self-study K1_U13 ? Can implement algorithms by means of selected programming languages, such as C or C#
<b>3</b>	<b>Social competencies</b>	K1-K01 - is aware of his/her knowledge and skills limitations; can precisely formulate the problems; understand the need of further study and of systematic reading of scientific publications in the range of the studied part of science; K1_K02 - Is aware of the need for professional treatment of the problems to be solved and for taking responsibility for proposed solutions K1_K03 ? is aware of his/her responsibilities for the developed systems
<b>Assumptions and objectives of the course:</b> The main goal of the course is to develop student's skills in programming of mobile terminals. After completing the course students will be able to implement their own application, ready for release in Internet markets. Particular attention will be put on the devices using Android system.		
<b>Study outcomes and reference to the educational results for a field of study</b>		
<b>Knowledge:</b>		
1. Possesses the grounded knowledge in the area of programming of mobile terminals - [K2_W03] 2. Possesses the knowledge about the possibilities of usage of various module and resources available in nowadays mobile terminals - [K2_W03]		
<b>Skills:</b>		

1. Possesses the skills of using various resources available in Internet (usually in English) - [K2_U01]
2. Is able to prepare the complete application together with the required documentation - [K2_U02]
<b>Social competencies:</b>
1. Is aware of his/her knowledge and skills limitations; understand the need of further study - [K2_K04]
2. Is aware of the need for professional treatment of the problems to be solved and for taking responsibility for proposed solutions - [K2_K05]
3. Is aware of his/her responsibilities for the developed systems - [K2_K06]

<b>Assessment methods of study outcomes</b>
Theoretic knowledge (based on the lectures) will be checked during the test scheduled on the 14th week. Laboratories will be credited based on the notes made for each laboratory unit.

<b>Course description</b>
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<p>Lecture - subjects:</p> <ol style="list-style-type: none"> <li>1. Description of the programming environment (Android)</li> <li>2. Description of the Project structure, resources used in the project, the meaning of the R.java file</li> <li>3. Supporting multi-language applications</li> <li>4. Layout descriptions</li> <li>5. Description of the life-cycle of each activity</li> <li>6. Running application on the emulator and device</li> <li>7. Description of particular classes: intent, service, broadcast, content provider</li> <li>8. Description of the "manifest.xml" file content</li> <li>9. Exceptions and threads</li> <li>10. Menus vs. Action-Bar</li> <li>11. Usage of listeners and handlers</li> <li>12. Widgets</li> <li>13. Application of sensors</li> <li>14. Ways of monetizing, certification, releasing and publishing of applications</li> </ol> <p>Laboratories:</p> <ol style="list-style-type: none"> <li>1. Preparation of the programming tools</li> <li>2. Implementation of the "Hello World" application</li> <li>3. Implementation of the "Ticket-Machine" application, part 1 (multi-activity approach)</li> <li>4. Implementation of the "Ticket-Machine" application, part 2 (toasts and dialogs)</li> <li>5. Implementation of the "ScreenSaver" application ? work with timers</li> <li>6. Creation of the own Custom View element</li> <li>7. Implementation of the application using light sensor, accelerometer and other sensors available on the hardware device</li> <li>8. Implementation of the simple widget with associated appropriate menu</li> </ol>
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<b>Basic bibliography:</b>
1. <a href="http://developer.android.com/index.html">http://developer.android.com/index.html</a>

<b>Additional bibliography:</b>
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<b>Result of average student's workload</b>
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Activity	Time (working hours)
1. Lectures	15
2. Laboratories	30
3. Literature search and study	20
4. Project preparation	20
3. Individual consultations	2
4. Preparation to the test	12
5. Test	1

<b>Student's workload</b>		
<b>Source of workload</b>	<b>hours</b>	<b>ECTS</b>
Total workload	100	4
Contact hours	48	2
Practical activities	50	2

