# Semester 3

# STUDY MODULE DESCRIPTION FORM

| Name of the module/subject | Code |
|---|---|
| **Electromagnetic Waves** | |

| Field of study | Profile of study (general academic, practical) | Year /Semester |
|---|---|---|
| **Electronics and Telecommunications** | **general academic** | **2 / 3** |
| 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%** |

## Responsible for subject / lecturer:

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## Prerequisites in terms of knowledge, skills and social competencies:

| | | |
|---|---|---|
| 1 | **Knowledge** | K1_W01<br>K1_W02<br>K1_W05<br>K1_W08 |
| 2 | **Skills** | K1_U01<br>K1_U07<br>K1_U09 |
| 3 | **Social competencies** | K1_K01 |

## Assumptions and objectives of the course:

Learning of basic electromagnetic phenomena, transmission lines, antenna parameters, the most popular and used antenna types (construction, principle of operation, parameters) for radio communication systems, design of simple antennas, measurements of antennas and feeders, and wave propagation in the Earth's atmosphere.

## 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 the theory of EM field, EM waves propagation, and of construction and properties of antennas. . - [K1_W07]
2. Has a systematic knowledge, together with necessary mathematical background, of the fundamentals of metrology, which is necessary to measure the signal properties and the parameters of electronic and telecommunication systems components. Has knowledge of measurement methods, measurement equipment and computerized measurement systems for antenna and feeder measurements). - [K1_W18]
3. Knows about antenna development trends in electronics and telecommunication. - [K1_W24]
4. Knows occupational health and safety principles. - [K1_W25 ]

### Skills:

1. Is able to extract information from English language literature, databases and other sources. Is able to synthesize gathered information, draw conclusions, and justify opinions. - [K1_U01]
2. Is capable of studying autonomously. - [K1_U05]
3. Is able to solve typical problems in EM field analysis, EM wave propagation, and design and realizations of antennas. - [K1_U11]
4. Is able to use catalogues, find required information from application notes of semiconductor elements and electronic circuits, select appropriate elements and electronic circuits. - [K1_U12]
5. Is able to measure typical parameters of signals, systems and devices, in particular those used in telecommunication. Is able to choose appropriate methods to measure given electrical quantities and parameters of signals and devices. Is able to plan and perform measurements and analyze the results. - [K1_U17]
6. Is able to select the construction of devices according to technical requirements and service conditions. - [K1_U21]
7. Can implement the occupational health and safety principles. - [K1_U27 ]

**Social competencies:**

1. Is aware of the limitations of his/her current knowledge and skills; is committed to further self-study. - [K1_K01]
2. Demonstrates responsibility and professionalism in solving technical problems. Is able to participate in collaborative projects. - [K1_K02]
3. 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]

## Assessment methods of study outcomes

1. Final written exam (theory and solutions of simple problems)
2. Reports from laboratory exercises
3. Tests during laboratory exercises

## Course description

1. Basics of electrostatics and magnetostatics
2. Maxwell's equations
3. Plane wave, wave equation, wave velocity, polarization, and skin effect
4. E and H fields on media boundary
5. Standing wave, VSWR, RL
6. Transmission lines – basic types, parameters, characteristic impedance, input impedance of a loaded transmission line, Smith chart
7. Antenna in a radio link
8. Basic antenna parameters
9. Simple antennas – short dipole, halfwave dipole
10. Wire antennas, monopoles
11. Broadband, aperture, reflector, and microstrip antennas
12. Antenna installation and maintenance
13. Simple antennas – short dipole, halfwave dipole
14. Environmental and occupational EM safety standards
15. Measurements of VSWR/RL, DTF function, measurements of antenna parameters
16. Basic propagation formulas (free space, Fresnel zones)
17. Propagation of long, medium, short, VHF/UHF waves and microwaves

## Basic bibliography:

1. D.Pozar, Microwave Engineering, Addison-Wesley Publishing Comp., New York 2005 (chapters 1, 2, 13.5, and 13.6).
2. W. Stutzman, G. Thiele, Antenna Theory and Design, John Wiley & Sons, 2001.
3. M. Hall et al. (ed.), Propagation of Radiowaves, The Institute of Electrical Engineers, London 1996 (chapter 1).

