# PROGRAM OF STUDIES

FACULTY: **Computer Science and Management**
MAIN FIELD OF STUDY: **Applied Computer Science**
BRANCH OF SCIENCE: **Dziedzina nauk inżynieryjno-technicznych**
DISCIPLINES: D1 **Informatyka techniczna i telekomunikacja** (major discipline)
D2* ……...
D3* ……
D4* ……

EDUCATION LEVEL: first-level (~~licencjat~~/inżynier) studies / ~~second-level studies~~ / ~~magister uniform studies~~*
FORM OF STUDIES: full-time studies / ~~part-time studies~~*
PROFILE: general academic / ~~practical~~ *
LANGUAGE OF STUDY: **English/Polish**

Content:



Resolution no. … of the Senate of Wroclaw University of Science and Technology
In effect since 2021/22

*delete as applicable

Zał. Nr 2 do ZW 16/2020

Attachment no. 1. to the Program of Studies

# ASSUMED LEARNING OUTCOMES

**FACULTY:** **Computer Science and Management**

**MAIN FIELD OF STUDY:** **Applied Computer Science**

**EDUCATION LEVEL:** first-level (~~licencjat~~/inżynier) studies ~~/ second-level studies~~ / ~~magister uniform studies~~*

**PROFILE:** general academic / ~~practical~~ *

Location of the main-field-of study:

Branch of science: **Nauki inżynieryjno-techniczne**

Discipline / disciplines (for several disciplines, please indicate the major discipline)
**Informatyka techniczna i telekomunikacja**

Explanation of the markings:
P6U – universal first degree characteristics corresponding to education at the first-level studies - 6 PRK level *
P7U – universal first degree characteristics corresponding to education at the second-level studies - 7 PRK level *

P6S – second degree characteristics corresponding to education at the first-level studies - 6 PRK level *
P7S – second degree characteristics corresponding to education at the second-level studies - 7 PRK level *

W - category "knowledge"
U - category "skills"
K - category "social competences"
K (*faculty symbol*) _W1, K (*faculty symbol*) _W2, K (*faculty symbol*) _W3, … - main-field-of study learning outcomes related to the category "knowledge"
K (*faculty symbol*) _U1, K (*faculty symbol*) _U2, K (*faculty symbol*) _U3, … - main-field-of study learning outcomes related to the category "skills"
K (*faculty symbol*) _K1, K (*faculty symbol*) _K2, K (*faculty symbol*) _K3, … - main-field-of study learning outcomes related to the category "social competences"
S (*faculty symbol*) _W.., S (*faculty symbol*) _W.., S (*faculty symbol*) _W.., … - specialization learning outcomes related to the category "knowledge"
S (*faculty symbol*) _U.., S (*faculty symbol*) _U.., S (*faculty symbol*) _U.., … - specialization learning outcomes related to the category "skills"
S (*faculty symbol*) _K.., S (*faculty symbol*) _K.., S (*faculty symbol*) _K.., … - specialization learning outcomes related to the category "social competences"
… _inż. – learning outcomes related to the engineer competences

* delete as applicable

| **Main field of study learning outcomes** | **Description of learning outcomes for the main-field-of study Applied Computer Science**<br>After completion of studies, the graduate:<br>Faculty of Computer Science and Management | Reference to PRK characteristics | | |
|---|---|---|---|---|
| | | Universal first degree characteristics (U) | Second degree characteristics typical for qualifications obtained in higher education (S) | |
| | | | Characteristics for qualifications on 6 / 7* levels of PRK | Characteristics for qualifications on 6 and 7 levels of PRK, enabling acquiring engineering competences |
| **KNOWLEDGE (W)** | | | | |
| KINF_W01 | Has basic general knowledge in the field of selected branches of mathematics: mathematical analysis, linear algebra and analytic geometry, mathematical logic, discrete mathematics, probability theory, and mathematical statistics, that form the theoretical foundations necessary to solve IT engineering problems | P6U_W | P6S_WG | |
| KINF_W02 | Has basic knowledge in the selected physics departments | P6U_W | P6S_WG | |
| KINF_W03 | Knows and understands basic data structures, algorithms, and programming constructs and can implement them in various programming languages | P6U_W | P6S_WG | P6S_WG_inż |
| KINF_W04 | He knows the basic programming paradigms and languages using these paradigms | P6U_W | P6S_WG | |
| KINF_W05 | Has detailed knowledge of software lifecycle models and its processes as well as methodologies, good practices, notation, and support tools for software development | P6U_W | P6S_WG | P6S_WG_inż |
| KINF_W06 | Has basic knowledge in the field of computer structure, organization and architecture | P6U_W | P6S_WG | P6S_WG_inż |
| KINF_W07 | Has knowledge about programming various types of applications, e.g. mobile, web, database, or distributed | P6U_W | P6S_WG | P6S_WG_inż |
| KINF_W08 | Has basic knowledge in the field of construction, operation and administration of operating systems | P6U_W | P6S_WG | P6S_WG_inż |
| KINF_W09 | Has knowledge of computer networks, their architecture and the operation of selected network devices | P6U_W | P6S_WK | P6S_WG_inż |
| KINF_W10 | Has basic knowledge in the field of IT systems security | P6U_W | P6S_WK | P6S_WG_inż |

| | | | | |
|---|---|---|---|---|
| KINF_W11 | Has knowledge of modeling different types of processes and knows the methods and techniques used in decision support systems | P6U_W | P6S_WK | P6S_WG_inż |
| KINF_W12 | Knows and understands the architecture of database systems and the basic methods and tools for collecting, processing and retrieving information as well as extracting knowledge from data | P6U_W | P6S_WK | P6S_WG_inż |
| KINF_W13 | Has systematic knowledge in the field of artificial intelligence, in particular methods of representing and processing knowledge. | | | P6S_WG_inż |
| KINF_W14 | Has detailed knowledge of software and database design | | | P6S_WG_inż |
| KINF_W15 | Has basic knowledge in the field of multimedia and multimedia systems | | | P6S_WG_inż |
| KINF_W16 | He knows typical technologies and programming tools for software developments | | | P6S_WG_inż |
| KINF_W17 | Has well-formed knowledge in the field of IT project management | | | P6S_WG_inż |
| KINF_W18 | He knows current IT development trends | | | |
| KINF_W19 | Has basic knowledge of managing the business activities; knows the general principles of creating and running various sorts of individual entrepreneurship | | | P6S_WK_inż |
| KINF_W20 | Has basic knowledge in the field of protection of intellectual property and patent law | | | |
| KINF_W21 | Has basic knowledge of humanities that is necessary to understand the social and philosophical conditions of engineering activities | | | |
| KINF_W22 | He knows and understands the fundamental problems facing modern civilization | | | |
| **SKILLS (U)** | | | | |
| KINF_U01 | Is able to construct and implement algorithms using basic algorithms and data structures | P6U_U | P6S_UW | P6S_UW_inż |
| KINF_U02 | Can choose and evaluate the usefulness of a programming paradigm to a problem and build an application that uses this paradigm | P6U_U | P6S_UW | P6S_UW_inż |
| KINF_U03 | Can describe requirements and design - using the selected modeling language - a general software architecture and a database schema | P6U_U | P6S_UW | P6S_UW_inż |

| | | | | |
|---|---|---|---|---|
| KINF_U04 | Is able to implement, in accordance with the design, software and database for simple, typical applications and verify the correctness of the solution. | P6U_U | P6S_UW | P6S_UW_inż |
| KINF_U05 | He can design and build simple logic circuits | P6U_U | P6S_UW | P6S_UW_inż |
| KINF_U06 | Can apply an indicated analytical method and plan and conduct a simple engineering experiment or computer simulation; is able to carry out measurements and analyze their results, in particular of selected IT system components | P6U_U | P6S_UW | P6S_UW_inż |
| KINF_U07 | He can configure basic devices and network software of computer networks | P6U_U | P6S_UW | P6S_UW_inż |
| KINF_U08 | He can apply the specified security techniques for a given IT system | P6U_U | P6S_UW | P6S_UW_inż |
| KINF_U09 | Is able to create and implement a schedule of works for developing a simple IT system and to pre-estimate the costs and time needed to implement this project. | P6U_U | P6S_UW | P6S_UW_inż |
| KINF_U10 | Is able to formulate and solve complex and atypical problems and carry out tasks in conditions that are not fully predictable | P6U_U | P6S_UW | P6S_UW_inż |
| KINF_U11 | Has the ability to program applications of various types, e.g. mobile, web and database | P6U_U | P6S_UW | P6S_UW_inż |
| KINF_U12 | He can implement a simple multimedia product using carefully selected methods, techniques, and tools | P6U_U | P6S_UW | P6S_UW_inż |
| KINF_U13 | He can apply selected technologies and programming tools | P6U_U | P6S_UW | P6S_UW_inż |
| KINF_U14 | He has practical skills related to the administration of selected systems | P6U_U | P6S_UW | P6S_UW_inż |
| KINF_U15 | Is able to describe and make a profound analysis of the functioning of existing IT solutions and evaluate these solutions | P6U_U | P6S_UW | P6S_UW_inż |
| KINF_U16 | Can acquire information from literature, databases and other sources, also in English, among others for the purposes of self-education and raising professional competences, can integrate the obtained information, interpret it, draw conclusions, formulate and justify opinions | P6U_U | P6S_UW | |
| KINF_U17 | Is able to develop documentation on the implementation of an engineering task, prepare a text containing a discussion of achieved results and present a short presentation using | P6U_U | P6S_UW | |

| | | | | |
|---|---|---|---|---|
| | advanced information and communication techniques on the results of this engineering task | | | |
| KINF_U18 | He can communicate using specialized terminology; take part in discussions, present and evaluate different opinions and stands | P6U_U | P6S_UK | |
| KINF_U19 | Has language skills in the fields of science and scientific disciplines, relevant to the studied field of study, in accordance with the requirements set for the B2 level of the European System of Language Description | P6U_U | P6S_UK | |
| KINF_U20 | Is able to plan and organize work both for an individual and for a team | P6U_U | P6S_UO | |
| KINF_U21 | He can cooperate with other people as part of a team undertaking | P6U_U | P6U_UO | |
| KINF_U22 | Has the ability to self-education, e.g. to improve his/her professional skills | P6U_U | P6S_UU | |
| | | | | |
| **SOCIAL COMPETENCES (K)** | | | | |
| KINF_K01 | Is ready to critically evaluate his/her knowledge and acquired information | P6U_K | P6U_KK | |
| KINF_K02 | He is conscious of knowledge significance in solving cognitive and practical problems; he recognises the need of consulting experts' opinions in case of difficulties with unassisted problem solving | P6U_K | P6U_KK | |
| KINF_K03 | He follows the rules of professional ethics and demands it from others | P6U_K | P6U_KR | |
| KINF_K04 | He is able to think and act in an entrepreneurial way, he is ready to take action for society | P6U_K | P6U_KO | |

