Semester 5

STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Optotelecommunications	

Field of study	Profile of study (general academic, practical)	Year /Semester
Electronics and Telecommunications	**general academic**	**3 / 5**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Information and Comm. Technologies	**English**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **-** Classes: **-** Laboratory: **2** Project/seminars: **1**	**3**

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	**2 100%**
Technical sciences	**2 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	K_W01 K_W02 K_W05 K_W08
2	**Skills**	K_U01 K_U07 K_U09
3	**Social competencies**	K_K01

Assumptions and objectives of the course:

Lerning of basic principles and techniques underlying the transmission of optical communication and optical signals in optical fiber communication systems.

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

Knowledge:

1. Has a systematic knowledge, together with necessary mathematical background, of light propagation and methods of its description in the fiber. - [K1_W07]

2. Has a wide, systematic knowledge of the properties and characteristics of active and passive components of fiber optic system teletransmission, as well as their classification, selection, analysis and design of opto-electronic circuits. - [K1_W08]

3. Has a systematic knowledge, together with theoretical background, of optoelectronics and opto-telecommunication. - [K1_W21]

Skills:

1. 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]

2. Is able to evaluate the parameters describing digital signals transmission quality in optical communication channels and fiber optic systems. - [K1_U19]

3. Is able to formulate specifications, design and conduct measurements of optoelectronic components parameters. Is able to conduct link analysis, formulate requirements and design an optical fibre link. - [K1_U20]

Social competencies:

1. Demonstrates responsibility and professionalism in solving technical problems. Is able to participate in collaborative projects. - [K1_K02]
2. Is aware of the impact electronics and ICT systems and optical networks will have on the development of the information society. - [K1_K04]

Assessment methods of study outcomes
- Reports from laboratory exercises.
- Tests during project exercises
Course description
Principles of light propagation. Step index, graded index, and single-mode optical fibers, numerical aperture and acceptance angle. Modes in optical waveguides. Mode and chromatic dispersion. Transmission characteristics. Non-linear effects. Methods of measuring attenuation and dispersion. Optical fibre cables, installation principles. Connecting fibres, joints and connectors. Optical sources, light-emitting and laser diodes, principles of operation, parameters. Photodiodes and optical receivers. Basic elements of an optical transmission system. Design principles. The idea of WDM, WDM couplers, optical filters, OTDM. Fibre optic networks.
Basic bibliography:
1. J. Senior, Optical Fiber Communications. Principles and Practice, Prentice Hall, 1992.
2. J.C. Palais, Fiber optic communications, Prentice-Hall, 1998.
3. Govind P. Agrawal, Fiber-Optic Communication Systems, John Wiley & Sons, Inc., 1997
Additional bibliography:
1. R.J. Hoss, Fiber optic communications design handbook, Prentice Hall, 1990 .

Result of average student's workload

Activity	Time (working hours)
1. Laboratory exercises.	30
2. Project exercises	15
3. Consultation	2
4. Preparation for labs and projects	10
5. Exam	3
6. Preparation for the exam	15

Student's workload

Source of workload	hours	ECTS
Total workload	75	3
Contact hours	50	2
Practical activities	70	3

STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Microprocessors	

Field of study	Profile of study (general academic, practical)	Year /Semester
Electronics and Telecommunications	**general academic**	**3 / 5**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Information and Comm. Technologies	**English**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **-** Classes: **-** Laboratory: **3** Project/seminars: **-**	**3**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
major	**university-wide**

Education areas and fields of science and art	ECTS distribution (number and %)
technical science	**3 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student has a well-organized knowledge in microprocessor and microcontroller architectures and mp systems. Student knows basics of MCS 8051/52 assembler and knows programming in C. Student knows architecture and parameters of Intel 8051/52 and ARM Cortex M4/M3 microcontrollers. (K1_W13)
2	**Skills**	Student is able to analyze operation of microprocessor systems. (K1_U24)
3	**Social competencies**	Student understands the necessity to widen his knowledge and skills concerning the applications of microcontrollers to solve the engineering problems.

Assumptions and objectives of the course:

The course objective is to get a student acquainted with Intel 8051/52 and ARM Cortex M4 microcontroller systems and to teach him to utilize the microcontroller systems to solve diverse engineering problems.

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

Knowledge:

Understanding Intel 8051/52 and ARM Cortex M4/M3 systems - [K1_W13]

Skills:

Using Intel 8051/52 and ARM Cortex M4 microcontroller systems to solve diverse engineering problems - [K1_U24]

Social competencies:

Ability to evaluate the usefulness of Intel 8051/52 and ARM Cortex M4/M3 microcontroller systems for engineering problems solution - [K1_01, 03, 04]

Assessment methods of study outcomes

Reports on the laboratory experiments

Course description

In the laboratory students solve engineering problems using Intel 8051/52 and ARM Cortex M4 microcontroller systems.

Basic bibliography:

1. Guide to the mc laboratory experiments - teaching materials available in the laboratory and in the internet
2. Literature concerning Intel 8051/52 and ARM Cortex M4 microcontrollers available in the internet.