<b>STUDY MODULE DESCRIPTION FORM</b>		
ZName of the module/subject <b>Programming of mobile terminals for iOS</b>		Code
Field of study <b>Electronics and Telecommunications</b>	Profile of study (general academic, practical) <b>general academic</b>	Year /Semester <b>4 / 7</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>1</b> Classes: <b>-</b> Laboratory: <b>2</b> Project/seminars: <b>-</b>		No. of credits <b>4</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>4 100%</b> <b>4 100%</b>
<b>Responsible for subject / lecturer:</b>  dr inż. Adrian Kliks email: akliks@et.put.poznan.pl tel. +48 61 665 3913 Faculty of Electronics and Telecommunications ul. Piotrowo 3A 60-965 Poznań		
<b>Prerequisites in terms of knowledge, skills and social competencies:</b>		
<b>1</b>	<b>Knowledge</b>	K1_W09 ? Knows the rules of preparing the computer programs, has the grounded knowledge in computer science and programming, knows the syntax of various programming languages, such as C, C++, C#, Matlab K1_W23 ? Knows the fundamentals of the functioning of the operating systems and databases. K2_W02 ? Has the basic knowledge in the area of creating and architecture of the programmable chips and of the potential of their practical application K2_W06 ? has the grounded and advanced knowledge on current wireless communications systems
<b>2</b>	<b>Skills</b>	K1-U01 ? Can find necessary information in the literature and various resources, prepared in Polish and English; can integrate and interpret the possessed information, and draw conclusions based on them K1_U05 ? Can make self-study K1_U13 ? Can implement algorithms by means of selected programming languages, such as C or C#
<b>3</b>	<b>Social competencies</b>	K1-K01 - is aware of his/her knowledge and skills limitations; can precisely formulate the problems; understand the need of further study and of systematic reading of scientific publications in the range of the studied part of science; K1_K02 - Is aware of the need for professional treatment of the problems to be solved and for taking responsibility for proposed solutions K1_K03 ? is aware of his/her responsibilities for the developed systems
<b>Assumptions and objectives of the course:</b> The main goal of the course is to develop student's skills in programming of mobile terminals. After completing the course students will be able to implement their own application, ready for release in Internet markets. Particular attention will be put on the devices using Android system.		
<b>Study outcomes and reference to the educational results for a field of study</b>		
<b>Knowledge:</b>		
1. Possesses the grounded knowledge in the area of programming of mobile terminals - [K2_W03] 2. Possesses the knowledge about the possibilities of usage of various module and resources available in nowadays mobile terminals - [K2_W03]		
<b>Skills:</b>		

1. Possesses the skills of using various resources available in Internet (usually in English) - [K2_U01]
2. Is able to prepare the complete application together with the required documentation - [K2_U02]
<b>Social competencies:</b>
1. Is aware of his/her knowledge and skills limitations; understand the need of further study - [K2_K04]
2. Is aware of the need for professional treatment of the problems to be solved and for taking responsibility for proposed solutions - [K2_K05]
3. Is aware of his/her responsibilities for the developed systems - [K2_K06]

<b>Assessment methods of study outcomes</b>
Theoretic knowledge (based on the lectures) will be checked during the oral exam scheduled on the 14th week. The exercises will be credited based on the presentation of the application prepared by each student in form of the project. Laboratories will be credited based on the notes made for each laboratory unit.

<b>Course description</b>
Lecture - subjects: 1. Description of the programming environment (XCode) 2. Description of the Project structure, resources used in the project 3. Introduction to Objective-C 4. Description of the life-cycle of each activity 5. Running application on the emulator and device 6. Description of particular classes 7. Exceptions and threads 8. Menus, layouts and other structures 9. Usage of listeners and handlers 10. Usage of sensors 11. Ways of application's monetizing, certification, releasing and publishing
Laboratories: 1. Preparation of the programming tools 2. Implementation of the "Hello World" application – introduction to Objective-C, emulation of the project on the emulator 3. Implementation of the "Ticket-Machine" application 4. Implementation of the "Xs and Os" game 5. Implementation of the application using light sensor, accelerometer and other sensors available on the hardware device 6. Implementation of the simple widget with associated appropriate menu