*delete as applicable

Zał. nr 3 do ZW 16/2020

Attachment no. 2. to the Program of Studies

# DESCRIPTION OF THE PROGRAM OF STUDIES

**Main field of study: Applied Computer Science** **Profile: general academic**

**Level of studies: first-level** **Form of studies: full-time studies**

## 1. General description

| | |
|---|---|
| *1.1 Number of semesters:*<br>**7** | *1.2 Total number of ECTS points necessary to complete studies at a given level:*<br>**210** |
| *1.3 Total number of hours:*<br>**2475** | *1.4 Prerequisites (particularly for second-level studies):*<br>Qualification is based on the results of the matriculation exam, in accordance with the terms and recruitment procedure established for a given academic year |
| *1.5 Upon completion of studies graduate obtains professional degree of:*<br>**INŻYNIER (ENGINEER)** | *1.6 Graduate profile, employability:*<br>A graduate has qualifications including knowledge, skills and engineering competences in the following areas:<br>• Computer architecture and organization and low-level programming of devices, such as elements of the Internet of Things (IoT).<br>• Programming languages, algorithms and data structures, programming paradigms and effective programming techniques.<br>• Computer networks, system administration and cybersecurity.<br>• Databases and data warehouses including database design. |

| | |
|---|---|
| | • Software design and project management.<br>• Advanced programming methods and tools, artificial intelligence and knowledge engineering, mobile applications and distributed systems.<br>• Various aspects of multimedia<br>• Trends in IT.<br><br>The graduate also has knowledge of basic sciences: mathematical analysis, algebra with analytical geometry, logic, discrete mathematics, probability and statistics, and physics which are necessary to solve engineering problems and to continue studies at the second degree.<br><br>An important supplement to the education is knowledge of the basics of entrepreneurship as well as social and professional problems of IT. In addition, the graduate knows English sufficiently to enable him or her to express freely, also in writing, on topics related to the work performed.<br><br>Soft skills and the ability to work in a team are also important in educating IT engineers.<br><br>Graduates of the first degree studies in Applied Computer Science may be employed in IT companies and IT departments of banks and financial institutions or enterprises in Wrocław, as well as throughout Poland and even abroad. Graduates are employed as software testers, programmers, designers, service technicians, system administrators and IT security specialists. |
| *1.7 Possibility of continuing studies:*<br><br>Graduates may continue their studies in the same or similar field in the second-level degree studies. | *1.8 Indicate connection with University's mission and its development strategy:*<br><br>The program of study in Applied Computer Science at the Faculty of Computer Science and Management is consistent with the mission of Wrocław University of Science and Technology and its development strategy.<br>The program provides the opportunity to acquire knowledge, skills, engineering competences and social competences necessary for a modern IT engineer. The mandatory courses and modules of elective courses offered as part of the study program |

| | |
|---|---|
| | meet the requirements of the Polish Qualifications Framework, and – on the other hand – they meet the dynamically changing needs of the social and economic environment.<br>It is expressed, among others, through:<br>• Participation of members of the Faculty Social Council in the work on the study program.<br>• Participation of highly qualified specialists from outside the university in conducting didactic activities.<br>• Offering student internships in companies or IT departments.<br>Practical classes are held in specialized laboratories with modern computer equipment, dedicated apparatus and software, regularly modernized. Acting in accordance with the strategy of Wroclaw University of Science and Technology in the field of internationalization, the Faculty of Computer Science and Management offers first-level studies in Applied Computer Science also in English for candidates from Poland and foreigners. Additionally, students can participate in international exchange programs (e.g. ERASMUS +). |

**2. Detailed description**

**2.1 Total number of learning outcomes in the program of study:**

**W (knowledge) = 22, U (skills) = 22, K (competences) = 4, W + U + K = 48**

**2.2 For the main field of study assigned to more than one discipline - the number of learning outcomes assigned to the discipline:**

**D1 (major) ..... (this number must be greater than half the total number of learning outcomes)**
**D2 .....**
**D3 .....**
**D4 .....**

**2.3 For the main field of study assigned to more than one discipline - percentage share of the number of ECTS points for each discipline:**

**D1 .....% ECTS points**
**D2 .....% ECTS points**
**D3 .....% ECTS points**
**D4 .....% ECTS points**

**2.4a. For the general academic profile of the main field of study – the number of ECTS points assigned to the classes related to the University's academic activity in the discipline or disciplines to which the main field of study is assigned – DN (must be greater than 50% of the total number of ECTS points from 1.2) 144**

**2.4b. For the practical profile of the main field of study - the number of ECTS points assigned to the classes shaping practical skills (must be greater than 50% of the total number of ECTS points from 1.2)**

**2.5 Concise analysis of compliance of the assumed learning outcomes with the needs of the labor market**

The study program is the result of close cooperation with the Social Council of the Faculty of Computer Science and Management. The Council includes representatives of the management of leading IT companies in the Lower Silesia. The assumed learning outcomes meet the current and prospective needs of the market. In particular, the outcomes meet needs for IT specialists of different companies (e-commerce, service, research) dealing with the maintenance/development of IT tools supporting their activities, developers of IT systems as well as companies designing, implementing and maintaining computer systems and networks.

**2.6. The total number of ECTS points that a student must obtain in classes requiring direct participation of academic teachers or other persons conducting classes and students** (enter the sum of ECTS points for courses / groups of courses marked with the BU[1] code)

**126** ECTS

**2.7. Total number of ECTS points, which student has to obtain from basic sciences classes**

| | |
|---|---|
| Number of ECTS points for obligatory subjects | **39** |
| Number of ECTS points for optional subjects | **0** |
| Total number of ECTS points | **39** |

**2.8. Total number of ECTS points, which student has to obtain from practical classes, including project and laboratory classes** (enter total number of ECTS points for courses/group of courses denoted with code P)

| | |
|---|---|
| Number of ECTS points for obligatory subjects | **40** |
| Number of ECTS points for optional subjects | **43** |
| Total number of ECTS points | **83** |

**2.9. Minimum number of ECTS points, which student has to obtain doing education blocks offered as part of University-wide classes or other main field of study** (enter number of ECTS points for courses/groups of courses denoted with code O)

**35** ECTS points

**2.10. Total number of ECTS points, which student may obtain doing optional blocks (min. 30% of total number of ECTS points)**

**70** ECTS points

**3. Description of the process leading to learning outcomes acquisition:**

The educational process includes active participation in classes organized at the university: lectures, classes, exercises, laboratories, projects and seminars, as well as student's self-learning activities allowing for consolidation, supplementation and extension of knowledge. If necessary, the student can take advantage of individual consultations. The learning outcomes are further developed during mandatory student's internship.

# 4. List of education blocks:

## 4.1. List of obligatory blocks:

### 4.1.1 List of general education blocks

#### 4.1.1.1 *Liberal-managerial subjects* block (*min. 6 ECTS points*):

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | ZMZ001643W | Basics of entrepreneurship | 2 | | | | | K1INF_W19 | 30 | 60 | 2 | | 1,2 | T | Z | | | | KO |
| 2. | SCZ001115S | Presentation Techniques | | | | | 2 | K1INF_U18 | 30 | 60 | 2 | | 1,2 | T | Z | | | | KO |
| 3. | INZ004440W | IT Social and Professional Problems | 2 | | | | | K1INF_W20 K1INF_W22 | 30 | 60 | 2 | | 1,2 | T | Z | | | | KO |
| | | Total | 4 | | | | 2 | | 90 | 180 | 6 | | 3,6 | | | | | | |

#### 4.1.1.4 *Information technologies* block (*min. 9 ECTS points*):

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ004400Wc | Computer System Organization (GK) | 2 | 1 | | | | K1INF_W06 | 45 | 90 | 3 | | 1,8 | T | Z (w) | | | | PD |
| 2. | INZ004399Wc | Structural and Object oriented Programming (GK) | 2 | 2 | | | | K1INF_W03 K1INF_U01 K1INF_U02 | 60 | 120 | 4 | | 2,4 | T | E (w) | | | | PD |
| 3. | INZ004399L | Structural and Object oriented Programming | | | 2 | | | K1INF_W03 K1INF_U01 K1INF_U02 | 30 | 60 | 2 | | 1,2 | T | Z | | | P (2) | PD |
| | | Total | 4 | 3 | 2 | | | | 135 | 270 | 9 | | 5,4 | | | | | 2 | |

### Altogether for general education blocks

| Total number of hours | | | | | Total number of ZZU hours | Total number of CNPS hours | Total number of ECTS points | Total number of ECTS points for DN classes[5] | Number of ECTS points for BU classes[1] |
|---|---|---|---|---|---|---|---|---|---|
| lec | cl | lab | pr | sem | | | | | |
| 8 | 3 | 2 | | 2 | 225 | 450 | 15 | | 9 |

## 4.1.2 List of basic sciences blocks

### 4.1.2.1 *Mathematics* block

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | MAT001688Wc | Algebra and Analytic Geometry (GK) | 2 | 2 | | | | K1INF_W01 | 60 | 180 | 6 | | 3,6 | T | E (w) | O | | | PD |
| 2. | MAT001689Wc | Mathematical Analysis I (GK) | 2 | 2 | | | | K1INF_W01 | 60 | 180 | 6 | | 3,6 | T | E (w) | O | | | PD |
| 3. | MAT001690Wc | Mathematical Analysis II (GK) | 2 | 1 | | | | K1INF_W01 | 45 | 150 | 5 | | 3 | T | E (w) | O | | | PD |
| 4. | INZ004406Wc | Discrete Mathematics (GK) | 2 | 2 | | | | K1INF_W01 | 60 | 150 | 5 | | 3 | T | Z (w) | | | | PD |
| 5. | INZ004410Wc | Theory of Probabilistic and Statistics (GK) | 2 | 2 | | | | K1INF_W01 | 60 | 200 | 7 | | 4,2 | T | E (w) | | | | PD |
| | | Total | 10 | 9 | | | | | 285 | 860 | 29 | | 17,4 | | | | | | |

### 4.1.2.2 *Physics* block

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | FZP001136Wc | General Physics I (GK) | 2 | 1 | | | | K1INF_W02 | 45 | 120 | 4 | | 2,4 | T | Z (w) | O | | | PD |
| 2. | FZP001137Wc | General Physics II (GK) | 2 | 1 | | | | K1INF_W02 | 45 | 120 | 4 | | 2,4 | T | E (w) | O | | | PD |
| 3. | FZP001137L | General Physics II | | | 1 | | | K1INF_W02 | 15 | 60 | 2 | | 1,2 | T | Z | O | | P (2) | PD |
| | | Total | 4 | 2 | 1 | | | | 105 | 300 | 10 | | 6 | | | | | 2 | |

### Altogether for basic sciences blocks:

| Total number of hours | | | | | Total number of ZZU hours | Total number of CNPS hours | Total number of ECTS points | Total number of ECTS points for DN classes[5] | Number of ECTS points for BU classes[1] |
|---|---|---|---|---|---|---|---|---|---|
| lec | cl | lab | pr | sem | | | | | |
| 14 | 11 | 1 | | | 390 | 1160 | 39 | | 23,4 |