Additional bibliography:

Result of average student's workload

Activity	Time (working hours)
1. Laboratory	45
2. Preparation for the laboratory and lab reports	45

Student's workload

Source of workload	hours	ECTS
Total workload	90	3
Contact hours	45	2
Practical activities	45	1

STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Introduction to Multimedia	

Field of study	Profile of study (general academic, practical)	Year /Semester
Electronics and Telecommunications	**general academic**	**3 / 5**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Information and Comm. Technologies	**English**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **2** Classes: **-** Laboratory: **2** Project/seminars: **-**	**5**

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	**5 100%**
Technical sciences	**5 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Has a systematic knowledge, together with necessary mathematical background, of basic digital signal processing methods. K1_W19
2	**Skills**	Is able to determine basic parameters and properties of signals and telecommunication systems, under predefined constraints. K1_U15 Is able to perform typical calculations and use appropriate software to design and analyze the operation of digital signal processing systems. K1_U18
3	**Social competencies**	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 Is aware of the limitations of his/her current knowledge and skills; is committed to further self-study. K1_K01

Assumptions and objectives of the course:

The course covers the state-of-the-art in techniques, methods of analysis and technical solutions in acquisition, processing, transmission, compression and representation of still images, video, and audio.

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

Knowledge:

1. Has a systematic knowledge, together with necessary mathematical background, on image, video and audio representation and perception, quality assessment, processing, compression, transmission and presentation of audio and video in the context of multimedia systems. - [K1_W11]

Skills:

1. Student is able to solve basic problems related to the state-of-the-art in techniques, methods of analysis and technical solutions in acquisition, processing, compression, transmission and presentation of still images, video, and audio. - [K_U16]

Social competencies:

1. Is aware of the limitations of his/her current knowledge and skills; is committed to further self-study. - [K1_K01]
2. 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. - [K1_K04]

Assessment methods of study outcomes
Oral and/or written exam. Laboratory classes are credited on the basis of student activity and tests.
Course description
Lectures: - introduction to multidimensional signals , - fundamentals of image perception, color image and video representation, - basics of image and video quality assessment, - basics of image processing, - fundamentals of still image and video compression and transmission, - fundamentals of audio perception, audio representation - fundamentals of audio processing, compression and transmission. Laboratory classes are based on the lecture subjects.
Basic bibliography:
1. J. Ohm, Multimedia Communication Technology , Springer, 2004. 2. M. Bosi, R.G.Goldberg, Introduction to Digital Audio Coding and Standards, Kluwer, 2003. 3. J.Watkinson , The MPEG Handbook: MPEG-1, MPEG-2, MPEG-4, Focal Press, 2004.
Additional bibliography:
A.K.Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1989. M. Petrou, C. Petrou, Image Processing: The Fundamentals, Wiley, 2010.

Result of average student's workload

Activity	Time (working hours)
1. Participation in the lectures.	30
2. Participation in various practical activities at laboratory classes (including the report)	30
3. Preparation for the exam.	20
4. Preparation laboratory reports	20
5. Literature studies	20
6. Consultations with the teachers	5

Student's workload

Source of workload	hours	ECTS
Total workload	125	5
Contact hours	65	3
Practical activities	60	2

STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Programmable Digital Circuits	

Field of study	Profile of study (general academic, practical)	Year /Semester
Electronics and Telecommunications	**general academic**	**3 / 5**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Information and Comm. Technologies	**English**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **2** Classes: **-** Laboratory: **2** Project/seminars: **-**	**4**

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	**4 100%**
Technical sciences	**4 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	1. Has a basic knowledge of Boolean algebra. 2. Has knowledge in area of programming in C / C + +. 3. Has a general knowledge about combinational and sequential digital circuits. 4. Has a general knowledge in area of binary arithmetic and digital representation of signals.
2	**Skills**	1. Is able to look for information required during design process and take educational courses, if needed, especially through Internet and distance education.
3	**Social competencies**	1. Knows the limitations of their own knowledge and skills; can precisely formulate questions; understands the need for further education and systematic reading of scietnific journals in the field. 2. Can work individually and in team; knows the responsibility for tasked realized in team.

Assumptions and objectives of the course:

The main purpose of the course is to show various design technics for digital systems that can be suitable for FPGA devices. As hardware description language the Verilog will be used. A lot of examples will show how to efficiently use all basic and generic FPGA blocks (like RAM, DSP, etc.).

Laboratory work will be performed with exploiting XILINX FPGA boards.

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

Knowledge:

1. Student has a basic skill in design of simple digital devices.
2. Student has a basic knowledge about the principle of operation of fast communication interfaces.
3. Student has a basic knowledge about designing a state machines.

Skills:

1. Can describe complex digital system as a hierarchy of modules using Verilog language.
2. Can correctly determine the parameters of the interface between the two frequency domains.
3. Can acquire data from the literature and other sources, can integrate the information, make their interpretation, as well as formulate and to justify opinions.

Social competencies:

1. Can see and analyse development of design techniques.
2. Ability of self-learning (textbooks, computer programs).
3. Knowing the responsibility for the electronic and telecommunication systems being designed.

Assessment methods of study outcomes
Individual projects, written or oral exam.
Course description
Introduction to digital programmable devices. FPGA devices (especially XILINX and ALTERA devices). Basic embedded blocks (RAM, PLL, FIFO, etc.) Inter-domain communication (source-synchronous interface). System-onChip (SoC). Communication s interfacesand buses (AMBA, CoreConnect, etc.). Network-on-Chip (NoC). Design and synthesis methods for FPGA devices.