<b>Basic bibliography:</b> <a href="https://developer.apple.com/">https://developer.apple.com/</a>
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<b>Additional bibliography:</b>
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<b>Result of average student's workload</b>
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Activity	Time (working hours)
1. Lectures	15
2. Laboratories	30
3. Literature search and study	20
4. Project preparation	20
3. Individual consultations	2
4. Preparation to the test	12
5. Test	1

<b>Student's workload</b>
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<b>Source of workload</b>	<b>hours</b>	<b>ECTS</b>
Total workload	100	4
Contact hours	48	2
Practical activities	50	2

<b>STUDY MODULE DESCRIPTION FORM</b>		
Name of the module/subject <b>Optoelectronics and Photonics</b>		Code
Field of study <b>Electronics and Telecommunications</b>	Profile of study (general academic, practical) <b>general academic</b>	Year /Semester <b>4 / 7</b>
Elective path/specialty <b>Information and Comm. Technologies</b>	Subject offered in: <b>English</b>	Course (compulsory, elective) <b>elective</b>
Cycle of study: <b>First-cycle studies</b>	Form of study (full-time, part-time) <b>full-time</b>	
No. of hours Lecture: <b>1</b> Classes: <b>-</b> Laboratory: <b>1</b> Project/seminars: <b>-</b>		No. of credits <b>4</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>4 100%</b> <b>4 100%</b>
<b>Responsible for subject / lecturer:</b>  dr inż. Jan Lamperski email: jlamper@et.put.poznan.pl tel. +48 61 665 3809 Faculty of Electronics and Telecommunications ul. Piotrowo 3A 60-965 Poznań		
<b>Prerequisites in terms of knowledge, skills and social competencies:</b>		
1	<b>Knowledge</b>	Basic knowledge of mathematics, EM field theory, optics and optocommunications.
2	<b>Skills</b>	Skills in the field of electronic metrology.
3	<b>Social competencies</b>	Ability to work in a group.
<b>Assumptions and objectives of the course:</b> In-depth knowledge and understanding of the design, operation and features of various optical devices used in optical transmission systems and equipment for the processing of optical signals.		
<b>Study outcomes and reference to the educational results for a field of study</b>		
<b>Knowledge:</b>		
1. The student has knowledge of the physical behavior of passive and active optical components - [-K1_W02] 2. Has knowledge of the features and possible applications of optical and optoelectronic materials - [-K1_W02, K1_W08] 3. Understands physical principles of operation and construction of the selected optical elements and optoelectronic devices (directional couplers, modulators, photodiodes, lasers, optical amplifiers, optical filters, acousto-optical cell. - [-K1_W21, K1_W08] 4. Understands the applications in which advanced photonics devices and sub-modules are used - [-K1-W24, K1_W21]		
<b>Skills:</b>		
1. Can define requirements and select appropriate optical elements for the specific application. - [-K1_U12] 2. Can calculate the basic parameters of optoelectronic components - [-K1_U08, K1_U20] 3. Has design skills to define problems, identifies constraints propose solutions for specific applications to fulfill performance and required specification - [-K1_U20] 4. Able to measure basic properties of optoelectronic components - [-K1_U17]		
<b>Social competencies:</b>		
1. Has awareness of the necessity of professional approach to solving of technical problems. - [-K1_K01] 2. Understands the role of photonics in next-generation systems for signal processing and transmission - [-K1_K04] 3. Is aware of the advantages of optical technology and necessity of transition from electronics to photonics. - [-K1_K04]		