## 4.1.3 List of the main field of study blocks

### 4.1.3.1 *Obligatory main field of study* blocks

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ004402Wc | Logic for IT Specialists (GK) | 2 | 2 | | | | K1INF_W01 | 60 | 150 | 5 | 5 | 3 | T | E (w) | | DN | | K |
| 2. | INZ004403L | Data Structures and Algorithms | | | 2 | | | K1INF_W03 K1INF_U01 | 30 | 60 | 2 | 2 | 1,2 | T | Z | | DN | P (2) | K |
| 3. | INZ004403Wc | Data Structures and Algorithms (GK) | 2 | 1 | | | | K1INF_W03 K1INF_U01 | 45 | 120 | 4 | 4 | 2,4 | T | E (w) | | DN | | K |
| 4. | INZ004404W | Computer Architecture | 2 | | | | | K1INF_W06 K1INF_U04 K1INF_U05 | 30 | 60 | 2 | 2 | 1,2 | T | Z | | DN | | K |
| 5. | INZ004404L | Computer Architecture | | | 2 | | | K1INF_W06 K1INF_U04 K1INF_U05 | 30 | 60 | 2 | 2 | 1,2 | T | Z | | DN | P (2) | K |
| 6. | INZ004405W | Operating Systems | 2 | | | | | K1INF_W08 K1INF_U06 | 30 | 60 | 2 | 2 | 1,2 | T | Z | | DN | | K |
| 7. | INZ004405L | Operating Systems | | | 2 | | | K1INF_W08 K1INF_U06 | 30 | 60 | 2 | 2 | 1,2 | T | Z | | DN | P (2) | K |
| 8. | INZ004407W | Computer Networks | 3 | | | | | K1INF_W09 K1INF_U07 | 45 | 110 | 4 | 4 | 2,4 | T | E | | DN | | K |
| 9. | INZ004407L | Computer Networks | | | 2 | | | K1INF_W09 K1INF_U07 | 30 | 90 | 3 | 3 | 1,8 | T | Z | | DN | P (3) | K |
| 10. | INZ004408W | Effective Programming Techniques | 1 | | | | | K1INF_W03 K1INF_U01 | 15 | 60 | 2 | 2 | 1,2 | T | Z | | DN | | K |
| 11. | INZ004408L | Effective Programming Techniques | | | 2 | | | K1INF_W03 K1INF_U01 | 30 | 90 | 3 | 3 | 1,8 | T | Z | | DN | P (3) | K |
| 12. | INZ004409L | Programming paradigms | | | 2 | | | K1INF_W04 K1INF_U02 | 30 | 60 | 2 | 2 | 1,2 | T | Z | | DN | P (2) | K |
| 13. | INZ004409Wc | Programming paradigms (GK) | 2 | 1 | | | | K1INF_W04 K1INF_U02 | 45 | 140 | 5 | 5 | | | | | DN | | K |
| 14. | INZ002023L | Data Bases | | | 1 | | | K1INF_W12 K1INF_U03 K1INF_U04 | 15 | 60 | 2 | 2 | 1,2 | T | Z | | DN | P (2) | K |
| 15. | INZ002023Wc | Databases (GK) | 2 | 1 | | | | K1INF_W12 K1INF_U03 K1INF_U04 | 45 | 115 | 4 | 4 | 2,4 | T | E(w) | | DN | | K |
| 16. | INZ002024L | Systems Analysis and Decision Support Methods | | | 1 | | | K1INF_W11 K1INF_U06 | 15 | 50 | 2 | 2 | 1,2 | T | Z | | DN | P (2) | K |
| 17. | INZ002024Wc | Systems Analysis and Decision Support Methods (GK) | 2 | 1 | | | | K1INF_W11 K1INF_U06 | 45 | 140 | 5 | 5 | 3 | T | E(w) | | DN | | K |
| 18. | INZ002027W | Introduction to IoT | 2 | | | | | K1INF_W09 K1INF_U04 K1INF_U07 | 30 | 60 | 2 | 2 | 1,2 | T | E | | DN | | K |
| 19. | INZ002027L | Introduction to IoT | | | 2 | | | K1INF_W09 K1INF_U04 K1INF_U07 | 30 | 90 | 3 | 3 | 1,8 | T | Z | | DN | P (3) | K |
| 20. | INZ004414L | Basics of Software Engineering | | | 1 | | | K1INF_W05 K1INF_U03 | 15 | 30 | 1 | 1 | 0,6 | T | Z | | DN | P (1) | K |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21. | INZ004414Wc | Basics of Software Engineering (GK) | 1 | 2 | | | | K1INF_W05<br>K1INF_U03 | 45 | 90 | 3 | 3 | 1,8 | T | Z(w) | | DN | | K |
| 22. | INZ004418W | Cybersecurity | 2 | | | | | K1INF_W10<br>K1INF_U08 | 30 | 90 | 3 | 3 | 1,8 | T | E | | DN | | K |
| 23. | INZ004418L | Cybersecurity | | | 2 | | | K1INF_W10<br>K1INF_U08 | 30 | 60 | 2 | 2 | 1,2 | T | Z | | DN | P (2) | K |
| 24. | INZ002025W | Script Languages | 2 | | | | | K1INF_W03<br>K1INF_U01 | 30 | 85 | 3 | 3 | 1,8 | T | E | | DN | | K |
| 25. | INZ002025L | Script Languages | | | 2 | | | K1INF_W03<br>K1INF_U01 | 30 | 90 | 3 | 3 | 1,8 | T | Z | | DN | P (3) | K |
| 26. | INZ004419W | Software Engineering | 2 | | | | | K1INF_W14<br>K1INF_U03<br>K1INF_U04<br>K1INF_U21 | 30 | 90 | 3 | 3 | 1,8 | T | E | | DN | | K |
| 27. | INZ004419P | Software Engineering | | | | 2 | | K1INF_W14<br>K1INF_U03<br>K1INF_U04<br>K1INF_U21 | 30 | 90 | 3 | 3 | 1,8 | T | Z | | DN | P (3) | K |
| 28. | INZ004427W | Artificial intelligence and knowledge engineering | 2 | | | | | K1INF_W13<br>K1INF_U06 | 30 | 60 | 2 | 2 | 1,2 | T | E | | DN | | K |
| 29. | INZ004427L | Artificial intelligence and knowledge engineering | | | 2 | | | K1INF_W13<br>K1INF_U06 | 30 | 90 | 3 | 3 | 1,8 | T | Z | | DN | P (3) | K |
| 30. | INZ002031W | Data Warehouses | 2 | | | | | K1INF_W12<br>K1INF_U06 | 30 | 60 | 2 | 2 | 1,2 | T | E | | DN | | K |
| 31. | INZ002031L | Data Warehouses | | | 2 | | | K1INF_W12<br>K1INF_U06 | 30 | 60 | 2 | 2 | 1,2 | T | Z | | | P (3) | K |
| | | Total | 31 | 8 | 25 | 2 | | | 990 | 2530 | 86 | 86 | 51,6 | | | | | 36 | |

## Altogether (for main field of study blocks):

| Total number of hours | | | | | Total number of ZZU hours | Total number of CNPS hours | Total number of ECTS points | Total number of ECTS points for DN classes[5] | Number of ECTS points for BU classes[1] |
|---|---|---|---|---|---|---|---|---|---|
| lec | cl | lab | pr | sem | | | | | |
| 31 | 8 | 25 | 2 | | 990 | 2530 | 86 | 86 | 51,6 |

# 4.2 List of optional blocks

## 4.2.1 List of general education blocks

### 4.2.1.1 Liberal-managerial subjects blocks: block M10 – Humanistic subject (*min. 3 ECTS points*):

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University-wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ118560BK | Humanities subject 1 | 2 | | | | | K1INF_W21 | 30 | 90 | 3 | | 1,8 | T | Z | O | | | KO |
| 2. | INZ118560BK | Humanities subject 2 | 2 | | | | | K1INF_W21 | 30 | 90 | 3 | | 1,8 | T | Z | O | | | KO |
| | | Total | 2 | | | | | | 30 | 90 | 3 | | | | | | | | |

### 4.2.1.2 *Foreign languages* block (*min. 5 ECTS points*):

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University-wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | JZL100927BK | Foreign language A1/A2/ B1/ B2.1/ C1.1 | | 4 | | | | K1INF_U19 | 30 | 60 | 2 | | 1,2 | T | Z | O | | | KO |
| 2. | JZL100928BK | Foreign language B2.2/C1.2 | | 4 | | | | K1INF_U19 | 60 | 90 | 3 | | 1,8 | T | Z | O | | | KO |
| | | Total | | 8 | | | | | 120 | 150 | 5 | | 3 | | | | | | |

### 4.2.1.3 Sporting classes block (*0. ECTS points*):

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University-wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | WFW030000BK | Sports I | | 2 | | | | | 30 | 30 | 0 | | 0 | T | Z | O | | | KO |
| 2. | WFW030000BK | Sports II | | 2 | | | | | 30 | 30 | 0 | | 0 | T | Z | O | | | KO |
| | | Total | | 2 | | | | | 60 | 60 | | | | | | | | | |

### Altogether for general education blocks:

| Total number of hours | | | | | Total number of ZZU hours | Total number of CNPS hours | Total number of ECTS points | Total number of ECTS points for DN classes[5] | Number of ECTS points for BU classes[1] |
|---|---|---|---|---|---|---|---|---|---|
| lec | cl | lab | pr | sem | | | | | |
| 2 | 12 | | | | 210 | 300 | 8 | | 4,8 |

## 4.2.3 List of blocks

### 4.2.3.1 M1 block - Administration of Computer Systems (*min. 4 ECTS points*):

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ004415WI | Linux Server Administration (GK) | 2 | | 2 | | | K1INF_W08 K1IN_U14 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 2. | INZ004468WI | Managing IT infrastructure (GK) | 2 | | 2 | | | K1INF_W08 K1IN_U14 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 3. | INZ002026WI | Routing and Switching in Computer Networks (GK) | 2 | | 2 | | | K1INF_W08 K1IN_U14 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| | | Total | 2 | | 2 | | | | 60 | 120 | 4 | 4 | 2,4 | | | | | 2 | |

### 4.2.3.2 M2 block – Web Technologies (*min. 4 ECTS points*):

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ004420WI | Web Systems Programming (GK) | 2 | | 2 | | | K1INF_W07 K1INF_U11 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 2. | INZ002028WI | Developing Web Applications with .NET (GK) | 2 | | 2 | | | K1INF_W07 K1INF_U11 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| | | Total | 2 | | 2 | | | | 60 | 120 | 4 | 4 | 2,4 | | | | | 2 | |

### 4.2.3.3 M3 block - Database Design (*min. 4 ECTS points*):

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ004422Wp | Database Systems Engineering (GK) | 1 | | | 2 | | K1INF_W14 K1INF_U03 K1INF_U04 | 45 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 2. | INZ004470Wp | Database Programming (GK) | 1 | | | 2 | | K1INF_W14 K1INF_U03 K1INF_U04 | 45 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 3. | INZ004424Wp | Database Design (GK) | 1 | | | 2 | | K1INF_W14 K1INF_U03 K1INF_U04 | 45 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| | | Total | 1 | | | 2 | | | 45 | 120 | 4 | 4 | 2,4 | 2,4 | | | | 2 | |

### 4.2.3.4 M4 block – Mobile applications (*min. 4 ECTS points*):

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ002029WI | Mobile Applications for Android (GK) | 2 | | 2 | | | K1INF_W07 K1INF_U11 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 2. | INZ002030WI | Mobile Applications for IOS (GK) | 2 | | 2 | | | K1INF_W07 K1INF_U11 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| | | Total | 2 | | 2 | | | | 60 | 120 | 4 | 4 | 2,4 | | | | | 2 | |

### 4.2.3.5 M5 block – Project Management Basics (*min. 4 ECTS points*):

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ002032WIs | Introduction to IT Project Management (GK) | 1 | | 2 | | 1 | K1INF_W17 K1INF_U09 K1INF_U16 K1INF_U18 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 2. | INZ002033WIs | Support for IT Project Management (GK) | 1 | | 2 | | 1 | K1INF_W17 K1INF_U09 K1INF_U16 K1INF_U18 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| | | Total | 1 | | 2 | | 1 | | 60 | 120 | 4 | 4 | | 2,4 | | | | 2 | |

### 4.2.3.6 M6 block – **Distributed Systems** (*min. 4 ECTS points*):

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University-wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ002035WI | Distributed Computer Systems (GK) | 2 | | 2 | | | K1INF_W07<br>K1INF_U11<br>K1INF_U16 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 2. | INZ004470WI | Cloud programming (GK) | 2 | | 2 | | | K1INF_W07<br>K1INF_U11<br>K1INF_U16 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| | | Total | 2 | | 2 | | | | 60 | 120 | 4 | 4 | 2,4 | | | | | 2 | |