Basic bibliography:

1. Skahill, K., VHDL
2. Węgrzyn M., Barkalov A.,"Design of Control Units with Programmable Logic". Zielona Góra 2006.

Additional bibliography:

1. . Palnitkar S., "Verilog HDL (2nd Edition)", Prentice Hall Professional, 3 mar 2003,

Result of average student's workload

Activity	Time (working hours)
1. Activities that require personal contact with an academic teacher	60
2. Reading literature (manuals, directories)	20
3. Preparation for the lab	10
4. Preparation for the exam	10

Student's workload

Source of workload	hours	ECTS
Total workload	100	4
Contact hours	60	2
Practical activities	40	2

STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Digital Communications	

Field of study	Profile of study (general academic, practical)	Year /Semester
Electronics and Telecommunications	**general academic**	**3 / 5**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Information and Comm. Technologies	**English**	**elective**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **2** Classes: **1** Laboratory: **-** Project/seminars: **-**	**4**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
Major	**university-wide**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**4 100%**
Technical sciences	**4 100%**

Responsible for subject / lecturer:

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ul. Piotrowo 3A 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Has a systematic knowledge of mathematical analysis, algebra and theory of probability [K1_W01] Has a systematic knowledge, together with necessary mathematical background, of 1D signal theory; this knowledge allows him/her to understand the representation of signals and signal analysis in time domain and frequency domain [K1_W06] Knows and understands basic concepts and methods of description of linear and non-linear electronic systems, control systems and telecommunications systems [K1_W10]
2	**Skills**	Is able to use known mathematical analysis, algebra and theory of probability concepts to solve basic problems in electronics and telecommunication [K1_U07] Demonstrates the ability to solve problems related to signal analysis in time domain and frequency domain [K1_U10]
3	**Social competencies**	Is aware of the limitations of his/her current knowledge and skills; is committed to further self-study [K1_K01]

Assumptions and objectives of the course:

To present the fundamentals of digital communication systems which cover baseband signal transmission, digital modulations of a sinusoidal carrier and transmission of digital signals over intersymbol interference channels.

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

Knowledge:

1. Has a knowledge of selection of elementary signals and data symbol formats for baseband signal transmission, structures of optimal synchronous and asynchronous receiver, digital modulation techniques and equalization of transmission channel characteristics. - [K1_W15]
2. Has a knowledge from communication theory of criteria and design of optimal receiver structures for baseband and passband signal transmission and of determining error probability for digital modulations over AWGN channels - [K1_W17]
3. Has an elementary knowledge of applications of presented digital transmission techniques in contemporary and future digital communication systems. - [K1_W24]

Skills:

1. Is able to calculate/determine basic parameters of signals used in baseband and passband transmission and of digital communication systems utilizing these signals. - [K1_U15]
2. Is able to analyze the operation of receivers for digital signals and to design the key blocks of the transmitter and receiver of digital transmission systems. - [K1_U19]

Social competencies:
1. Is able to notice and formulate directions of digital communication systems evolution both in the dimension of fundamental research and system view. - [K1_K04]

Assessment methods of study outcomes
Credit for exercise classes. Written exam of lecture content.

Course description

Lectures:
1. Digital baseband transmission
- Shaping of Elementary Signals
- Selection of the Data Symbol Format
- Optimal Reception of Binary and Multilevel Signals
2. Digital Modulations of the Sinusoidal Carrier
- Optimal Synchronous Receiver
- Optimal Asynchronous Receiver
- ASK Modulation
- FSK Modulation
- PSK Modulation
- Differential Phase Shift Keying (DPSK)
- QAM Modulation
- Constant Envelope Modulations - Continuous Phase Modulation (CPM)
- Trellis Coded Modulation - TCM
- Multitone Modulations - OFDM
3. Digital Transmission on Channels Introducing Intersymbol Interference
- Intersymbol Interference
- Linear Equalizers
- Nonlinear Equalizers

Exercises:
1. PSDs of baseband digital modulation signals
2. Optimal receiver for binary digital baseband transmission
3. Multilevel signals in digital baseband transmission
4. Digital transmission systems with regenerative repeaters
5. Cross-correlation coefficient of digital modulation signals
6. Optimal receiver for signals of digital modulations of the sinusoidal carrier
7. Average power of signals of digital modulations of the sinusoidal carrier
8. Error probability for optimal synchronous receiver with inexact carrier phase estimation
9. Differential encoding of QPSK signals
10. CPM signals
11. Reception of TCM signals
12. Design of an OFDM signal

Basic bibliography:

1. Introduction to Digital Communication Systems, K. Wesołowski, Wiley, Chichester, 2009

Additional bibliography:

1. Communication Systems, 5th Ed., S. Haykin, M. Moher, Wiley, Chichester, 2010
2. Digital Communications, 5th Ed. , J. G. Proakis, M. Salehi, McGraw-Hill, New York, 2007

Result of average student's workload

Activity	**Time (working hours)**

1. Participation in lectures	30
2. Participation in exercise classes	15
3. Solving problems given as a homework during exercise classes and self-reliant preparation to exercise classes	30
4. Presence on the final test of exercise classes	2
5. Preparation to the written exam and presence on the exam	23

Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	100	4
Contact hours	49	2
Practical activities	47	2

STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Digital Modulations	

Field of study	Profile of study (general academic, practical)	Year /Semester
Electronics and Telecommunications	**general academic**	**3 / 5**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Information and Comm. Technologies	**Polish**	**elective**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **2** Classes: **1** Laboratory: **-** Project/seminars: **-**	**4**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
other	**university-wide**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**4 100%**
Technical sciences	**4 100%**