<b>Assessment methods of study outcomes</b>		
Final test, colloquium, lab reports.		
<b>Course description</b>		
<p>Duality of light: rays, waves, electromagnetism, quanta. Polarization of light. Electro- and acousto-optic effects. Nonlinear optics. Fundamentals of quantum mechanics.</p> <p>Selected components of integrated optics: planar waveguides, coupled mode waveguides, electro-optic modulators, electro absorption (Franz-Keldysh) modulators, Mach-Zehnder type modulators, acousto-optic modulators.</p> <p>Photonic fibers.</p> <p>Optical resonators.</p> <p>Optoelectronic semiconductor materials: electrical carriers, energy band-gap structure, direct indirect semiconductors.</p> <p>Interaction of radiation with atoms.</p> <p>Basic principles of light detection and emission in semiconductors. LED spectral characteristics. Optical amplifiers. Classification and properties of semiconductor lasers. Mode locked lasers.</p> <p>Advanced modulation formats of optical signals. Wavelength conversion. All optical signal regeneration. Optical switching. Optical computers. All-optical signal processing.</p> <p>Optical Metrology. Optical frequency standards.</p>		
<b>Basic bibliography:</b>		
<ol style="list-style-type: none"> <li>1. Optoelectronics and Photonics Principles and Practices, S. O. Kasap, Pearson, Essex, 2013</li> <li>2. Optical Electronics in Modern Communications, A. Yariv, Oxford University Press, N. York, 1998</li> <li>3. <a href="http://www.rp-photonics.com/encyclopedia.html">http://www.rp-photonics.com/encyclopedia.html</a></li> </ol>		
<b>Additional bibliography:</b>		
<ol style="list-style-type: none"> <li>1. Introduction to Classical and Modern Optics, J.R. Meyer-Arendt, Prentice Hall, 1995</li> <li>2. <a href="http://www.invocom.et.put.poznan.pl/~invocom/C/P1-9/swiatlowody_en/index.htm">http://www.invocom.et.put.poznan.pl/~invocom/C/P1-9/swiatlowody_en/index.htm</a></li> <li>3. Pomiary w optycznych systemach telekomunikacyjnych, K. Perlicki, WKŁ, 2002</li> </ol>		
<b>Result of average student's workload</b>		
Activity	Time (working hours)	
1. Participation in lectures	15	
2. Participation in labs	15	
3. Self-study	23	
4. Final test	2	
5. Preparation to the labs	20	
6. Writing lab reports	25	
<b>Student's workload</b>		
Source of workload	hours	ECTS
Total workload	100	4
Contact hours	32	2
Practical activities	40	1

<b>STUDY MODULE DESCRIPTION FORM</b>		
Name of the module/subject <b>Optoelectronic and Photonics Devices and Technology</b>		Code
Field of study <b>Electronics and Telecommunications</b>	Profile of study (general academic, practical) <b>general academic</b>	Year /Semester <b>4 / 7</b>
Elective path/specialty <b>Information and Comm. Technologies</b>	Subject offered in: <b>English</b>	Course (compulsory, elective) <b>elective</b>
Cycle of study: <b>First-cycle studies</b>	Form of study (full-time, part-time) <b>full-time</b>	
No. of hours Lecture: <b>1</b> Classes: <b>-</b> Laboratory: <b>1</b> Project/seminars: <b>-</b>		No. of credits <b>4</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>4 100%</b> <b>4 100%</b>
<b>Responsible for subject / lecturer:</b>  dr inż. Jan Lamperski email: jlamper@et.put.poznan.pl tel. +48 61 665 3809 Faculty of Electronics and Telecommunications ul. Piotrowo 3A 60-965 Poznań		
<b>Prerequisites in terms of knowledge, skills and social competencies:</b>		
1	<b>Knowledge</b>	Basic knowledge of mathematics, EM field theory, optics and optocommunications.
2	<b>Skills</b>	Skills in the field of electronic metrology.
3	<b>Social competencies</b>	Ability to work in a group.
<b>Assumptions and objectives of the course:</b> In-depth knowledge and understanding of the design, operation and features of various optical devices used in optical transmission systems and equipment for the processing of optical signals.		
<b>Study outcomes and reference to the educational results for a field of study</b>		
<b>Knowledge:</b>		
1. The student has knowledge of the physical behavior of passive and active optical components - [-K1_W02] 2. Has knowledge of the features and possible applications of optical and optoelectronic materials - [-K1_W02, K1_W08] 3. Understands physical principles of operation and construction of the selected optical elements and optoelectronic devices (directional couplers, modulators, photodiodes, lasers, optical amplifiers, optical filters, acousto-optical cell. - [-K1_W21, K1_W08] 4. Understands the applications in which advanced photonics devices and sub-modules are used - [-K1-W24, K1_W21]		
<b>Skills:</b>		
1. Can define requirements and select appropriate optical elements for the specific application. - [-K1_U12] 2. Can calculate the basic parameters of optoelectronic components - [-K1_U08, K1_U20] 3. Has design skills to define problems, identifies constraints propose solutions for specific applications to fulfill performance and required specification - [-K1_U20] 4. Able to measure basic properties of optoelectronic components - [-K1_U17]		
<b>Social competencies:</b>		
1. Has awareness of the necessity of professional approach to solving of technical problems. - [-K1_K01] 2. Understands the role of photonics in next-generation systems for signal processing and transmission - [-K1_K04] 3. Is aware of the advantages of optical technology and necessity of transition from electronics to photonics. - [-K1_K04]		