### 4.2.3.7 M7 block – **Programming Tools and Technologies** (*min. 4 ECTS points*):

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University-wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ004376WI | Game Programming (GK) | 2 | | 2 | | | K1INF_W16<br>K1INF_U13 | 60 | 110 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 2. | INZ004436WI | Advanced Web Technologies (GK) | 2 | | 2 | | | K1INF_W16<br>K1INF_U13 | 60 | 110 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| | | Total | 2 | | 2 | | | | 60 | 110 | 4 | 4 | 2,4 | | | | | 2 | |

### 4.2.3.8 M8 block – **Multimedia** (*min. 4 ECTS points*):

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University-wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ004437WI | Computer Graphics (GK) | 2 | | 2 | | | K1INF_W15<br>K1INF_U12 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 2. | INZ004438WI | Programming Multimedia Applications (GK) | 2 | | 2 | | | K1INF_W15<br>K1INF_U12 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 3. | INZ004439WI | Digital Media Processing Techniques (GK) | 2 | | 2 | | | K1INF_W15<br>K1INF_U12 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| | | Total | 2 | | 2 | | | | 60 | 120 | 4 | 4 | | 2,4 | | | | 2 | |

### 4.2.3.9 M9 block – Current trends in Computer Science (*min. 5 ECTS points*):

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University-wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ002040WI | Data Science (GK) | 2 | | 2 | | | K1INF_W18<br>K1INF_U10 | 60 | 120 | 5 | 5 | 3 | T | Z (w) | | DN | P (3) | K |
| 2. | INZ002041WI | Neural Networks (GK) | 2 | | 2 | | | K1INF_W18<br>K1INF_U10 | 60 | 120 | 5 | 5 | 3 | T | Z (w) | | DN | P (3) | K |
| 3. | INZ002042WI | Metaheuristics in Problems Solving (GK) | 2 | | 2 | | | K1INF_W18<br>K1INF_U10 | 60 | 120 | 5 | 5 | 3 | T | Z (w) | | DN | P (3) | K |
| 4. | INZ002043WI | Human–Computer Interaction (GK) | 2 | | 2 | | | K1INF_W18<br>K1INF_U10 | 60 | 120 | 5 | 5 | 3 | T | Z (w) | | DN | P (3) | K |
| | | Total | 2 | | 2 | | | | 60 | 120 | 5 | 5 | 3 | | | | | 3 | |

### 4.2.3.10 Other elective courses/group of courses (*min. 25 ECTS points*):

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University-wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ002017Ps | Team Project (GK) | | | | 8 | 1 | K1INF_U10<br>K1INF_U17<br>K1INF_U20<br>K1INF_U21<br>K1INF_U22<br>K1INF_K01<br>K1INF_K02<br>K1INF_K03<br>K1INF_K04 | 135 | 600 | 20 | 20 | 2,4 | T | Z | | DN | P (19) | K |
| 2. | INZ002044Q | Practical training | | | | | | | 160 | 160 | 5 | 1 | 2,4 | | Z | | DN | P (5) | K |
| | | Total | | | | 8 | 1 | | 135 | 760 | 25 | 20 | 2,4 | | | | | 24 | |

## Altogether for blocks:

| Total number of hours | | | | | Total number of ZZU hours | Total number of CNPS hours | Total number of ECTS points | Total number of ECTS points for DN classes[5] | Number of ECTS points for BU classes[1] |
|---|---|---|---|---|---|---|---|---|---|
| lec | cl | lab | pr | sem | | | | | |
| 16 | | 18 | 10 | 2 | 660 | 1830 (including 160 of training) | 62 (including 5 of training) | 58 | 37,2 (including 3 of training) |

**4.3 Training block - concerning principles of training crediting – attachment no. 4**

**Opinion of the Advisory Faculty Council concerning the rules of crediting training block**

| Name of training | | | |
|---|---|---|---|
| **Number of ECTS points** | **Number of ECTS points for BU[1] classes** | **Training crediting mode** | **Code** |
| 5 | 3 | Z | |

| **Training duration** | **Training objective** |
|---|---|
| 4 weeks | Getting familiar with the functioning of an IT company or IT department. Getting knowledge about the design, programming, testing or implementation of professional IT solutions as well as practical system administration (connection with one or more mandatory courses is necessary).<br>Implementation of typical IT tasks required practical skills and social competences gained so far, with particular focus on group work. |

**5. Ways of verifying assumed learning outcomes**

| **Type of classes** | **Ways of verifying assumed learning outcomes** |
|---|---|
| lecture | Examination, progress/final test |
| class | progress/final test |
| laboratory | pretest, report from laboratory, assessment of a solution delivered by student during laboratory |
| project | project defence, project documentation |
| seminar | participation in discussion, topic presentation, essay |
| training | report from training |

**6. Range of diploma examination**

1. Basic digital circuits: logic gates, switches, sequence circuits.
2. Binary arithmetic, Boolean functions, Karnaugh tables.
3. Rules of structural programming. Overview of structural statements.
4. Object-oriented programming – basic concepts and their applications.
5. Basic operations on sets, functions and relations. Propositional calculus. Predicate calculus.
6. Deterministic finite automata – definitions, applications.
7. Examples of computer architectures: von Neuman, Princeton, Harvard.
8. RISC and CISC processors – characteristics, differences.
9. Graphs. Spanning trees. Euler and Hamilton cycles. Cohesion. Graph traversal algorithms.

10. Algorithm – definition. Sorting algorithms. Search algorithms.
11. Basics of algorithm analysis. Computational complexity.
12. Layered structure of the operating system. The concept of system kernel.
13. The OSI layer model.
14. Data link layer protocols. Ethernet network. TCP/IP internet protocol stack.
15. Application layer protocols.
16. Effective programming techniques – examples.
17. Memory management. Common problems. Pointers.
18. Selection of programming paradigms for solving IT problems.
19. Functional programming and imperative programming.
20. Abstract data types and their implementation in programming languages.
21. Identification algorithms of static objects. Analytical and numerical optimization methods.
22. The specificity of the Internet of Things (IoT), application areas, solving problems resulting from a large number of devices, their distribution and a number of generated data.
23. Hardware solutions supporting communication and communication protocols used in embedded systems and IoT.
24. Database models. Relational database. Normalization. Transactions.
25. SQL language. Characteristics. Sub-languages.
26. Software life cycle models.
27. Software development methodologies.
28. The use of lists, sets and dictionaries in Python.
29. Differences and similarities between Java and Python.
30. Principles of parallel programming in Python.
31. UML as a project specification language. Diagrams and their application.
32. Architectural and design patterns – classification, examples, applications.
33. Data protection methods.
34. Basic cryptographic algorithms.
35. Multidimensional data modeling (transactional and analytical data systems, types of multidimensional OLAP structures).
36. ETL process.
37. MDX expressions and directives.
38. Methods of knowledge processing in expert systems.
39. Inference in non-monotonic logic – a planning task.

## 7. Requirements concerning deadlines for crediting courses/groups of courses for all courses in particular blocks

| *No.* | *Course / group of courses code* | *Name of course / group of courses* | *Crediting by deadline of... (number of semester)* |
|---|---|---|---|
| 1. | FZP001136Wc | General Physics I (GK) | 5 |
| 2. | INZ004400Wc | Computer System Organization (GK) | 3 |
| 3. | INZ004399Wc | Structural and Object oriented Programming (GK) | 3 |
| 4. | INZ004399L | Structural and Object oriented Programming | 3 |
| 5. | INZ004402Wc | Logic for IT Specialists (GK) | 5 |
| 6. | MAT001688Wc | Algebra and Analytic Geometry (GK) | 5 |
| 7. | MAT001689Wc | Mathematical Analysis I (GK) | 5 |
| 8. | INZ004403L | Data Structures and Algorithms | 6 |
| 9. | INZ004403Wc | Data Structures and Algorithms (GK) | 6 |
| 10. | INZ004404W | Computer Architecture | 6 |
| 11. | INZ004404L | Computer Architecture | 6 |
| 12. | INZ004405W | Operating Systems | 6 |
| 13. | INZ004405L | Operating Systems | 6 |
| 14. | FZP001137L | General Physics II | 5 |
| 15. | FZP001137Wc | General Physics II (GK) | 5 |
| 16. | INZ004406Wc | Discrete Mathematics (GK) | 5 |
| 17. | MAT001690Wc | Mathematical Analysis II (GK) | 5 |
| 18. | ZMZ001643W | Basics of entrepreneurship | 6 |
| 19. | INZ004407W | Computer Networks | 6 |
| 20. | INZ004407L | Computer Networks | 6 |
| 21. | INZ004408W | Effective Programming Techniques | 6 |
| 22. | INZ004408L | Effective Programming Techniques | 6 |
| 23. | INZ004409L | Programming paradigms | 6 |
| 24. | INZ004409Wc | Programming paradigms (GK) | 6 |
| 25. | INZ004410Wc | Theory of Probabilistic and Statistics (GK) | 5 |
| 26. | JZL100927BK | Foreign language A1/A2/ B1/ B2.1/ C1.1 | 5 |
| 27. | WFW030000BK | Sports I | 5 |
| 28. | INZ002023L | Databases | 6 |
| 29. | INZ002023Wc | Databases (GK) | 6 |
| 30. | INZ002024L | Systems Analysis and Decision Support Methods | 6 |
| 31. | INZ002024Wc | Systems Analysis and Decision Support Methods (GK) | 6 |

| | | | |
|---|---|---|---|
| 32. | INZ002027W | Introduction to IoT | 6 |
| 33. | INZ002027L | Introduction to IoT | 6 |
| 34. | INZ004414L | Basics of Software Engineering | 5 |
| 35. | INZ004414Wc | Basics of Software Engineering (GK) | 5 |
| 36. | JZL100928BK | Foreign language B2.2/C1.2 | 6 |
| 37. | WFW030000BK | Sports II | 6 |
| 38. | SCZ001115S | Presentation Techniques | 6 |
| 39. | INZ004418W | Cybersecurity | 6 |
| 40. | INZ004418L | Cybersecurity | 6 |
| 41. | INZ002025W | Script Languages | 6 |
| 42. | INZ002025L | Script Languages | 6 |
| 43. | INZ004419W | Software Engineering | 6 |
| 44. | INZ004419P | Software Engineering | 6 |
| 45. | INZ004427W | Artificial intelligence and knowledge engineering | 6 |
| 46. | INZ004427L | Artificial intelligence and knowledge engineering | 6 |
| 47. | INZ002031W | Data Warehouses | 6 |
| 48. | INZ002031L | Data Warehouses | 6 |
| 49. | INZ004440W | IT Social and Professional Problems | 6 |

**8. Plan of studies (attachment no. 4)**

Approved by faculty student government legislative body:

11.03.2021
Date

Mateusz Sulak, Mateusz Sulak
name and surname, signature of student representative

11.03.2021
Date

DZIEKAN
dr hab. inż. Katarzyna Tworek, prof. uczelni
Dean / Deputy Dean
(3)

*delete as appropriate

Zał. nr 4 do ZW 16/2020
Attachment no. 3 to Program of Studies

# PLAN OF STUDIES

**FACULTY**: Computer Science and Management

**MAIN FIELD OF STUDY:** Applied Computer Science

**EDUCATION LEVEL:** first-level (~~licencjat~~/inżynier) studies / ~~second-level studies~~ / ~~magister uniform studies~~*