Responsible for subject / lecturer:

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ul. Piotrowo 3A 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Has a systematic knowledge of mathematical analysis, algebra and theory of probability [K1_W01] Has a systematic knowledge, together with necessary mathematical background, of 1D signal theory; this knowledge allows him/her to understand the representation of signals and signal analysis in time domain and frequency domain [K1_W06] Knows and understands basic concepts and methods of description of linear and non-linear electronic systems, control systems and telecommunications systems [K1_W10]
2	**Skills**	Is able to use known mathematical analysis, algebra and theory of probability concepts to solve basic problems in electronics and telecommunication [K1_U07] Demonstrates the ability to solve problems related to signal analysis in time domain and frequency domain [K1_U10]
3	**Social competencies**	Is aware of the limitations of his/her current knowledge and skills; is committed to further self-study [K1_K01]

Assumptions and objectives of the course:

To present the fundamentals of digital modulation techniques which are used in digital communication systems. It covers baseband signal transmission, transmission with the use of a sinusoidal carrier and digital signal transmission over intersymbol interference channels.

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

Knowledge:

1. Has a knowledge of selection of elementary signals and data symbol formats for baseband signal transmission, structures of optimal synchronous and asynchronous receiver, digital modulation techniques and equalization of transmission channel characteristics. - [K1_W15]

2. Has a knowledge from communication theory of criteria and design of optimal receiver structures for baseband and passband signal transmission and of determining error probability for digital modulations over AWGN channels - [K1_W17]

3. Has an elementary knowledge of applications of presented digital transmission techniques in contemporary and future digital communication systems. - [K1_W24]

Skills:

1. Is able to calculate/determine basic parameters of signals used in baseband and passband transmission and of digital communication systems utilizing these signals. - [K1_U15]

2. Is able to analyze the operation of receivers for digital signals and to design the key blocks of the transmitter and receiver of digital transmission systems. - [K1_U19]

Social competencies:
1. Is able to notice and formulate directions of digital communication systems evolution both in the dimension of fundamental research and system view. - [K1_K04]

Assessment methods of study outcomes
Credit for exercise classes. Written exam of lecture content.

Course description

Lectures:
1. Digital baseband transmission
- Shaping of Elementary Signals
- Selection of the Data Symbol Format
- Optimal Reception of Binary and Multilevel Signals
2. Digital Modulations of the Sinusoidal Carrier
- Optimal Synchronous Receiver
- Optimal Asynchronous Receiver
- ASK Modulation
- FSK Modulation
- PSK Modulation
- Differential Phase Shift Keying (DPSK)
- QAM Modulation
- Constant Envelope Modulations - Continuous Phase Modulation (CPM)
- Trellis Coded Modulation - TCM
- Multitone Modulations - OFDM
3. Digital Transmission on Channels Introducing Intersymbol Interference
- Intersymbol Interference
- Linear Equalizers
- Nonlinear Equalizers

Exercises:
1. PSDs of baseband digital modulation signals
2. Optimal receiver for binary digital baseband transmission
3. Multilevel signals in digital baseband transmission
4. Digital transmission systems with regenerative repeaters
5. Cross-correlation coefficient of digital modulation signals
6. Optimal receiver for signals of digital modulations of the sinusoidal carrier
7. Average power of signals of digital modulations of the sinusoidal carrier
8. Error probability for optimal synchronous receiver with inexact carrier phase estimation
9. Differential encoding of QPSK signals
10. CPM signals
11. Reception of TCM signals
12. Design of an OFDM signal

Basic bibliography:

1. Introduction to Digital Communication Systems, K. Wesołowski, Wiley, Chichester, 2009

Additional bibliography:

1. Communication Systems, 5th Ed., S. Haykin, M. Moher, Wiley, Chichester, 2010
2. Digital Communications, 5th Ed. , J. G. Proakis, M. Salehi, McGraw-Hill, New York, 2007

Result of average student's workload

Activity	**Time (working hours)**

1. Participation in lectures 2. Participation in exercise classes 3. Solving problems given as a homework during exercise classes and self-reliant preparation to exercise classes 4. Presence on the final test of exercise classes 5. Preparation to the written exam and presence on the exam	30 15 30 2 23

Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	100	4
Contact hours	49	2
Practical activities	47	2

STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Simulation techniques	

Field of study	Profile of study (general academic, practical)	Year /Semester
Electronics and Telecommunications	**general academic**	**3 / 5**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Information and Communication Technologies	**English**	**obligatory**

Cycle of study:	Form of study (full-time, part-time)
First-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **2** Classes: **-** Laboratory: **-** Project/seminars: **1**	**3**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
other	**university-wide**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**3 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	A basic knowledge in probability, stochastic processes, statistics, telecommunication systems, and programming languages.
2	**Skills**	Can use programming languages such as C, C++, C# or Python.
3	**Social competencies**	A student is aware of his/her limitations and skills, he/she understands necessity of further continuing of education.

Assumptions and objectives of the course:

The course presents the state-of-the-art techniques used in modelling of telecommunications systems and networks. It also overviews freely available simulation tools and libraries, e.g. NS-3 and IT++. For that purpose basic simulation techniques are presented such as event driven simulation and Monte Carlo simulation. The course teaches methods of generation of pseudorandom sequences, methods of their verification and statistical analysis of the data collected during simulation experiments. The course explains how to validate and test the developed simulation tool.