<b>Assessment methods of study outcomes</b>		
Final test, colloquium, lab reports.		
<b>Course description</b>		
<p>Duality of light: rays, waves, electromagnetism, quanta. Polarization of light. Electro- and acousto-optic effects. Nonlinear optics. Fundamentals of quantum mechanics.</p> <p>Selected components of integrated optics: planar waveguides, directional couplers, EAM (Franz-Keldysh), MZM, AOM. Photonic crystal fibers. PCF supercontinuum.</p> <p>Fabry-Perot resonator.</p> <p>Optoelectronic semiconductor materials: electrical carriers, energy band-gap structure, direct indirect semiconductors. Interaction of radiation with atoms.</p> <p>Basic principles of light detection and emission in semiconductors. LED electrical and optical features. Semiconductor optical amplifiers. Properties of F-P, DFB, DBR semiconductor lasers. Mode locked lasers.</p> <p>Modulators for advanced modulation formats: PSK, QPSK, DQPSK, PoSK. Coherent detection. Detection of multilevel optical signals. SOA: Wavelength conversion and regeneration. Nonlinear based all optical signal processing and regeneration (NOM, SL, SPM-MZI, XPM-MZI). Optical switching: MEMS, OE, LC, CI technology. Optical control loops: OIL, OPLL. Optical computers.</p> <p>Optical comb generation. Optical frequency standards.</p>		
<b>Basic bibliography:</b>		
<ol style="list-style-type: none"> <li>1. Optoelectronics and Photonics Principles and Practices, S. O. Kasap, Pearson, Essex, 2013</li> <li>2. Optical Electronics in Modern Communications, A. Yariv, Oxford University Press, N. York, 1998</li> <li>3. <a href="http://www.rp-photonics.com/encyclopedia.html">http://www.rp-photonics.com/encyclopedia.html</a></li> </ol>		
<b>Additional bibliography:</b>		
<ol style="list-style-type: none"> <li>1. Introduction to Classical and Modern Optics, J.R. Meyer-Arendt, Prentice Hall, 1995</li> <li>2. <a href="http://www.invocom.et.put.poznan.pl/~invocom/C/P1-9/swiatlowody_en/index.htm">http://www.invocom.et.put.poznan.pl/~invocom/C/P1-9/swiatlowody_en/index.htm</a></li> <li>3. Pomiar w optycznych systemach telekomunikacyjnych, K. Perlicki, WKŁ, 2002</li> </ol>		
<b>Result of average student's workload</b>		
<b>Activity</b>	<b>Time (working hours)</b>	
1. Participation in lectures	15	
2. Participation in labs	15	
3. Self-study	33	
4. Final test	2	
5. Preparations for laboratories	15	
6. Writing lab reports	20	
<b>Student's workload</b>		
<b>Source of workload</b>	<b>hours</b>	<b>ECTS</b>
Total workload	100	4
Contact hours	32	2
Practical activities	30	1