## Additional bibliography:

1. S. Ramo, J. Whinnery, T. van Duzer, Fields and Waves in Communication Electronics, John Wiley & Sons, 1994.
2. P. Young, Electronic Communication Techniques, Pearson Prentice Hall, 2004 (chapters 14 and 15).
3. J.D. Kraus, Antennas, McGraw – Hill Book Company, 1988.
4. A. Balanis, Antenna Theory and Design, John Wiley & Sons, 2006.
5. J. Carr, G. Hippisley, Practical Antenna Handbook, McGraw-Hill, 2011.
6. The ARRL Antenna Handbook, The American Radio Relay League (www.arrl.org)

| Result of average student's workload | |
|---|---|
| **Activity** | **Time (working hours)** |
| 1. Lecture | 30 |
| 2. Laboratory exercises | 30 |
| 3. Preparation for labs | 10 |
| 4. Preparation of lab reports | 20 |
| 5. Consulting | 2 |
| 6. Preparation for the exam and the exam | 23 |

| Student's workload | | |
|---|---|---|
| **Source of workload** | **hours** | **ECTS** |
| Total workload | 115 | 4 |
| Contact hours | 65 | 3 |
| Practical activities | 60 | 2 |

# STUDY MODULE DESCRIPTION FORM

| Name of the module/subject | Code |
|---|---|
| **Semiconductor Devices and Analog Electronics** | |

| Field of study | Profile of study (general academic, practical) | Year /Semester |
|---|---|---|
| **Electronics and Telecommunications** | **general academic** | **2 / 3** |
| 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: **0** Laboratory: **3** 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 of mathematical analysis, algebra and theory of probability. [K1_W01]<br>Has a detailed, systematic 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.[K1_W05] |
| 2 | **Skills** | Is able to extract information from English language literature, databases and other sources. Is able to synthesize gathered information, draw conclusions, and justify opinions. [K1_U01] |
| 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:

Familiarizing the students with the basic electronic components, principles of their operations and possible applications in electronic circuits. Demostrating the basic calculations required in basic electronic circuit design. Providing the basic knowledge of electronic design.

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

### Knowledge:

1. Has the basic knowledge about electonic components, their properties and basic characteristics. Is familiar with basic semiconductor components. Has the knowledge about electronic devices applications. Is familiar with the most basic typical circuits. - [K1_W08]

2. Knows history and contemporary developments in application and production of electronic components. - [K1_W24]

### Skills:

1. Is able to search for required information about electronic components, select the components for basic applications, design and implement a basic circuit - [K1_U01]

2. Is able to find information about new electronic components and their applications - [K1_U05]

3. Is able to select appropriate components for a given application, is able to use the documentation of electronic components. - [K1_U12]

### Social competencies:

1. Is aware of fast development of electronics and understands the necessity of constant development of the knowledge - [K1_K01]

2. Is able to cooperate in the implementation of more complex objectives. - [K1_K02]

| **Assessment methods of study outcomes** |
|---|
| laboratory exercises: reports and activity during exercises<br>Final written exam. |
| **Course description** |
| Lectures:<br>diodes and their applications<br>bipolar transistor<br>JFET transistor<br>MOSFET transistor<br>silicon controlled rectifier<br>ideal operational amplifier<br>power supplies<br>oscillators<br><br>laboratory exercises:<br>diode circuits<br>bipolar transistor circuits<br>field effect transistor circuits<br>ideal operational amplifier in linear circuits<br>ideal operational amplifier in nonlinear circuits |
| **Basic bibliography:**<br>1. Thomas L. Floyd , „Electronic Devices (Conventional Current Version)", Pearson<br>2. Paul Horowitz, Winfield Hill, „The Art of Electronics", Cambridge University Press |
| **Additional bibliography:**<br>1. Adel S. Sedra, Kenneth C. Smith, „Microelectronic Circuits", Oxford University Press |