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

Knowledge:

1. A student is familiar with state-of-the-art. techniques used in modelling of telecommunication systems and with freely available simulation tools [K1_W16].

2. Students obtain understanding of basic rules of computer simulation of discrete-event systems. Students know how to design a simulation program using an object-oriented approach. - [K1_W16]

3. A student learns a set of basic techniques applied in computer simulation, such as pseudorandom number generators, simulation time management techniques, and procedures used to estimate required simulation parameters and monitor and record simulation results - [K1_W16]

4. A student gains a knowledge related to techniques used to design and schedule simulation experiments, including validation of simulation models, statistical analysis of simulation results, and variance reduction techniques. - [K1_W16]

Skills:

1. A student is able to select the most appropriate method of modeling of a given aspect of a telecommunication system. – [K1_U13]
2. A student is able to develop a relatively advanced simulation tool using object-oriented programming language such as C++ and Python. [K1_U13]
3. In case of event-driven simulations, a student is able to choose adequate simulation algorithms based on the number of events, mutual interaction between components of a simulated system, and is able to evaluate the resultant complexity of a simulation model. - [K1_U13]
4. A student is able to carry out a validation process of the resultant simulator. - [K1_U13]

Social competencies:

1. Is able to develop a simulation tool in a team. - [K1_K02]

Assessment methods of study outcomes

The assessment is based on projects aimed at developing computer simulation models of a given discrete-event system. The student is obliged to successively provide parts of the final project defined in advance. The final project evaluation consists of three parts: discussion aimed at determining the knowledge of the subject theory and terminology, discussion about developed simulation program and review of the simulation experiment report. The final grade for the course depends on successively provided parts of the final project, the final project evaluation and participation in classes and tutorials.

Course description

Design of a simulation tool, state-of-the-art in wireless communication systems modeling, link level simulations, system level simulations, link-to-system interface, environment modeling, simulation based evaluation of wireless communication systems, discrete-event systems, clock advance mechanisms, the concept of an event, activity scanning, event scheduling, ABC approach, events vs. activities, implementation of event lists, run-time efficiency of event scheduling, process interaction, co-routines, distributed simulation, random number generators, statistical tests of the random number generators, generation of non-uniform distributed variables, design of simulation experiments, validation of simulation models, analysis of variance, collection and analysis of simulation results, estimation of transient and steady-state phase characteristics, independent replication method, method of batch means, regenerative method, variance reduction, examples of simulation models, methodology of computer simulation, unit testing, automatic documentation generation, in source code documentation.

Basic bibliography:

1. M. C. Jeruchim, P. Balaban, and K. S. Shanmugan, Simulation of Communication Systems, Modeling, Methodology, and Techniques, 2nd ed., Kluwer Academic Publishers, New York, 2000
2. J. Tyszer, Object-oriented computer simulation of discrete-event systems, Kluwer Academic Publishers, New York, 1999.
3. W. H. Tranter, K. S. Shanmugan, T. S. Rappaport, and K. L. Kosbar, Principles of Communication Systems Simulation with Wireless Applications, Prentice Hall, Upper Saddle River, NJ, 2004

Additional bibliography:

1. A.M. Law, W. D. Kelton, Simulation modeling and analysis, McGraw Hill, Boston, 2000.
2. 2. F. M. Gardner, and J. D. Baker, Simulation Techniques, Models of Communication Signals and Processes, John Wiley & Sons, New York, 1997
3. J. Banks, J.C. Carson, B.L. Nelson, Discrete-event system simulation, Prentice Hall 1996.
4. K. Watkins, Discrete event simulation in C, McGraw Hill 1993.
5. I. Mitrani, Simulation techniques for discrete event systems, Cambridge University Press 1986.

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures	30
2. Participation in project exercises	15
3. Individual development of the simulation tool	30
4. Literature studies	5
5. Preparation for exam and credits	10

Student's workload

Source of workload	hours	ECTS
Total workload	**90**	3
Contact hours	**45**	2
Practical activities	**45**	1

STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Computer Aided Design	

Field of study	Profile of study (general academic, practical)	Year /Semester
Electronics and Telecommunications	**general academic**	**3 / 5**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Information and Comm. Technologies	**English**	**elective**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **1** Classes: **-** Laboratory: **2** Project/seminars: **-**	**3**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
Other	**university-wide**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**3 100%**
Technical sciences	**3 100%**

Responsible for subject / lecturer:

dr inż. Sławomir Michalak
email: michalak@et.put.poznan.pl
tel. +48 616653824
Faculty of Electronics and Telecommunications
ul. Piotrowo 3A 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Has a basic knowledge of the fundamentals of circuit theory, together with necessary mathematical background; this knowledge allows him/her to understand, analyze and evaluate the operation of electrical circuits. Has a basic knowledge about basic electronic elements and theirs characteristics. Have very basic knowledge about measurements and metrology.
2	**Skills**	Is able to extract information from Polish or English language literature, databases and other sources. Is able to use known mathematical analysis, algebra and theory to solve basic problems in electronics.
3	**Social competencies**	Is aware of the limitations of his knowledge and skills; is committed to further self-study. Is active in solving technical electronics problems. Is able to consulting in group.