**FORM OF STUDIES**: full-time studies / ~~part-time studies~~*

**PROFILE:** general academic /~~practical~~ *

**SPECIALIZATION**: not applicable

**LANGUAGE OF STUDY:** English/Polish

In effect since 2021/22

*delete as applicable

## Plan of studies structure (optionally)

1) in point layout; *practical training after VI semester, 5 ECTS + 160 h CNPS added to the balance of semester VI, Mi – modules of optional courses; 1 course to choose*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 28 | CNPS ECTS | CNPS ECTS | CNPS ECTS | CNPS ECTS | CNPS ECTS | CNPS ECTS | CNPS ECTS | |
| 27 | 900 30 | 900 30 | 900 30 | 900 30 | 900 30 | 900 30 | 900 30 | |
| 26 | | | | Sports II<br>30 0 | | | | |
| 25 | | | Sports I<br>30 0 | | Presentation Tech.niques<br>60 2 | | | |
| 24 | General Physics I<br>120 4 (2+2) | General Physics II<br>180 6 (3+1+2) | | Foreign language B2.2/C1.2<br>90 3 | | **M8** – Multimedia<br>120 4 (2+2) | | |
| 23 | | | Foreign language A1/A2/ B1/ B2.1/ C1.1<br>60 2 | | **M4** – Mobile Applications<br>120 4 (2+2) | | | |
| 22 | | | | | | | | |
| 21 | Computer System Organization<br>90 3 (2+1) | | | | | | | |
| 20 | | Computer Architecture<br>120 4 (2+2) | | **M1** – Administration of Computer<br>120 4 (2+2) | | **M7** – Programming Tools and Technologies<br>110 4 (2+2) | | |
| 19 | | | Basics of entrepreneurship<br>60 2 | | **M3** – Database design<br>120 4 (2+2) | | | |
| 18 | Structural and Object oriented Programming<br>180 6 (2+2+2) | | | | | | | |
| 17 | | | Computer Networks 200<br>7 (4+3) | | | | M10 – Humanistic subject<br>90 3 | |
| 16 | | Data Structures and Algorithms<br>180 6 (2+2+2) | | Systems Analysis and Decision Support<br>190 7 (3+2+2) | **M2** – Web Technologies<br>120 4 (2+2) | **M6** – Distributed Systems<br>120 4 (2+2) | | |
| 15 | | | | | | | **M9** – Current Trends in Computer Science<br>150 5 (2+3) | |
| 14 | | | | | | | | |
| 13 | | | | | | | | |
| 12 | Logics for IT Specialists<br>150 5 (3+2) | | Effective Programming Techniques<br>150 5 (2+3) | Script Langugages<br>175 6 (3+3) | Cybersecurity<br>150 5 (3+2) | **M5** – Project Management Basics<br>120 4 (1+2+1) | | |
| 11 | | Operating Systems<br>120 4 (2+2) | | | | | Team Project<br>600 20 (19+1) | |
| 10 | | | | | | | | |
| 9 | | | Programming Paradigms<br>200 7 (3+2+2) | | | | | |
| 8 | Algebra and Analytic Geometry<br>180 6 (3+3) | | | Databases<br>175 6 (2+2+2) | Introduction to IoT<br>150 5 (2+3) | Data Warehouses<br>120 4 (2+3) | | |
| 7 | | Discrete Mathematics<br>150 5 (2+3) | | | | | | |
| 6 | | | | | | | | |
| 5 | | | | | | | | |
| 4 | Mathematical Analysis I<br>180 6 (3+3) | | Theory of Probabilistic and Statistics<br>200 7 (4+3) | Basics of Software Engineering<br>120 4 (1+2+1) | Software Engineering<br>180 6 (3+3) | Artificial Intelligence and Knowledge Engineering<br>150 5 (2+3) | | |
| 3 | | Mathematical Analysis II<br>150 5 (3+2) | | | | | | |
| 2 | | | | | | | IT Social and Prof. Problems<br>60 2 | |
| 1 | | | | | | | | |
| | I | II | III | IV | V | VI | VII | Total |
| | 24/360 | 24/360 | 25/375 | 26/360 | 25/375 | 24/360 | 17/285 | 165/2475 |

2) in hourly layout

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | CNPS | ECTS | CNPS | ECTS | CNPS | ECTS | CNPS | ECTS | CNPS | ECTS | CNPS | ECTS | |
| 27 | 900 | 30 | 900 | 30 | 900 | 30 | 900 | 30 | 900 | 30 | 900 | 30 | |
| 26 | | | | | | | Sports II (2h) | | | | | | |
| 25 | | | | | Sports I (2h) | | | | Presentation Techniques (00002) | | | | |
| 24 | General Physics I (21000) | | General Physics II (21100 E) | | | | Foreign language B2.2/C1.2 (4h) | | | | **M8** - Multimedia (20200) | | |
| 23 | | | | | Foreign language A1/A2/ B1/ B2.1/ C1.1 (4h) | | | | **M4** – Mobile applications (20200) | | | | |
| 22 | | | | | | | | | | | | | |
| 21 | Computer System Organization (21000) | | | | | | | | | | | | |
| 20 | | | Computer Architecture (20200) | | | | **M1** - Administration of Computer (20200) | | | | **M7** – Programming Tools and Technologies (20200) | | |
| 19 | | | | | Basics of entre-preneurship (20000) | | | | **M3** - Database design (10020) | | | | |
| 18 | Structural and Object oriented Programming (22200) | | | | | | | | | | | | |
| 17 | | | | | Computer Networks (30200 E) | | | | | | | **M10** - Humanistic subject (2h) | |
| 16 | | | Data Structures and Algorithms (21200 E) | | | | Systems Analysis and Decision Support (21100 E) | | **M2** – Web Technologies (20200) | | **M6** – Distributed Systems (20200) | | |
| 15 | | | | | | | | | | | | **M9** - Current Trends in Computer Science (20200) | |
| 14 | | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | | |
| 12 | Logics for IT Specialists (22000 E) | | | | Effective Programming Techniques (10200) | | Script Languages (20200 E) | | Cybersecurity (20200 E) | | **M5** - Project Management Basics (10201) | | |
| 11 | | | Operating Systems (20200) | | | | | | | | | Team Project (00081) | |
| 10 | | | | | | | | | | | | | |
| 9 | | | | | Programming Paradigms (21200 E) | | | | | | | | |
| 8 | Algebra and Analytic Geometry (22000 E) | | | | | | Databases (21100 E) | | Introduction to IoT (20200 E) | | Data Warehouses (20200 E) | | |
| 7 | | | Discrete Mathematics (22000) | | | | | | | | | | |
| 6 | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | |
| 4 | Mathematical Analysis I (22000 E) | | | | Theory of Probabilistic and Statistics (22000 E) | | Basics of Software Engineering (12100) | | Software Engineering (20020 E) | | Artificial Intelligence and Knowledge Engineering (20200 E) | | |
| 3 | | | Mathematical Analysis II (21000 E) | | | | | | | | | | |
| 2 | | | | | | | | | | | | IT Social and Professio-nal Problems (20000) | |
| 1 | | | | | | | | | | | | | |
| | I | | II | | III | | IV | | V | | VI | VII | Total |
| | 24/360 | | 24/360 | | 25/375 | | 26/360 | | 25/375 | | 24/360 | 17/285 | 165/2475 |

# 1. Set of obligatory and optional courses and groups of courses in semestral arrangement

## Semester 1

### Obligatory courses / groups of courses  Number of ECTS points 30

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ004399L | Structural and Object oriented Programming | | | 2 | | | K1INF_W03 K1INF_U01 K1INF_U02 | 30 | 60 | 2 | | 1,2 | T | Z | | | P (2) | PD |
| 2. | INZ004400Wc | Computer System Organization (GK) | 2 | 1 | | | | K1INF_W06 | 45 | 90 | 3 | | 1,8 | T | Z (w) | | | | PD |
| 3. | INZ004399Wc | Structural and Object oriented Programming (GK) | 2 | 2 | | | | K1INF_W03 K1INF_U01 K1INF_U02 | 60 | 120 | 4 | | 2,4 | T | E (w) | | | | PD |
| 4. | INZ004402Wc | Logic for IT Specialists (GK) | 2 | 2 | | | | K1INF_W01 | 60 | 150 | 5 | 5 | 3 | T | E (w) | | DN | | K |
| 5. | FZP001136Wc | General Physics I (GK) | 2 | 1 | | | | K1INF_W02 | 45 | 120 | 4 | | 2,4 | T | Z (w) | O | | | PD |
| 6. | MAT001688Wc | Algebra and Analytic Geometry (GK) | 2 | 2 | | | | K1INF_W01 | 60 | 180 | 6 | | 3,6 | T | E (w) | O | | | PD |
| 7. | MAT001689Wc | Mathematical Analysis I (GK) | 2 | 2 | | | | K1INF_W01 | 60 | 180 | 6 | | 3,6 | T | E (w) | O | | | PD |
| | | Total | 12 | 10 | 2 | | | | 360 | 900 | 30 | 5 | 18 | | | | | 2 | |

### Altogether in semester

| Total number of hours | | | | | Total number of ZZU hours | Total number of CNPS hours | Total number of ECTS points | Total number of ECTS points for DN classes[5] | Number of ECTS points for BU classes[1] |
|---|---|---|---|---|---|---|---|---|---|
| lec | cl | lab | pr | sem | | | | | |
| 12 | 10 | 2 | | | 360 | 900 | 30 | 5 | 18 |

# Semester 2

## Obligatory courses / groups of courses  Number of ECTS points 30

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University-wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ004403L | Data Structures and Algorithms | | | 2 | | | K1INF_W03 K1INF_U01 | 30 | 60 | 2 | 2 | 1,2 | T | Z | | DN | P (2) | K |
| 2. | INZ004404W | Computer Architecture | 2 | | | | | K1INF_W06 K1INF_U04 K1INF_U05 | 30 | 60 | 2 | 2 | 1,2 | T | Z | | DN | | K |
| 3. | INZ004404L | Computer Architecture | | | 2 | | | K1INF_W06 K1INF_U04 K1INF_U05 | 30 | 60 | 2 | 2 | 1,2 | T | Z | | DN | P (2) | K |
| 4. | FZP001137L | General Physics II | | | 1 | | | K1INF_W02 | 15 | 60 | 2 | | 1,2 | T | Z | O | | P (2) | PD |
| 5. | INZ004405W | Operating Systems | 2 | | | | | K1INF_W08 K1INF_U06 | 30 | 60 | 2 | 2 | 1,2 | T | Z | | DN | | K |
| 6. | INZ004405L | Operating Systems | | | 2 | | | K1INF_W08 K1INF_U06 | 30 | 60 | 2 | 2 | 1,2 | T | Z | | DN | P (2) | K |
| 7. | INZ004403Wc | Data Structures and Algorithms (GK) | 2 | 1 | | | | K1INF_W03 K1INF_U01 | 45 | 120 | 4 | 4 | 2,4 | T | E (w) | | DN | | K |
| 8. | FZP001137Wc | General Physics II (GK) | 2 | 1 | | | | K1INF_W02 | 45 | 120 | 4 | | 2,4 | T | E (w) | O | | | PD |
| 9. | INZ004406Wc | Discrete Mathematics (GK) | 2 | 2 | | | | K1INF_W01 | 60 | 150 | 5 | | 3 | T | Z (w) | | | | PD |
| 10. | MAT001690Wc | Mathematical Analysis II (GK) | 2 | 1 | | | | K1INF_W01 | 45 | 150 | 5 | | 3 | T | E (w) | O | | | PD |
| | | Total | | | | | | | | | | | | | | | | | |