**Result of average student's workload**

| Activity | Time (working hours) |
|---|---|
| 1. Attendance at lectures | 30 |
| 2. Attendance at laboratory exercises | 45 |
| 3. preparation for labs | 15 |
| 6. homeworks, reading,self study | 15 |
| 7. exam preparation | 15 |
| 8. consultations | 3 |
| 9. exam | 2 |

**Student's workload**

| Source of workload | hours | ECTS |
|---|---|---|
| Total workload | 125 | 5 |
| Contact hours | 80 | 3 |
| Practical activities | 63 | 3 |

# STUDY MODULE DESCRIPTION FORM

| Name of the module/subject | Code |
|---|---|
| **Digital systems design** | |

| Field of study | Profile of study (general academic, practical) | Year /Semester |
|---|---|---|
| **Electronics and Telecommunications** | **general academic** | **2 / 3** |
| 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: **2** Laboratory: **-** Project/seminars: **-** | **5** |

| 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** | **5 100%** |

## Responsible for subject / lecturer:

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## Prerequisites in terms of knowledge, skills and social competencies:

| | | |
|---|---|---|
| 1 | **Knowledge** | Fundamentals of Boolean algebra, an ability to analyze and design simple electrical circuits and devices. |
| 2 | **Skills** | Can acquire knowledge from the technical literature in English and can apply that knowledge in various areas, interpret facts, and draw conclusions. |
| 3 | **Social competencies** | A student understands necessity of further and continuing education, he or she is aware of his/her skills. |

## Assumptions and objectives of the course:

The course aim is to provide students with the principles of digital circuit design, including both theoretical paradigms and a practical guide. The presentation starts from Boolean algebra principles and then moves on synthesis of both combinational logic and finite state machines. At the right time, several integrated circuits, like multiplexers, arithmetic logic units, registers, counters, etc., are introduced. Afterwards, hardware description languages along with their application for VLSI devices are demonstrated. The presentation finishes with a glimpse into circuit fault issues.

Throughout the course students are exposed to modern technologies, and are motivated to develop their logical thinking skills by designing digital circuits in an effective way.

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

### Knowledge:

1. A student knows how to describe the function of logic circuits, understands various data representation, and knows how to implement arithmetic operations on hardware, including both fixed and floating-point addition, subtraction, multiplication and division. - [K1_W12]

2. A student knows several building blocks (like multiplexers, demultiplexers, registers, counters, arithmetic-logic unit) used in digital circuits design; he/she is familiar with complex digital systems, such as one- and two-dimensional combinational iterative devices and finite state machines (synchronous and asynchronous) working in accordance with the Mealy and Moore paradigms. - [K1_W12]

3. A student has a preliminary knowledge regarding fault sources and detection procedure in digital VLSI designs and is familiar with the methods used to design reliable and easy to test digital circuits and systems. - [K1_W12]

| **Skills:** |
|---|
| 1. A student can minimize a combinational digital circuit, represented either as a two-level Boolean expression or a multi-level and multi-output circuit in order to reduce hardware complexity, its power consumption (toggling level), heat dissipation, and latency. - [K1_U16] |
| 2. A student can design and assemble both synchronous and clock-less finite state machines (including state minimization, state coding, flip-flop-based implementation, and safety analysis). - [K1_U16] |
| 3. A student can use fault models and find proper test vectors to detect given faults - [K1_U16] |
| **Social competencies:** |
| 1. Appreciate the practical significance of the systems developed in the course. - [K1_K01] |