Assumptions and objectives of the course:

Computer Aided Design in electronics. SPICE - a general-purpose circuit simulation program for nonlinear DC, nonlinear transient, and linear AC analyses. Models of decices: resistors, capacitors, inductors, independent and dependent voltage and current

sources, switches, the most common semiconductor devices: diodes, BJTs, JFETs,

MESFETs, and MOSFETs.

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

Knowledge:

1. Has a wide, systematic knowledge of the properties and characteristics of electronic components, as well as of construction, analysis and design of electronic circuits. - [K1_W08]

2. Knows the theoretical foundations and principles of design of digital circuits, and of construction of digital electronic elements; knows the theoretical foundations of analysis and design of digital circuits and CAD. - [K1_W12]

Skills:

1. Is able to analyze, design and build digital circuits , using appropriate methods and engineering tools, and taking into consideration predefined criteria. Is able to use models, catalogue cards and application notes of semiconductor electronic elements. Is able to analyze and design circuits and systems using CAD. - [K1_U18]
2. 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. Is able to communicate in English or in Polish in the professional environment and other environments. - [K1_U02]
4. Is capable of studying autonomously. - [K1_U05]
Social competencies:
1. 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]
2. Is aware of the limitations of his/her current knowledge and skills; is committed to further self-study. - [K1_K01]

Assessment methods of study outcomes
1. Projects
2. Reports from laboratory execercises
3. Activity durning labs
Course description
- Basic analyses: DC, AC, Transient and FFT analysies.
- Parametric analysis.
- Temperature analysis.
- Worst Case and Monte Carlo analysis.
- Noise analysis.
- Models of basic electronic passive devices (resistor, capacitor, inductor) used in CAD programs.
- Models of active elements (diode, Zener diode, bipolar transistor, unipolar transistor).
- Models of voltage and current sources (DC, AC, SIN, PULSE, EXP)
- Models and macro-models of OpAmp.
- Models of devices used in SPICE and APLAC.
Basic bibliography:
1. Joseph G. Tront, PSpice for Basic Circuit Analysis, 2nd ed., McGraw-Hill, 2005.
2. Dennis Fitzpatric, Analog Design and Simulation using OrCAD Capture and PSpice, Newnes, 2007.
3. Muhammad H. Rashid, SPICE for Circuits and Electronics Using PSPICE, 2nd ed., Prentice Hall, 1995.
Additional bibliography:
1. K. Mitzner, Complete PCB Design Using OrCAD Capture and PCB Editor Newnes, 2009.
2. P. Wilson, The Circuit Designer's Companion, Third Edition, Newnes, 2008.
3. G. W. Roberts, A. S. Sedra, SPICE, 2nd ed., Oxford Univ. Press, 1997.
4. S. Michalak, Symulacja układów elektronicznych w środowisku APLAC, Wydawnictwo PP, Poznań, 2005. (in polish)

Result of average student's workload

Activity	Time (working hours)
1. Lectures	15
2. Labs	30
3. Preparing the lab reports	20
4. Preparation to the test and participation in it	20

Student's workload

Source of workload	hours	ECTS
Total workload	85	3
Contact hours	50	2
Practical activities	50	2

STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Computer analysis of electronic circuits	

Field of study	Profile of study (general academic, practical)	Year /Semester
Electronics and Telecommunications	**general academic**	**3 / 5**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Information and Comm. Technologies	**English**	**elective**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **1** Classes: **-** Laboratory: **2** Project/seminars: **-**	**3**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
Other	**university-wide**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**3 100%**
Technical sciences	**3 100%**

Responsible for subject / lecturer:

dr inż. Sławomir Michalak
email: michalak@et.put.poznan.pl
tel. +48 616653824
Faculty of Electronics and Telecommunications
ul. Piotrowo 3A 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Has a basic knowledge of the fundamentals of circuit theory, together with necessary mathematical background; this knowledge allows him/her to understand, analyze and evaluate the operation of electrical circuits. Has a basic knowledge about basic electronic elements and theirs characteristics. Have very basic knowledge about measurements and metrology.
2	**Skills**	Is able to extract information from Polish or English language literature, databases and other sources. Is able to use known mathematical analysis, algebra and theory to solve basic problems in electronics.
3	**Social competencies**	Is aware of the limitations of his knowledge and skills; is committed to further self-study. Is active in solving technical electronics problems. Is able to consulting in group.

Assumptions and objectives of the course:

Electronic Computer Aided Design (ECAD, use of computer systems to assist in the creation, modification, analysis, or optimization of a electronic design. Use of SPICE for creation and simulation own projects. Models of passive and active electronic devices. Analog and digital simulations. DC, ac, Trans simulationc. Advanced simulations FTT, noise, parametric, Worst Case and Monte Carlo.