<b>STUDY MODULE DESCRIPTION FORM</b>		
Name of the module/subject <b>Wireless networks (LANs, PANs, WANs)</b>		Code
Field of study <b>Electronics and Telecommunications</b>	Profile of study (general academic, practical) <b>general academic</b>	Year /Semester <b>4 / 7</b>
Elective path/specialty <b>Radio - communications</b>	Subject offered in: <b>English</b>	Course (compulsory, elective) <b>elective</b>
Cycle of study: <b>First-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>2</b> Project/seminars: <b>-</b>		No. of credits <b>5</b>
Status of the course in the study program (Basic, major, other) <b>other</b>		(university-wide, from another field) <b>university-wide</b>
Education areas and fields of science and art <b>technical sciences</b> <b>Technical sciences</b>		ECTS distribution (number and %) <b>5 100%</b> <b>5 100%</b>
<b>Responsible for subject / lecturer:</b> dr hab. inż. Paweł Szulakiewicz, prof. nadzw. email: szulak@et.put.poznan.pl tel. 61 6653870 Faculty of Electronics and Telecommunications ul. Piotrowo 3A 60-965 Poznań		
<b>Prerequisites in terms of knowledge, skills and social competencies:</b>		
1	<b>Knowledge</b>	Students have well ordered knowledge concerning signal theory, wireless communications, wireless channels, digital communication systems and theory of telecommunications (K1_W06, K1_W14, K1_W15, K1_W17)
2	<b>Skills</b>	Student is able to compare and evaluate digital communication systems, is able to compare wireless system parameters, digital modulations, methods of signal transmission, receivers, wireless channels. (K11_U05, K1_U10, K1_U17, K1_U21)
3	<b>Social competencies</b>	Student understands the necessity of professional approach to engineering problems solving (K1_K01) Student feels responsibility for the designed systems (K1_K03) Student is up to the challenges coming from the rising demand for the spectrum and higher transmission rate (K1_K04)
<b>Assumptions and objectives of the course:</b> The objective of the course is to teach a student the wireless network structures and enable him to understand how such networks operate. A student should be able to utilize, compare and evaluate wireless networks, which are available at the market or are in the standardization process.		
<b>Study outcomes and reference to the educational results for a field of study</b>		
<b>Knowledge:</b> 1. Student knows the structure, parameters, advantages and disadvantages of the wireless networks such as IEEE 802.11, 802.15, 802.16, UWB, VLC, H2, ... - [K1_U25]		
<b>Skills:</b> 1. Student is able to explain, develop, deploy and apply Wi Fi (IEEE 802.11) network - [K1_U25] 2. Student is able to compare the parameters of different wireless networks - [K1_U25] 3. Student is able to participate in the development of new networks which are in the standardization process - [K1_U25]		
<b>Social competencies:</b> 1. Student understands the necessity to learn the new wireless networks and to keep up with the new standards - [K1_K01] 2. Student understands the necessity for cooperation of the different groups of professionals - [K1_K03] 3. Student is able to participate in the wireless networks development - [K1_K04]		
<b>Assessment methods of study outcomes</b>		

Oral examination which concerns the selected subjects covered during the lectures and studied by the student. Evaluation of the problem solving by the student in the laboratory .		
<b>Course description</b>		
Lectures concern: The Wi Fi network (802.11 b,a g,n,ac,e,...) Physical (PHY), Link (MAC sublayer) and other WiFi layers MIMO technique, STBC, capacity and outage capacity Multi-access methods Mesh networks ICI cancelling, SIC method, V-BLAST WiMAX,H2, Bluetooth, ZigBee, UWB, VLC,... Laboratory: Design, analysis, deployment, parameters measurement of the WiFi network		
<b>Basic bibliography:</b>		
1. Selected parts of the network standards available in the IEEE digital eLibrary 2. Selected papers in scientific journals and available in the internet. 3. Handouts concerning wireless networks		
<b>Additional bibliography:</b>		
<b>Result of average student's workload</b>		
<b>Activity</b>		<b>Time (working hours)</b>
1. Lectures		30
2. Laboratory		30
3. Studying the literature, preparation to the laboratory and examination		65
<b>Student's workload</b>		
<b>Source of workload</b>	<b>hours</b>	<b>ECTS</b>
Total workload	125	4
Contact hours	60	2
Practical activities	30	2