## Altogether in semester

| Total number of hours | | | | | Total number of ZZU hours | Total number of CNPS hours | Total number of ECTS points | Total number of ECTS points for DN classes[5] | Number of ECTS points for BU classes[1] |
|---|---|---|---|---|---|---|---|---|---|
| lec | cl | lab | pr | sem | | | | | |
| 12 | 5 | 7 | | | 360 | 900 | 30 | 14 | 18 |

# Semester 3

## Obligatory courses / groups of courses  Number of ECTS points 28

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | ZMZ001643W | Basics of entrepreneurship | 2 | | | | | K1INF_W19 | 30 | 60 | 2 | | 1,2 | T | Z | | | | KO |
| 2. | INZ004407W | Computer Networks | 3 | | | | | K1INF_W09 K1INF_U07 | 45 | 110 | 4 | 4 | 2,4 | T | E | | DN | | K |
| 3. | INZ004407L | Computer Networks | | | 2 | | | K1INF_W09 K1INF_U07 | 30 | 90 | 3 | 3 | 1,8 | T | Z | | DN | P (3) | K |
| 4. | INZ004408W | Effective Programming Techniques | 1 | | | | | K1INF_W03 K1INF_U01 | 15 | 60 | 2 | 2 | 1,2 | T | Z | | DN | | K |
| 5. | INZ004408L | Effective Programming Techniques | | | 2 | | | K1INF_W03 K1INF_U01 | 30 | 90 | 3 | 3 | 1,8 | T | Z | | DN | P (3) | K |
| 6. | INZ004409Wc | Programming paradigms | | | 2 | | | K1INF_W04 K1INF_U02 | 30 | 60 | 2 | 2 | 1,2 | T | Z | | DN | P (2) | K |
| 7. | INZ004409L | Programming paradigms (GK) | 2 | 1 | | | | K1INF_W04 K1INF_U02 | 45 | 140 | 5 | 5 | 3 | T | E (w) | | DN | | K |
| 8. | INZ004410Wc | Theory of Probabilistic and Statistics (GK) | 2 | 2 | | | | K1INF_W01 | 60 | 200 | 7 | | 4,2 | T | E (w) | | | | PD |
| | | Total | 10 | 3 | 6 | | | | 285 | 810 | 28 | 19 | 16,8 | | | | | 8 | |

## Optional courses / groups of courses (minimum 90 hours in semester, 2 ECTS points)

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | JZL100927BK | Foreign language A1/A2/ B1/ B2.1/ C1.1 | | 4 | | | | K1INF_U19 | 60 | 60 | 2 | | 1,2 | T | Z | O | | | KO |
| 2. | WFW030000BK | Sports I | | 2 | | | | | 30 | 30 | 0 | | 0 | T | Z | O | | | KO |
| | | Total | | 6 | | | | | 90 | 90 | 2 | | 1,2 | | | | | | |

## Altogether in semester

| Total number of hours | | | | | Total number of ZZU hours | Total number of CNPS hours | Total number of ECTS points | Total number of ECTS points for DN classes[5] | Number of ECTS points for BU classes[1] |
|---|---|---|---|---|---|---|---|---|---|
| lec | cl | lab | pr | sem | | | | | |
| 10 | 7 | 6 | | | 375 | 900 | 30 | 19 | 18 |

# Semester 4

## Obligatory courses / groups of courses  Number of ECTS points 23

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ002023L | Data Bases | | | 1 | | | K1INF_W13 K1INF_U03 K1INF_U04 | 15 | 60 | 2 | 2 | 1,2 | T | Z | | DN | P (2) | K |
| 2. | INZ002024L | Systems Analysis and Decision Support Methods | | | 1 | | | K1INF_W12 K1INF_U07 | 15 | 50 | 2 | 2 | 1,2 | T | Z | | DN | P (2) | K |
| 3. | INZ002025W | Script Languages | 2 | | | | | K1INF_W03 K1INF_U01 | 30 | 85 | 3 | 3 | 1,8 | T | E | | DN | | |
| 4. | INZ002025L | Script Languages | | | 2 | | | K1INF_W03 K1INF_U01 | 30 | 90 | 3 | 3 | 1,8 | T | Z | | DN | P (3) | K |
| 5. | INZ004414L | Basics of Software Engineering | | | 1 | | | K1INF_W06 K1INF_U03 | 15 | 30 | 1 | 1 | 0,6 | T | Z | | DN | P (1) | K |
| 6. | INZ002023Wc | Data Bases (GK) | 2 | 1 | | | | K1INF_W13 K1INF_U03 K1INF_U04 | 45 | 115 | 4 | 4 | 2,4 | T | E(w) | | DN | | K |
| 7. | INZ002024Wc | Systems Analysis and Decision Support Methods (GK) | 2 | 1 | | | | K1INF_W12 K1INF_U07 | 45 | 140 | 5 | 5 | 3 | T | E(w) | | DN | | K |
| 8. | INZ004414Wc | Basics of Software Engineering (GK) | 1 | 2 | | | | K1INF_W06 K1INF_U03 | 45 | 90 | 3 | 3 | 1,8 | T | Z(w) | | DN | | K |
| | | Total | 7 | 4 | 5 | | | | 240 | 660 | 23 | 23 | 13,8 | | | | | 8 | |

## Optional courses / groups of courses (minimum 60 hours in semester, 3 ECTS points)

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | JZL100928BK | Foreign language B2.2/C1.2 | | 4 | | | | K1INF_U17 | 60 | 90 | 3 | | 1,8 | T | Z | O | | | KO |
| 2. | WFW030000BK | Sports II | | 2 | | | | | 30 | 30 | 0 | | 0 | T | Z | O | | | KO |
| | | Total | | 6 | | | | | 90 | 120 | 3 | | 1,8 | | | | | | |

## Optional M1 block - Administration of Computer Systems (minimum 60 hours in semester, 4 ECTS points, selection of 1 course)

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 4. | INZ004415WI | Linux Server Administration (GK) | 2 | | 2 | | | K1INF_W08 K1IN_U14 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 5. | INZ004468WI | Managing IT infrastructure (GK) | 2 | | 2 | | | K1INF_W08 K1IN_U14 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 6. | INZ002026WI | Routing and Switching in Computer Networks (GK) | 2 | | 2 | | | K1INF_W08 K1IN_U14 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| | | Total | 2 | | 2 | | | | 60 | 120 | 4 | 4 | 2,4 | | | | | 2 | |

## Altogether in semester

| Total number of hours | | | | | Total number of ZZU hours | Total number of CNPS hours | Total number of ECTS points | Total number of ECTS points for DN classes[5] | Number of ECTS points for BU classes[1] |
|---|---|---|---|---|---|---|---|---|---|
| lec | cl | lab | pr | sem | | | | | |
| 9 | 10 | 7 | | | 390 | 900 | 30 | 27 | 18 |

# Semester 5

## Obligatory courses / groups of courses  Number of ECTS points 18

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | SCZ001115S | Presentation Techniques | | | | | 2 | K1INF_U18 | 30 | 60 | 2 | | 1,2 | T | Z | | | | KO |
| 2. | INZ004418W | Cybersecurity | 2 | | | | | K1INF_W10 K1INF_U08 | 30 | 90 | 3 | 3 | 1,8 | T | E | | DN | | K |
| 3. | INZ004418L | Cybersecurity | | | 2 | | | K1INF_W10 K1INF_U08 | 30 | 60 | 2 | 2 | 1,2 | T | Z | | DN | P (2) | K |
| 4. | INZ002027W | Introduction to IoT | 2 | | | | | K1INF_W09 K1INF_U04 K1INF_U07 | 30 | 60 | 2 | 2 | 1,2 | T | E | | DN | | K |
| 5. | INZ002027L | Introduction to IoT | | | 2 | | | K1INF_W09 K1INF_U04 K1INF_U07 | 30 | 90 | 3 | 3 | 1,8 | T | Z | | DN | P (3) | K |
| 6. | INZ004419W | Software Engineering | 2 | | | | | K1INF_W14 K1INF_U03 K1INF_U04 K1INF_U21 | 30 | 90 | 3 | 3 | 1,8 | T | E | | DN | | K |
| 7. | INZ004419P | Software Engineering | | | | 2 | | K1INF_W14 K1INF_U03 K1INF_U04 K1INF_U21 | 30 | 90 | 3 | 3 | 1,8 | T | Z | | DN | P (3) | K |
| | | Total | 6 | | 4 | 2 | 2 | | 210 | 540 | 18 | 16 | 10,8 | | | | | 8 | |

## Optional block M2 - Web Technologies (minimum 60 hours in semester, 4 ECTS points, selection of 1 course)

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 3. | INZ004420WI | Web Systems Programming (GK) | 2 | | 2 | | | K1INF_W07 K1INF_U11 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 4. | INZ002028WI | Developing Web Applications with .NET (GK) | 2 | | 2 | | | K1INF_W07 K1INF_U11 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| | | Total | 2 | | 2 | | | | 60 | 120 | 4 | 4 | 2,4 | | | | | 2 | |

## Optional block M3 - Database Design (minimum 45 hours in semester, 4 ECTS points, selection of 1 course)

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 4. | INZ004422Wp | Database Systems Engineering (GK) | 1 | | | 2 | | K1INF_W14 K1INF_U03 K1INF_U04 | 45 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 5. | INZ004470Wp | Database Programming (GK) | 1 | | | 2 | | K1INF_W14 K1INF_U03 K1INF_U04 | 45 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 6. | INZ004424Wp | Database Design (GK) | 1 | | | 2 | | K1INF_W14 K1INF_U03 K1INF_U04 | 45 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| | | Total | 1 | | | 2 | | | 45 | 120 | 4 | 4 | 2,4 | | | | | 2 | |

## Optional block M4 - Mobile applications (minimum 60 hours in semester, 4 ECTS points, selection of 1 course)

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 3. | INZ002029WI | Mobile Applications for Android (GK) | 2 | | 2 | | | K1INF_W07 K1INF_U11 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 4. | INZ002030WI | Mobile Applications for IOS (GK) | 2 | | 2 | | | K1INF_W07 K1INF_U11 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| | | Total | 2 | | 2 | | | | 60 | 120 | 4 | | 4 | | | | | 2 | |

## Altogether in semester

| Total number of hours | | | | | Total number of ZZU hours | Total number of CNPS hours | Total number of ECTS points | Total number of ECTS points for DN classes[5] | Number of ECTS points for BU classes[1] |
|---|---|---|---|---|---|---|---|---|---|
| lec | cl | lab | pr | sem | | | | | |
| 11 | | 8 | 4 | 2 | 375 | 900 | 30 | 28 | 18 |

# Semester 6

## Obligatory courses / groups of courses Number of ECTS points 9

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University-wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ004427W | Artificial intelligence and knowledge engineering | 2 | | | | | K1INF_W13 K1INF_U06 | 30 | 60 | 2 | 2 | 1,2 | T | E | | DN | | K |
| 2. | INZ004427L | Artificial intelligence and knowledge engineering | | | 2 | | | K1INF_W13 K1INF_U06 | 30 | 90 | 3 | 3 | 1,8 | T | Z | | DN | P (3) | K |
| 3. | INZ002031W | Data Warehouses | 2 | | | | | K1INF_W12 K1INF_U06 | 30 | 60 | 2 | 2 | 1,2 | T | E | | DN | | K |
| 4. | INZ002031L | Data Warehouses | | | 2 | | | K1INF_W12 K1INF_U06 | 30 | 60 | 2 | 2 | 1,2 | T | Z | | DN | P (2) | K |
| 5. | INZ002044Q | Practical training | | | | | | | 0 | 160 | 5 | 1 | 0 | T | Z | | | | K |
| | | Total | 4 | | 4 | | | | 120 | 430 | 14 | 10 | 5,4 | | | | | 5 | |