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

Knowledge:

1. Has a wide, systematic knowledge of the properties and characteristics of electronic components, as well as of construction, analysis and design of electronic circuits. - [K1_W08]
2. Knows the theoretical foundations and principles of design of digital circuits, and of construction of digital electronic elements; knows the theoretical foundations of analysis and design of digital circuits and CAD. - [K1_W12]

Skills:

1. Is able to analyze, design and build digital circuits , using appropriate methods and engineering tools, and taking into consideration predefined criteria. Is able to use models, catalogue cards and application notes of semiconductor electronic elements. Is able to analyze and design circuits and systems using CAD. - [K1_U18]
2. 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. Is able to communicate in English or in Polish in the professional environment and other environments. - [K1_U02]
4. Is capable of studying autonomously. - [K1_U05]

Social competencies:

1. 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]
2. Is aware of the limitations of his/her current knowledge and skills; is committed to further self-study. - [K1_K01]

Assessment methods of study outcomes
1. Projects
2. Reports from laboratory execercises
3. Activity durning labs

Course description
- Models of basic electronic passive devices (resistor, capacitor, inductor) used in CAD programms.
- Models of active elements (dioda, Zener dioda, bipolar transitor, unipolar transistor).
- Models of voltage and current sources (DC, AC, SIN, PULSE, EXP)
- Models i macromodels OpAmp.
- Models of devices used in SPICE and APLAC.
- DC analyse.
- AC analyse.
- Transient and FFT analysies.
- Parametric analysie.
- Temperature analysie.
- Worst Case and Monte Carlo analysies.
- Noise analysie.

Basic bibliography:

1. Joseph G. Tront, PSpice for Basic Circuit Analysis, 2nd ed., McGraw-Hill, 2005.
2. Dennis Fitzpatric, Analog Design and Simulation using OrCAD Capture and PSpice, Newnes, 2007.
3. Muhammad H. Rashid, SPICE for Circuits and Electronics Using PSPICE, 2nd ed., Prentice Hall, 1995.

Additional bibliography:

1. Kraig Mitzner, Complete PCB Design Using OrCAD Capture and PCB Editor Newnes, 2009.
2. Peter Wilson, The Circuit Designer's Companion, Third Edition, Newnes, 2008.
3. G.W.Roberts, A.S.Sedra, SPICE, 2nd ed., Oxford Univ. Press, 1997.
4. Michalak S., Symulacja układów elektronicznych w środowisku APLAC, Wydawnictwo PP, Poznań, 2005. (in polish)

Result of average student's workload

Activity	Time (working hours)
1. Lectures	15
2. Laboratory	30
3. Writing the lab reports	20
4. Preparation and participation in the final test	20

Student's workload

Source of workload	hours	ECTS
Total workload	85	3
Contact hours	50	2
Practical activities	50	2

STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Java programming		
Field of study **Electronics and Telecommunications**	Profile of study (general academic, practical) **general academic**	Year /Semester **3 / 5**
Elective path/specialty **Information and Comm. Technologies**	Subject offered in: **English**	Course (compulsory, elective) **elective**
Cycle of study: **First-cycle studies**	Form of study (full-time,part-time) **full-time**	
No. of hours Lecture: **2** Classes: **-** Laboratory: **2** Project/seminars: **-**		No. of credits **5**
Status of the course in the study program (Basic, major, other) **major**	(university-wide, from another field) **from field**	
Education areas and fields of science and art **technical sciences** **Technical sciences**		ECTS distribution (number and %) **5 100%** **5 100%**

Responsible for subject / lecturer:

dr inż. Mariusz Żal
email: mariusz.zal@put.poznan.pl
tel. +48 61 665 3926
Wydział Elektroniki i Telekomunikacji
ul. Piotrowo 3A 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Has a basic knowledge of computer networks; Has a basic knowledge of C++ programming
2	**Skills**	Is able to find information in literature, as well as other reference sources; is able to integrate and interpret obtained information, draws conclusions and justifies
3	**Social competencies**	Student understands a necessity to acquire a new knowledge and skills stemming from a chosen field of studies.

Assumptions and objectives of the course:

To provide students with theoretical and practical knowledge about information exchanging in computer networks, network socket programing in Java; To prepare students to programming application for network, transport and application layer protocols and database application.

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

Knowledge:

1. Knows the principles of construction of computer programs; has knowledge from the area of computing science; knows the syntax of Java for PC and mobile devices - [K1_W09]
2. Has a systematich knoledge of computer architectures. Knows mobile device configruation profiles and programming techniques. - [K1_W13]
3. Has a basic knowledge of network device architectures, standards, network protocols and construction. Knows network layer, transport layer and application layer protocols - [K1_W22]

Skills:

1. Is able to find information in literature, as well as other reference sources - [K1_U01]
2. Is able to use future SQL extensions and normal form for solving data base optimization problem - [K1_U05]
3. Is able to determine the best of network device configuration according to given specification - [K1_U23]
4. Is able to configure network device in local area network - [K1_U27]

Social competencies:

1. Demonstrates responsibility for designed software. Is aware of the hazards they pose for individuals and communities if they are improperly designed - [K1_K03]
2. A student is able to formulate opinions concerning challenges of contemporary networks application programming; A student is aware of the impact of network application on the information society - [K1_K04]

Assessment methods of study outcomes

Forming assessment:

Lectures: Written exam; exam is passed when student receives at least 50% points. Exam can be taken after the completion of excercises.

Exercices and laboratories:

- evaluation and assessment of knowledge increment that need to be effective in solving problems covering all tasks within a given subject area;

- continuous assessment during daily classroom practice - rewarding knowledge increment in skills in management of using rules and methods learnt in class.