| **Assessment methods of study outcomes** |
|---|
| Tests and written exam |
| **Course description** |
| positional numeral system, binary numbers, coded number systems, Boolean algebra, gate-level circuits, two-level design, logic minimization, multiplexing and demultiplexing devices, arithmetic circuits, iterative designs, combinational logic blocks, programmable logic devices, hardware description languages, sequential logic, latches and flip-flops, registers and counters, design of sequential circuits according to Mealy and More models, finite-state machines, asynchronous circuits, algorithmic state machines, device faults, test generation for combinational circuits, design for testability, built-in self-test. |
| **Basic bibliography:** |
| 1. R. J. Tocci, N. Widmer, G. Moss, *Digital systems – Principles and applications,* 11th edition, Pearson Education Ltd., 2014 |
| 4. J.P. Hayes, *Digital logic design*, Addison-Wesley 1994. |
| 5. P.K. Lala, *Practical digital logic design and testing*, Prentice Hall 1996. |
| **Additional bibliography:** |
| 1. M. Zwoliński, *Digital system design with VHDL*, 2nd Edition, Pearson Education Ltd., 2004 |

**Result of average student's workload**

| **Activity** | **Time (working hours)** |
|---|---|
| **Attending lecture and exercises** | **60** |
| **Consultation** | **15** |
| **Preparation for tests the students take when participating in classes** | **25** |
| **Doing homework** | **25** |

**Student's workload**

| **Source of workload** | **hours** | **ECTS** |
|---|---|---|
| Total workload | 125 | 5 |
| Contact hours | 75 | 3 |
| Practical activities | 30 | 1 |

# STUDY MODULE DESCRIPTION FORM

| Name of the module/subject | Code |
|---|---|
| **System Theory** | |

| Field of study | Profile of study (general academic, practical) | Year /Semester |
|---|---|---|
| **Electronics and Telecommunications** | **general academic** | **2 / 3** |
| 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: **0** Laboratory: **2** Project/seminars: **-** | **5** |

| 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** | **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 of mathematical analysis, algebra and theory of probability. [K1_W01]<br>Has a basic, systematic knowledge of physics. [K1_W02]<br>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] |
| 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] |
| 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:

The aim of the course is to present the theory of continuous linear systems, and a description of these systems in the domain of Fourier transform, Laplace transform, and the state space. There are presented issues that are related to systems stability and minimal phase systems (according to selected criteria), as well as issues of automatic control systems. The student becomes familiar with issue of the design of digital filters and their synthesis. There are presented aspects of nonlinear systems and their stability, the base of deterministic chaos and artificial neural networks.

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

### Knowledge:

1. Has a detailed, systematic knowledge of the linear systems description in the domain of transforms (Fourier, Laplace) and in the state space. Has knowledge in systems stability and minimal phase, according to selected criteria. - [K1_W05]
2. Has basic knowledge in systhematic regulation systems and descrete systems. - [K1_W10]
3. Has knowledge in designing and synthesizing digital filters with the use of known methods. - [K1_W08]
4. Has basic knowledge on nonlinear systems, their stability, knows the theory and issues connected with artificial neural networks. - [K1_W10]

### Skills:

1. A student can describe a physical system in a state space - [K1_U01 K1_U07]
2. A student can describe, basing on a defined problem, the digital filter parameters, design such a filter and synthesize it. - [K1_U01 K1_U18]
3. At basic level a student can design and teach an artificial neural network to solve a technical problem. - [-]

### Social competencies:

| |
|---|
| 1. A student is open and understands the need of constant learning and improving her/his professional qualifications. - [K1_K01] |

| **Assessment methods of study outcomes** |
|---|
| 1. Written or oral exam in the lectures subjects<br>2. Various knowledge tests at the laboratory classes and a test veryfying the knowledge from exercises. |

**Course description**

Lectures:

1. The base of continuous linear systems
2. The state space technique
3. Systems stability, minimal phase systems
4. Signal flow graphs
5. Automatic control systems
6. Discrete systems
7. Introduction to digital filter design
8. Approximation of frequency-domain characteristics
9. Approximation of frequency-domain characteristics
10. Filter synthesis
11. Filter synthesis
12. Nonlinear systems
13. Stability of nonlinear systems, oscillations generation
14. Deterministic chaos
15. Artificial neural networks

Exercise:

1. Frequency characteristics of linear systems
2. Analysis of a second order system
3. Stability, minimal phase systems
4. State space technique
5. Signal flow graphs
6. Transmittance of a system and the state space technique.
7. Approximation of frequency-domain characteristics

Laboratories:

1. Introduction
2. Matlab software
3. Fourier series

**Basic bibliography:**

1. A. V. Oppenheim, A. S. Willsky, S. Hamid, Signals and systems (2nd Edition), 1996.

**Additional bibliography:**

1. Chi-Tsong Chen, Signals and Systems, 2004.

**Result of average student's workload**

| Activity | Time (working hours) |
|---|---|
| 1. Activities requiring a direct contact with the lecturer (lectures, classes) | 60 |
| 2. Preparation for the classes and laboratories | 20 |
| 3. Literature study | 25 |
| 4. Preparations for the exam and tests | 20 |
| 5. Participation in the exam | 2 |
| 6. Consulations | 3 |

| **Student's workload** | | |
|---|---|---|
| **Source of workload** | **hours** | **ECTS** |
| Total workload | 130 | 5 |
| Contact hours | 65 | 3 |
| Practical activities | 65 | 2 |

# STUDY MODULE DESCRIPTION FORM

| | | |
|---|---|---|
| Name of the module/subject<br>**Probabilistic methods in electronics and telecommunications** | | Code |
| Field of study<br>**Information and Comm. Technologies** | Profile of study (general academic, practical)<br>**general academic** | Year /Semester<br>**2 / 3** |
| Elective path/specialty<br>**Technologies** | Subject offered in:<br>**English** | Course (compulsory, elective)<br>**obligatory** |
| Cycle of study:<br>**First-cycle studies** | Form of study (full-time,part-time)<br>**full-time** | |
| No. of hours<br>Lecture: **2** Classes: **1** Laboratory: **-** Project/seminars: | | No. of credits<br>**3** |
| Status of the course in the study program (Basic, major, other)<br>**basic** | (university-wide, from another field)<br>**university-wide** | |
| Education areas and fields of science and art<br>**technical sciences**<br>**Technical sciences** | | ECTS distribution (number and %)<br>**3 100%**<br>**3 100%** |

**Responsible for subject / lecturer:**

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**Prerequisites in terms of knowledge, skills and social competencies:**

| | | |
|---|---|---|
| 1 | **Knowledge** | Has a basic knowledge of mathematics on a secondary school level. |
| 2 | **Skills** | Is able to extract information from English language literature, databases and other sources. [K1_U01] |
| 3 | **Social competencies** | Is committed to further self-study. [K1_K01] |

**Assumptions and objectives of the course:**

Familiarizing the students with the fundamentals of probability and probabilistic methods used in engineering practice of E&T.

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

**Knowledge:**

1. Has a systematic knowledge of theory of probability. [K1_W01]

**Skills:**

1. Is able to use theory of probability concepts to solve basic problems in electronics and telecommunication. [K1_U07]
2. Is capable of studying autonomously. [K1_U05]

**Social competencies:**

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**

Written exercises credit.
Final written exam.

**Course description**

1. Combinatorial analysis.
2. Basic notions and rules of probability theory.
3. Properties of random variables.
4. Discrete and continuous distributions important in E&T engineering.
5. Sampling and estimation problems.
6. Statistical inference.
7. Bernoulli-Poisson random processes.
8. Markov processes.
9. Selected continuous-time stochastic processes.
10. Basics of simulation methods.

**Basic bibliography:**

1. S. Ross, A First Course in Probability, Prentice Hall, New Jersey, 2010
2. T.T. Soong, Fundamentals of Probability and Statistics for Engineers, John Wiley and Sons, Ltd, 2004.
3. Yates, R. D. and Goodman, D. J.; "Probability and Stochastic Processes: A Friendly Introduction For Electrical and Computer Engineers," Second Edition, Willey Publishers 2005.