## Optional block M5 - Project Management Basics (minimum 60 hours in semester, 4 ECTS points, selection of 1 course)

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University-wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 3. | INZ002032Wls | Introduction to IT Project Management (GK) | 1 | | 2 | | 1 | K1INF_W17 K1INF_U09 K1INF_U16 K1INF_U18 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 4. | INZ002033Wls | Support for IT Project Management (GK) | 1 | | 2 | | 1 | K1INF_W17 K1INF_U09 K1INF_U16 K1INF_U18 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| | | Total | 1 | | 2 | | 1 | | 60 | 120 | 4 | 4 | 4 | | | | | 2 | |

## Optional block M6 - Distributed Systems (minimum 60 hours in semester, 4 ECTS points, selection of 1 course)

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University-wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 3. | INZ002035WI | Distributed Computer Systems (GK) | 2 | | 2 | | | K1INF_W07 K1INF_U11 K1INF_U16 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 4. | INZ004470WI | Cloud programming (GK) | 2 | | 2 | | | K1INF_W07 K1INF_U11 K1INF_U16 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | 2 | | 2 | | | | 60 | 120 | 4 | 4 | 2,4 | | | | | 2 | |

## Optional block M7 - Programming Tools and Technologies (minimum 60 hours in semester, 4 ECTS points, selection of 1 course)

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 3. | INZ004376WI | Game Programming (GK) | 2 | | 2 | | | K1INF_W16 K1INF_U13 | 60 | 110 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 4. | INZ004436WI | Advanced Web Technologies (GK) | 2 | | 2 | | | K1INF_W16 K1INF_U13 | 60 | 110 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| | | Total | 2 | | 2 | | | | 60 | 110 | 4 | 4 | 4 | | | | | 2 | |

## Optional block M8 - Multimedia (minimum 60 hours in semester, 4 ECTS points, selection of 1 course)

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University -wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 4. | INZ004437WI | Computer Graphics (GK) | 2 | | 2 | | | K1INF_W15 K1INF_U12 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 5. | INZ004438WI | Programming Multimedia Applications (GK) | 2 | | 2 | | | K1INF_W15 K1INF_U12 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | DN | P (2) | K |
| 6. | INZ004439WI | Digital Media Processing Techniques (GK) | 2 | | 2 | | | K1INF_W15 K1INF_U12 | 60 | 120 | 4 | 4 | 2,4 | T | Z (w) | | | P (2) | K |
| | | Total | 2 | | 2 | | | | 60 | 120 | 4 | 4 | 2,4 | | | | DN | 2 | |

## Altogether in semester

| Total number of hours | | | | | Total number of ZZU hours | Total number of CNPS hours | Total number of ECTS points | Total number of ECTS points for DN classes[5] | Number of ECTS points for BU classes[1] |
|---|---|---|---|---|---|---|---|---|---|
| lec | Cl | lab | pr | sem | | | | | |
| 11 | | 12 | | 1 | 360 | 900 (including 160 of training) | 30 (including 5 of training) | 26 (including 1 of training) | 18 (including 3 of training) |

# Semester 7

## Obligatory courses / groups of courses  Number of ECTS points 22

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University-wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ004440W | IT Social and Professional Problems | 2 | | | | | K1INF_W20<br>K1INF_W22 | 30 | 60 | 2 | | 1,2 | T | Z | | | | KO |
| 2. | INZ002039Ps | Team Project (GK) | | | | 8 | 1 | K1INF_U10<br>K1INF_U17<br>K1INF_U20<br>K1INF_U21<br>K1INF_U22<br>K1INF_K01<br>K1INF_K02<br>K1INF_K03<br>K1INF_K04 | 135 | 600 | 20 | 20 | 12 | T | Z | | DN | P (19) | K |
| | | Total | 2 | | | 8 | 1 | | 165 | 660 | 22 | 20 | 13,2 | | | | | | |

## Optional block M9 - Current trends in Computer (minimum 60 hours in semester, 5 ECTS points, selection of 1 course)

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University-wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 5. | INZ002040WI | Data Science (GK) | 2 | | 2 | | | K1INF_W18<br>K1INF_U10 | 60 | 150 | 5 | 5 | 3 | T | Z (w) | | DN | P (3) | K |
| 6. | INZ002041WI | Neural Networks (GK) | 2 | | 2 | | | K1INF_W18<br>K1INF_U10 | 60 | 150 | 5 | 5 | 3 | T | Z (w) | | DN | P (3) | K |
| 7. | INZ002042WI | Metaheuristics in Problems Solving (GK) | 2 | | 2 | | | K1INF_W18<br>K1INF_U10 | 60 | 150 | 5 | 5 | 3 | T | Z (w) | | DN | P (3) | K |
| 8. | INZ002043WI | Human–Computer Interaction (GK) | 2 | | 2 | | | K1INF_W18<br>K1INF_U10 | 60 | 150 | 5 | 5 | 3 | T | Z (w) | | DN | P (3) | K |
| | | Total | 2 | | 2 | | | | 60 | 150 | 5 | 5 | 3 | | | | | 3 | |

## Optional block M10 - Humanistic subject (minimum 30 hours in semester, 3 ECTS points, selection of 1 course)

| No. | Course/ group of courses code | Name of course/group of courses (denote group of courses with symbol **GK**) | Weekly number of hours | | | | | Learning effect symbol | Number of hours | | Number of ECTS points | | | Form[2] of course/group of courses | Way[3] of crediting | Course/group of courses | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | lec | cl | lab | pr | sem | | ZZU | CNPS | Total | DN[5] classes | BU[1] classes | | | University-wide[4] | Concerning scientific activities[5] | Practical[6] | Type[7] |
| 1. | INZ118560BK | Humanities subject 1 | 2 | | | | | K1INF_W22 | 30 | 90 | 3 | | 1,8 | T | Z | O | | | KO |
| 2. | INZ118560BK | Humanities subject 2 | 2 | | | | | K1INF_W22 | 30 | 90 | 3 | | 1,8 | T | Z | O | | | KO |
| | | Total | 2 | | | | | | 30 | 90 | 3 | | 1,8 | | | | | | |

## Altogether in semester

| Total number of hours | | | | | Total number of ZZU hours | Total number of CNPS hours | Total number of ECTS points | Total number of ECTS points for DN classes[5] | Number of ECTS points for BU classes[1] |
|---|---|---|---|---|---|---|---|---|---|
| lec | cl | lab | pr | sem | | | | | |
| 6 | | 2 | 8 | 1 | 255 | 900 | 30 | 25 | 18 |

## 3. Set of examinations in semestral arrangement

| Course / group of courses code | Names of courses / groups of courses ending with examination | Semester |
|---|---|---|
| INZ004402Wc<br>MAT001688Wc<br>MAT001689Wc | 1. Logic for IT Specialists<br>2. Algebra and Analytic Geometry<br>3. Mathematical Analysis I | 1 |
| INZ004403Wc<br>MAT001690Wc<br>FZP001137Wc | 1. Data Structures and Algorithms<br>2. Mathematical Analysis II<br>3. General Physics II | 2 |
| INZ004407W<br>INZ004409Wc<br>INZ004410Wc | 1. Computer Networks<br>2. Programming paradigms<br>3. Theory of Probabilistic and Statistics | 3 |
| INZ002024Wc<br>INZ002023Wc<br>INZ002025W | 1. Systems Analysis and Decision Support Methods<br>2. Databases<br>3. Script Languages | 4 |
| INZ004418W<br>INZ002027W<br>INZ004419W | 1. Cybersecurity<br>2. Introduction to IoT<br>3. Software Engineering | 5 |
| INZ004427W<br>INZ002031W | 1. Artificial intelligence and knowledge engineering<br>2. Data Warehouses | 6 |

**4. Numbers of allowable deficit of ECTS points after particular semesters**

| Semester | Allowable deficit of ECTS points after semester |
|---|---|
| 1 | 8 |
| 2 | 8 |
| 3 | 8 |
| 4 | 8 |
| 5 | 8 |
| 6 | 0 |
| 7 | 0 |

Opinion of student government legislative body

11.03.2021. Mateusz Salach Mateusz Salach

Date — Name and surname, signature of student representative

11.03.2021 Katarzyna Tworek

DZIEKAN

dr hab. inż. Katarzyna Tworek, prof. uczelni

Date — Dean's signature

(3)

**Concerning principles of training crediting**



**UCHWAŁA nr 8/1/2020–2024**
**RADY KONSULTACYJNEJ**
**Wydziału Informatyki i Zarządzania Politechniki Wrocławskiej**
**z dnia 29.09.2020 r.**
w sprawie przyjęcia zasad funkcjonowania Wydziałowego Systemu Jakości Kształcenia

§ 1. Rada Konsultacyjna Wydziału Informatyki i Zarządzania, działając w oparciu o ZW 34/2018 pozytywnie opiniuje aktualizację Wydziałowego Systemu Zapewnienia Jakości Kształcenia.

§ 2. Uchwała wchodzi w życie z dniem podjęcia.

DZIEKAN
dr hab. inż. Katarzyna Tworek, prof. uczelni
(1)

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name in Polish:** **Zaawansowane technologie webowe**
**Name in English:** **Advanced Web Technologies**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: practical**
**Level and form of studies:** **1st, full-time**
**Kind of subject:** **optional**
**Subject code** **INZ004436**
**Group of courses:** **YES**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 50 | | 60 | | |
| Form of crediting | Crediting with grade | | Crediting with points | | |
| For group of courses mark (X) final course | X | | | | |
| Number of ECTS points | 4 | | 0 | | |
| including number of ECTS points for practical (P) classes | 2 | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 2,4 | | | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Ability to structured and object-oriented programming.
2. Basic database skills

**SUBJECT OBJECTIVES**

C1 The ability to develop advanced web applications using web frameworks

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:

PEK_W01 Student could describe basic software components using by developing web systems

PEK_W02 Selects the appropriate technology for programming Web-based systems

relating to skills:

PEK_U01: Student is able to analyze and select the proper types and language constructs to support object-oriented programming paradigm on selected platform

PEK_U02: Student is able to implement a desktop application with the submitted requirements

PEK_U03: Student using information from various sources and is able to choose the right technology to implement an advance web application.

relating to social competences:

PEU_K01 Presents the results of their work

**PROGRAMME CONTENT**

| Form of classes – lecture | | Number of hours |
|---|---|---|
| Lec1 | An introduction to the course and the principles of assessment. Architecture of web services. | 2 |
| Lec2 | Single Page application principles | 2 |
| Lec3 | Design patterns (MVC, MVP, MVVM) | 2 |
| Lec4 | Overview of programming languages and usage of AJAX | 2 |
| Lec5 | Frameworks overview | 2 |
| Lec6 | Frontend, backend communication (REST) | 2 |
| Lec7 | Prototyping | 2 |
| Lec8 | Object-relational mapping Tools | 2 |
| Lec9 | Django framework and architecture | 2 |
| Lec10 | Case study of framework and architecture (II part ) | 2 |
| Lec11 | Performance of web services | 2 |
| Lec12 | Test of web services | 2 |
| Lec13 | Prediction in web services | 2 |
| Lec14 | Web mining | 2 |
| Lec15 | Final test | 2 |
| | Total hours | **30** |

| Form of classes - laboratory | | Number of hours |
|---|---|---|
| Lab 1 | Introductory classes: presentation of health and safety regulations, fire protection rules as well as grading and class policies. | 2 |
| Lab 2 | Define the functionality of web service Technology selection. | 2 |
| Lab 3 | Presenting of developing environment | 2 |
| Lab 4 | System design (UC Diagrams, DB Model, Mockups) | 2 |
| Lab 5 | Web application - basic version | 2 |
| Lab 6 | Web application applying data base | 2 |
| Lab 7 | Web application - functionality part I | 2 |
| Lab 8 | Web system with login ability | 2 |

| | | |
|---|---|---|
| Lab 9 | Web application - functionality part II | 2 |
| Lab 10 | Web application - functionality part III | 2 |
| Lab 11 | Web application - functionality part IV | 2 |
| Lab 12 | Applying charts in web systems | 2 |
| Lab 13 | Final application + test | 2 |
| Lab 14 | Bugs + Final application | 2 |
| Lab 15 | Credit | 2 |
| | Total number of hours | **30** |