<b>STUDY MODULE DESCRIPTION FORM</b>		
Name of the module/subject <b>IEEE 802 Networks</b>		Code
Field of study <b>Electronics and Telecommunications</b>	Profile of study (general academic, practical) <b>general academic</b>	Year /Semester <b>4 / 7</b>
Elective path/specialty <b>Information and Comm. Technologies</b>	Subject offered in: <b>English</b>	Course (compulsory, elective) <b>elective</b>
Cycle of study: <b>First-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>2</b> Project/seminars: <b>-</b>		No. of credits <b>5</b>
Status of the course in the study program (Basic, major, other) <b>other</b>		(university-wide, from another field) <b>university-wide</b>
Education areas and fields of science and art <b>technical sciences</b> <b>Technical sciences</b>		ECTS distribution (number and %) <b>5 100%</b> <b>5 100%</b>
<b>Responsible for subject / lecturer:</b>  dr hab. inż. Paweł Szulakiewicz, prof. nadzw. email: szulak@et.put.poznan.pl tel. 61 6653870 Faculty of Electronics and Telecommunications ul. Piotrowo 3A 60-965 Poznań		
<b>Prerequisites in terms of knowledge, skills and social competencies:</b>		
1	<b>Knowledge</b>	Student has a well ordered knowledge concerning signal theory, signal transmission, wireless channels, digital communication systems and theory of telecommunications (K1_W06, K1_W14, K1_W15, K1_W17)
2	<b>Skills</b>	Student is able to compare and evaluate digital communication systems, knows the system parameters, digital modulations, transmitters and receivers, wireless channels. (K1U01, K1_U05, K1_U17, K1_U21)
3	<b>Social competencies</b>	Student understands the necessity of professional approach to engineering problems solving (K1_K01), he feels responsibility for the systems designed by him (K1_K03), he understands the challenges caused by the rising demand for the spectrum (K1_K04)
<b>Assumptions and objectives of the course:</b> The course objective is to teach a student to understand the wireless networks and to know how to utilize them. Student is able to study and understand standards of the wireless networks. He/she is able to design, analyze or deploy wireless networks.		
<b>Study outcomes and reference to the educational results for a field of study</b>		
<b>Knowledge:</b> 1. Student knows the structure, advantages and disadvantages and the applications of different wireless networks (IEEE 802.11, 802.15, 802.16, UWB, VLC, H2, ...) - [K1_W14]		
<b>Skills:</b> 1. Student is able to design and deploy WiFi network. He/she can compare parameters of the various wireless networks - [K1_U25] 2. Student is able to take part in the standardization processes, he/she understands the necessity of the standardization, he/she understands standards and knows the US and EU standardization institutions. - [K1_U25]		
<b>Social competencies:</b> 1. Student understands the importance of standardization in the field of wireless networks - [K1_K01] 2. Student understands the necessity of professionals cooperation in the standardization process - [K1_K03] 3. Student knows the main challenges concerning the wireless networks - [K1-K04]		
<b>Assessment methods of study outcomes</b>		
Oral examination concerning the subjects covered by the course. Evaluation of reports concerning laboratory experiments		

<b>Course description</b>		
Lectures: WiFi standards (IEEE 802.11). Physical layer, link layer, other layers of WLANs MIMO technique, STBC, MAC protocols Mesh networks (802.11s) WiMAX (IEEE 802.16) Overview of Bluetooth, Zigbee, UWB, VLC, H2.		
<b>Basic bibliography:</b> 1. Selected parts of the wireless network standards available in IEEE e-Library. 2. Papers in scientific journals and available in the internet 3. Handouts concerning studied networks		
<b>Additional bibliography:</b>		
<b>Result of average student's workload</b>		
Activity	Time (working hours)	
1. Lectures	30	
2. Laboratory	30	
3. Student self-studies	20	
4. Preparation for labs and writing the reports	30	
5. Preparation for the exam	20	
<b>Student's workload</b>		
Source of workload	hours	ECTS
Total workload	130	4
Contact hours	60	2
Practical activities	60	2