Course description

Lectures:

1. Network application architectures at 3 and 4 OSI RM layer
2. Network sockets and transport layer addresses
3. Synchronous and asynchronous application. Multithread application
4. Transport layer application - FTP and TFTP.
5. Fundamentals of Java part 1
6. Fundamentals of Java part 2
7. Fundamentals of Java part 3
8. Fundamentals of Java part 4
9. Applets - part 1.
10. Servlets- part 1.
11. Mobile device programming - device configuration profiles.
12. Mobile device programming midlets
13. Application layer protocol programming ? part
14. Application layer protocol programming ? part 1
15. Database application

Labs:

1. Fundamentals of Java part 1
2. Fundamentals of Java part 2.
3. Simple network application.
4. Database clients
5. Application layer - http protocol,
6. FTP and TFTP clients
7. Simple servlets.
8. Applets

Basic bibliography:

1. Anthony Potts, David H. Friedel Jr, Java programming language handbook, Coriolis Group Inc. 1996
2. Cay S. Horstmann, Gary Cornell,Core Java Volume I--Fundamentals, Prentice Hall; 9 edition (December 7, 2012)

Additional bibliography:

1. Jason Price, Oracle Database 11gSQL, McGrawHill 2008
2. Elizabeth Sugar Boese Java Applets: Interactive Programming, Lulu.com, 2007
3. Crawford, William and Hunter, Jason Java Servlet Programming (Java Series) O'Reilly Media; 2 edition (April 26, 2010)

Result of average student's workload

Activity	Time (working hours)
1. Lectures	30
2. Laboratories	30
3. Preparation for laboratories	30
5. Preparation for test	30
6. Consultation	5

Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	125	5
Contact hours	60	2
Practical activities	60	3

STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
C# programming	

Field of study	Profile of study (general academic, practical)	Year /Semester
Electronics and Telecommunications	**general academic**	**4 / 7**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Information and Comm. Technologies	**English**	**elective**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **30** Classes: **-** Laboratory: **30** Project/seminars: **-**	**5**

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	**5 100%**
Technical sciences	**5 100%**

Responsible for subject / lecturer:

dr inż. Mariusz Żal
email: mariusz.zal@put.poznan.pl
tel. +48 61 665 3926
Wydział Elektroniki i Telekomunikacji
ul. Piotrowo 3A 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Has a basic knowledge of computer networks; Has a basic knowledge of C# programming
2	**Skills**	Is able to find information in literature, as well as other reference sources; is able to integrate and interpret obtained information, draws conclusions and justifies
3	**Social competencies**	Student understands a necessity to acquire a new knowledge and skills stemming from a chosen field of studies.

Assumptions and objectives of the course:

To provide students with theoretical and practical knowledge about information exchanging in computer networks, network socket programing in C #; To prepare students to programming application for network, transport and application layer protocols and database application.

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

Knowledge:

1. Knows the principles of construction of computer programs; has knowledge from the area of computing science; knows the syntax of C# for PC and mobile devices - [K1_W09]
2. Has a systematich knoledge of computer architectures. Knows mobile device configruation profiles and programming techniques. - [K1_W13]
3. Has a basic knowledge of network device architectures, standards, network protocols and construction. Knows network layer, transport layer and application layer protocols - [K1_W22]

Skills:

1. Is able to find information in literature, as well as other reference sources - [K1_U01]
2. Is able to use future SQL extensions and normal form for solving data base optimization problem - [K1_U05]
3. Is able to determine the best of network device configuration according to given specification - [K1_U23]
4. Is able to configure network device in local area network - [K1_U27]

Social competencies:

1. Demonstrates responsibility for designed software. Is aware of the hazards they pose for individuals and communities if they are improperly designed - [K1_K03]
2. A student is able to formulate opinions concerning challenges of contemporary networks application programming; A student is aware of the impact of network application on the information society - [K1_K04]

Assessment methods of study outcomes

Forming assessment:

Lectures: Written exam; exam is passed when student receives at least 50% points. Exam can be taken after the completion of excercises.

Exercices and laboratories:

- evaluation and assessment of knowledge increment that need to be effective in solving problems covering all tasks within a given subject area;

- continuous assessment during daily classroom practice - rewarding knowledge increment in skills in management of using rules and methods learnt in class.

Course description

Lectures:

1. Network application architectures at 3 and 4 OSI RM layer
2. Network sockets and transport layer addresses
3. Synchronous and asynchronous application.
4. Multithread application
5. Transport layer application - FTP and TFTP.
6. Web service programming.part 1
7. Web service programing. part 2
8. Mobile device programming - device configuration profiles.
9. Mobile device programming - database problems.
10. Application layer protocol programming part 1
11. Application layer protocol programming part 2
12. Database application part 1
13. Database application part 2
14. Database source and windows form controls binding
15. Multicast applications

Labs:

1. Simple, synchronous network application.
2. Nonblocking, asynchronous applications
3. Multtithread network applications
4. Database clients
5. Application layer - http protocol,
6. FTP and TFTP clients

Basic bibliography:

1. 1. Richard Blum, C# Network Programming, Sybex 2003

Additional bibliography:

1. 2. Stephen C. Perry, Core C# and .NET: The Complete and Comprehensive Developer's Guide to C# 2.0 and .NET 2.0 Prentice Hall (September 16, 2005)
2. 3. Jason Price, Oracle Database 11gSQL, McGrawHill 2008

Result of average student's workload

Activity	Time (working hours)
1. Lectures	30
2. Laboratories	30
3. Preparation for laboratories	30
4. Preparation for test	30
5. Consultation	5

Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	125	5
Contact hours	60	3
Practical activities	60	2