**Additional bibliography:**

1. J. Walrand, Lecture Notes on Probability Theory and Random Processes, Departament of Electrical Engineering and Computer Sciences, University of California, Berkeley, 2004.
2. A. Papoulis, Probability, Random Variables and Stochastic Processes, McGraw-Hill, Inc., 1991.

**Result of average student's workload**

| Activity | Time (working hours) |
|---|---|
| 1. Lectures | 30 |
| 2. Exercises | 15 |
| 3. Preparation for the exercises | 15 |
| 4. Preparation for the exam | 20 |

**Student's workload**

| Source of workload | hours | ECTS |
|---|---|---|
| Total workload | 80 | 3 |
| Contact hours | 45 | 2 |
| Practical activities | 30 | 1 |

# STUDY MODULE DESCRIPTION FORM

| Name of the module/subject | Code |
|---|---|
| **Programming in C++** | |

| Field of study | Profile of study (general academic, practical) | Year /Semester |
|---|---|---|
| **Electronics and Telecommunications** | **general academic** | **2 / 3** |
| 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: **30** Classes: **-** Laboratory: **30** Project/seminars: **-** | **5** |

| 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** | **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** | Basic knowledge about programming in C [K1_W09] |
| 2 | **Skills** | Is able to retrieve and interpret information from books and Internet K1_U01 |
| 3 | **Social competencies** | Student understands a necessity to acquire a new knowledge and skills stemming from a chosen field of studies. K1_K01 |

## Assumptions and objectives of the course:

The aim of the subject is to deliver to a student a systematic knowledge and skills related to solving computational problems in C++ programming language

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

### Knowledge:

1. Has a systematic knowledge from the area of computing science; knows the syntax of C++ - [K1_W09]
2. Has a systematic knowledge of solving various computational problems using C++ programming language [K1_W09]

### Skills:

1. Is able to write software for computational algorithms, using C++ programming languages - [K1_U13]
2. Uses high level programming languages: C++ - [K1_U13]
3. Is able to write and run programs to solve various problems in telecommunication - [K1_U13]

### Social competencies:

1. Is aware of the limitations of his/her current knowledge and skills; is committed to further self-study. - [K1_K01]
2. Demonstrates responsibility and professionalism in solving technical problems. Is able to participate in collaborative projects. - [K1_K02]

## 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 laboratories.

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

- structure of C++ program
- pointers
- classes and objects
- operator overloading
- inheritance
- polymorphism
- file processing
- standard library containers, interators and algorithms
-exceptions
- class templates
- bitwise operators

## Basic bibliography:

1. D.E. Knuth, The art of computer programming, Addison-Wesley Publishing Company, Reading, MA, 1968, 1973.
2. Paul Deitel, Harvey Deitel, C++ How to Program, Prentice Hall; 9 edition (February 22, 2013)

## Additional bibliography:

## Result of average student's workload

| Activity | Time (working hours) |
|---|---|
| 1. Lectures | 30 |
| 2. Laboratories | 30 |
| 3. Self-training in C++ programming | 30 |
| 4. Preparation for laboratories | 30 |
| 5. Exam | 2 |
| 6. Discussion of exam otucomes | 1 |

## Student’s workload

| Source of workload | hours | ECTS |
|---|---|---|
| Total workload | 125 | 5 |
| Contact hours | 65 | |
| Practical activities | 60 | |

# STUDY MODULE DESCRIPTION FORM

| Name of the module/subject | Code |
|---|---|
| **Foundations of Telecommunication** | |

| Field of study | Profile of study (general academic, practical) | Year /Semester |
|---|---|---|
| **Electronics and Telecommunications** | **general academic** | **2 / 3** |
| Elective path/specialty | Subject offered in: | Course (compulsory, elective) |
| **Information and Comm. Technologies** | **Polish / 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: **1** Laboratory: **-** Project/seminars: **-** | **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** | **3 100%** |
| **Technical sciences** | **3 100%** |