<b>STUDY MODULE DESCRIPTION FORM</b>		
Name of the module/subject <b>Diploma Seminar</b>		Code
Field of study <b>Electronics and Telecommunications</b>	Profile of study (general academic, practical) <b>general academic</b>	Year /Semester <b>4 / 7</b>
Elective path/specialty <b>Information and Comm. Technologies</b>	Subject offered in: <b>English</b>	Course (compulsory, elective) <b>obligatory</b>
Cycle of study: <b>First-cycle studies</b>	Form of study (full-time, part-time) <b>full-time</b>	
No. of hours Lecture: - Classes: - Laboratory: - Project/seminars: <b>2</b>		No. of credits <b>14</b>
Status of the course in the study program (Basic, major, other) <b>other</b>		(university-wide, from another field) <b>university-wide</b>
Education areas and fields of science and art <b>technical sciences</b> <b>Technical sciences</b>		ECTS distribution (number and %) <b>14 100%</b> <b>14 100%</b>
<b>Responsible for subject / lecturer:</b> prof. dr hab. inż. Maciej Stasiak email: stasiak@et.put.poznan.pl tel. +48 61 665 39 06 Wydział Elektroniki i Telekomunikacji ul. Piotrowo 3A 60-965 Poznań		<b>Responsible for subject / lecturer:</b> prof. dr hab. inż. Maciej Stasiak email: stasiak@et.put.poznan.pl tel. +48 61 665 39 06 Wydział Elektroniki i Telekomunikacji ul. Piotrowo 3A 60-965 Poznań
<b>Prerequisites in terms of knowledge, skills and social competencies:</b>		
1	<b>Knowledge</b>	Knows and understands the technical meaning of the terms describing telecommunication and computer networks. [K1_W22]
2	<b>Skills</b>	Is capable of studying autonomously. [K_U05] 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_U01]
3	<b>Social competencies</b>	Is aware of the limitations of his/her current knowledge and skills; is committed to further self-study.
<b>Assumptions and objectives of the course:</b> Preparation of BSC thesis. Familiarizing students with the methods of presentation of the engineering works.		
<b>Study outcomes and reference to the educational results for a field of study</b>		
<b>Knowledge:</b>		
1. Has a basic, systematic knowledge of structure, operation and standards related to various types of telecommunication and computer networks - [K1_W22]		
2. . Knows about development trends in electronics and telecommunication. - [K1_W24]		
<b>Skills:</b>		
1. . Is able to prepare a well-documented study, in English or in Polish, on problems related to electronics and telecommunication. - [K1_U03]		
2. Is able to prepare an oral presentation on particular issues in electronics and telecommunication (in Polish or in English). - [K1_U04]		
<b>Social competencies:</b>		
1. . Demonstrates responsibility and professionalism in solving technical problems. Is able to participate in collaborative projects. - [K1_K02]		
2. 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. - [K1_K03]		
<b>Assessment methods of study outcomes</b>		

Credit on the basis of the prepared, 20-30 minute presentation.		
<b>Course description</b>		
1. Requirements concerning engineering works 2. Ways of presenting the results of design works 3. Rhetoric of presentation of design works 4. Ways of realization of team-works. 5. Analysis and optimization of the technical problem solution		
<b>Basic bibliography:</b>		
<b>Additional bibliography:</b>		
<b>Result of average student's workload</b>		
<b>Activity</b>	<b>Time (working hours)</b>	
1. Seminars	30	
2. Preparation of BSC thesis	300	
3. Preparation for presentations	20	
<b>Student's workload</b>		
<b>Source of workload</b>	<b>hours</b>	<b>ECTS</b>
Total workload	350	14
Contact hours	60	2
Practical activities	280	12