## Responsible for subject / lecturer:

dr inż. Michał Kasznia
email: mkasznia@et.put.poznan.pl
tel. (061)6653858
Faculty of Electronics and Telecommunications
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)<br>Has a basic, systematic knowledge of physics(K1_W02)<br>Has a detailed, systematic knowledge of the fundamentals of circuit theory (K1_W05)<br>Has a systematic knowledge, together with necessary mathematical background, of 1D signal theory (K1_W06)<br>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 extract information from literature, databases and other sources (K1_U01)<br>Is competent in a foreign language, knows the electronics and telecommunication terminology in this language (K1_U06)<br>Is able to use known mathematical analysis, algebra and theory of probability concepts to solve basic problems in electronics and telecommunication (K1_U07)<br>Demonstrates the ability to solve typical tasks and problems related to analysis of electrical circuits (K1_U09)<br>Demonstrates the ability to solve problems related to signal analysis (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)<br>Demonstrates responsibility and professionalism in solving technical problems. Is able to participate in collaborative projects (K1_K02) |

## Assumptions and objectives of the course:

Presentation of the basic ideas of telecommunications, the techniques and principles that underlie the analysis, design, construction and maintenance of telecommunications systems and networks

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

**Knowledge:**

1. Knows the principle of operation of digital transmission systems, including baseband transmission, digital modulations, signal transmission in channels, signal reception, forming the spectral properties of signals, countering channel distortions. - [K1_W15]

2. Has a detailed, systematic knowledge, together with necessary mathematical background, of the fundamentals of the telecommunication theory, which is necessary to understand, analyze and evaluate the operation of analogue and digital telecommunications systems - [K1_W17]

3. Knows about development trends in electronics and telecommunication - [K1_W24]

**Skills:**

1. Demonstrates the ability to solve problems related to signal analysis in time domain and frequency - [K1_U10]

2. Is able to measure typical parameters of signals, systems and devices, in particular those used in telecommunication. Is able to choose appropriate methods to measure given electrical quantities and parameters of signals and devices. Is able to plan and perform measurements and analyze the results - [K1_U17]

3. Is able to select the construction of devices according to technical requirements and service conditions - [K1_U21]

**Social competencies:**

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

2. Demonstrates responsibility and professionalism in solving technical problems. Is able to participate in collaborative projects - [K1_K02]

3. Is aware of the main challenges facing electronics and telecommunication in the 21st century. Is aware of the impact electronics and ICT systems and networks will have on the development of the information society - [K1_K04]

## Assessment methods of study outcomes

- Activity during classes
- Written test during classes and homeworks

## Course description

Lectures

Characteristic of telecommunication, telecommunication services and standards; telecommunication system; sources of information; signals in telecommunication system; transmittter and receiver; telecommunication channel; analog and digital modulations of harmonic carrier; sampling and quantization; spectrum and bandwidth of telecommunication signals; baseband and passband transmission; PDH, SDH, WDM, DWDM.

Classes

- random and deterministic signals
- Fourier transform and spectral analysis of deterministic and random signals
- representation of baseband and passband signals,
- mathematical description of modulation processes for AM, DSB-SC, and SSB signals

## Basic bibliography:

1. S. Haykin, Communication Systems, Wiley
2. B. P. Lathi, Z. Ding, Modern Digital and Analog Communication Systems, Oxford University Press, 2010

## Additional bibliography:

1. S. Haykin, M. Moher, Communication Systems, International Student Version, Wiley, 2010
2. T. Anttalainen, Introduction to Telecommunications Nework Engineering, Artech House, 1999
3. T. Oeberg, Modulation, Detection and Coding, Wiley, 2001

## Result of average student's workload

| Activity | Time (working hours) |
|---|---|
| 1. participation in lectures | 30 |
| 2. participation in classes | 15 |
| 3. individual literature studies | 15 |
| 4. preparations for excercises | 15 |

## Student's workload

| Source of workload | hours | ECTS |
|---|---|---|
| Total workload | 75 | 3 |
| Contact hours | 45 | 2 |
| Practical activities | 15 | 1 |