**TEACHING TOOLS USED**

N1. Multimedia lecture.
N2. Computer laboratory with development environment.
N3. An e-learning system used for the publication of teaching materials, tests and communication

**EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Educational effect number | Way of evaluating educational effect achievement |
|---|---|---|
| FL – points from laboratory | PEK_U01<br>PEK_U02<br>PEK_U03<br>PEU_K01 | Implementation of tasks indicated by the teacher.<br>Scoring on scale (0-10).<br>Positive grade determined by proportional ranges from 50% to 100% of total points. |
| P Lec | PEK_W01<br>PEK_W02 | Solving tasks from test. Crediting: over 50% points for correct answers in the final test.<br>Positive grade determined by proportional ranges from 50% to 100% of total points. |
| | | |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

[1] Scott, Emmit. *SPA design and architecture: understanding single page web applications*. Manning Publications Co., 2015.

[2] Ravindran, Arun. *Django Design Patterns and Best Practices: Industry-standard web development techniques and solutions using Python*. Packt Publishing Ltd, 2018.

[3] Souders, Steve. "High-performance web sites." *Communications of the ACM* 51.12 (2008):

[4] Crowder, Phillip, and David A. Crowder. *Creating web sites bible*. John Wiley & Sons, 2008.

**SECONDARY LITERATURE:**

[1] Ganeshan, Amuthan. *Spring MVC: Beginner's Guide*. Packt Publishing Ltd, 2016.

[2] Melé, Antonio. *Django 3 By Example: Build powerful and reliable Python web applications from scratch*. Packt Publishing Ltd, 2020.

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

**Jolanta Wrzuszczak-Noga, jolanta.wrzuszczak-noga@pwr.edu.pl**

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish** Sztuczna Inteligencja i inżynierii wiedzy
**Name of subject in English** Artificial Intelligence and Knowledge Engineering
**Main field of study (if applicable):** Applied Computer Science
**Specialization (if applicable):**
**Profile: academic / ~~practical~~***
**Level and form of studies: 1st/ ~~2nd level~~, ~~uniform magister studies~~*, full-time / ~~part-time~~***
**Kind of subject: obligatory / ~~optional / university-wide~~***
**Subject code** INZ004427
**Group of courses ~~YES~~ / NO***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 60 | | 90 | | |
| Form of crediting | Examination / ~~crediting with grade~~* | Examination / crediting with grade* | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark (X) final course | | | | | |
| Number of ECTS points | 2 | | 3 | | |
| including number of ECTS points for practical classes (P) | | | 3 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,2 | | 1,8 | | |

*delete as not necessary

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Programming skills (Java, C ++)
2. Ability to read scientific texts with comprehension, including in English

**SUBJECT OBJECTIVES**

C1 Acquainting students with the field of artificial intelligence and its possibilities
C2 The ability to identify problems suitable for AI methods and select an appropriate approach to them

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEU_W01 Getting to know the field of artificial intelligence
PEU_W02 Learning the basic intelligent techniques, applicable to various types of problems

relating to skills:
PEU_U01 The ability to correctly identify problems suitable for the use of intelligent methods
PEU_U02 Ability to select the appropriate intelligent technique for a given problem

relating to social competences:

| |
|---|
| PEU_K01 The ability to transfer the acquired knowledge and the results of experiments<br>PEU_K02 |

| PROGRAMME CONTENT | | |
|---|---|---|
| **Lecture** | | **Number of hours** |
| Lec 1 | Introductory information to the course, discussion on artificial intelligence: understanding and defining AI, the state of development and prospects of AI in Poland | 2 |
| Lec 2 | Development of the field of AI by discussing selected key achievements of artificial intelligence, legal and ethical aspects of AI development | 2 |
| Lec 3 | Classic genetic algorithm as an example of a nature-inspired method | 2 |
| Lec 4 | Search problems | 2 |
| Lec 5 | Constraint satisfaction problems - definition, methods of solving | 2 |
| Lec 6 | Designing logical games: game tree, MINMAX algorithm and alpha-beta pruning on the example of a two-player game | 2 |
| Lec 7 | Planning task as an example of state space searching - forward state propagation, backward state propagation | 2 |
| Lec 8 | Knowledge base systems, expert systems, discussion of sample expert systems | 2 |
| Lec 9 | Knowledge, the role of knowledge in artificial intelligence, knowledge representation methods | 2 |
| Lec 10 | Knowledge processing - forward, backward, mixed reasoning | 2 |
| Lec 11 | Information uncertain. Methods of processing uncertain information; probability calculus, certainty factor | 2 |
| Lec 12 | Uncertain information - fuzzy inference | 2 |
| Lec 13 | Introduction to Machine Learning (ML). ML types. Inductive reasoning | 2 |
| Lec 14 | Generating decision trees | 2 |
| Lec 15 | Generating classification rules | 2 |
| | Total hours | 30 |
| **Laboratory** | | **Number of hours** |
| Lab 1 | Discussion of classes, purpose, regulations, forms of credits | 2 |
| Lab 2 | Exercise 1: Applying Evolutionary Computing: Performing the first step | 2 |
| Lab 3 | Exercise 1: Implementation of the second stage of the exercise, discussion of intermediate results | 2 |
| Lab 4 | Exercise 1: Ending the exercise, submitting the final report | 2 |
| Lab 5 | Exercise 2: Constraint satisfaction problems - discussion of the exercise, starting the first stage | 2 |
| Lab 6 | Exercise 2: Carrying out the second stage of the exercise | 2 |
| Lab 7 | Exercise 2: Ending the exercise, compiling the results, submitting the report | 2 |
| Lab 8 | Exercise 3: Designing a logical game - overview of the exercise, implementation of the first stage | 2 |
| Lab 9 | Exercise 3: Implementation of the second stage, min-max | 2 |

| | | |
|---|---|---|
| Lab10 | Exercise 3: Implementing the third stage, algae. alpha-beta | 2 |
| Lab11 | Exercise 3: Finishing the exercise, submitting the report | 2 |
| Lab12 | Exercise 4: The application of selected machine learning methods in the analysis of text or images - introducing students to the problems of the exercise | 2 |
| Lab13 | Exercise 4: Carrying out the first stage of the exercise | 2 |
| Lab14 | Exercise 4: Completing the exercise, submitting the report | 2 |
| Lab15 | Discussion and summary of the classes, completion of the course | 2 |
| | Total hours | 30 |

**TEACHING TOOLS USED**

N1. Projector
N2. Remote education systems available at Wrocław University of Science and Technology

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming during semester), P – concluding (at semester end) | Learning outcomes code | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | | Points for individual laboratory exercises, in accordance with the regulations provided to students, the sum of points will provide the basis for the final laboratory grade. |
| P Written exam in the form of a test - a selection test with negative points for a wrong answer | | |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**


[1] M. Tim Jones, ARTIFICIAL INTELLIGENCE: A Systems Approach. Infinity Science Press LLC, 2008, dostępna pod adresem: https://archive.org/details/2008ArtificialIntelligenceASystemsApproachM.TimJones http://www.freebookspot.es/Comments.aspx?Element_ID=306137
[2] Mariusz Flasiński, Wstęp do sztucznej inteligencji. Wydawnictwo Naukowe PWN, 2021
[3] Introduction to Machine Learning. Draft, Nils J. Nilsson http://ai.stanford.edu/~nilsson, 2010. Stanford University.
[4] Kwaśnicka H., Spirydowicz A., Uczący się komputer. Programowanie gier logicznych. Oficyna Wydawnicza PWr. Wrocław. 2004.


**SECONDARY LITERATURE:**


[1] John R. Searle Umysł, mózg i nauka, Wyd. Naukowe PWN, W-wa, 1995, seria Logos. Książkowa wersja cyklu 6 wykładów, po 30 minut każdy na antenie, każdy wykład stanowi całość, wszystkie też stanowią jedną całość – oryginalne treści. Wykłady na zaproszenie dla BBC w 1984 roku, tzw. Wykłady Reithowskie
[2] Terry Dartnall Ed., Artificial Intelligence and Creativity, Kluwer Academic Publishers (Studies in Cognitive Systems, volume 17), 1994.
[3] Publikacje w czasopismach wskazane przez prowadzącego, internetowe źródła o światowych projektach z AI


**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**


Halina Kwaśnicka, halina.kwasnicka@pwr.edu.pl

FACULTY OF COMPUTER SCIENCE AND MANAGEMENT

**SUBJECT CARD**

**Name of subject in Polish Podstawy przedsiębiorczości**
**Name of subject in English Basics of entrepreneurship**
**Main field of study (if applicable): Computer Science**
**Specialization (if applicable): ……..**
**Profile: academic**
**Level and form of studies: 1st, full-time**
**Kind of subject: obligatory**
**Subject code ZMZ001643W**
**Group of courses NO**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | **30** | | | | |
| Number of hours of total student workload (CNPS) | **60** | | | | |
| Form of crediting | **crediting with grade** | Examination / crediting with grade* | Examination / crediting with grade* | crediting with grade | Examination / crediting with grade* |
| For group of courses mark (X) final course | | | | | |
| Number of ECTS points | **2** | | | | |
| including number of ECTS points for practical classes (P) | | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | **1,2** | | | | |

*delete as not necessary

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1.The course is dedicated to students of various specializations who want to gain elementary knowledge about creating and managing the companies (also on Polish market).

**SUBJECT OBJECTIVES**

C1. Acquiring knowledge of entrepreneurship.
C2. Getting to know the instruments (strategies, models, methods) necessary for business management
C3. An acquaintance with principles of a business plan's preparation and presentation.

**SUBJECT EDUCATIONAL EFFECTS**

Relating to knowledge:
PEK_W01 has a structured knowledge of creating organizational and legal forms of conducting business activity in terms of creating new enterprises,
PEK_W02 characterizes and knows the basic areas of capital raising and strategies, models, management methods and development of business organization.

Relating to skills:
PEK_U01 can search and interpret knowledge related to entrepreneurship,

PEK_U02 is able to construct a business plan for a new company.

Relating to social competences:
PEK_K01 will acquire an active entrepreneurial attitude to the realization of undertakings innovative and creative thinking

**PROGRAMME CONTENT**

| | **Lecture** | **Number of hours** |
|---|---|---|
| Lec 1 | Defining entrepreneurship and supporting institutions. Global Entrepreneurship Index. | 2 |
| Lec 2 | Types of entrepreneurship - nature of business. Characteristics of the entrepreneur | 2 |
| Lec 3 | Locations of entrepreneurship: households, administrative institutions and market. An exchange of information | 2 |
| Lec 4 | Analysis of the company's environment | 2 |
| Lec 5 | Business models and marketing strategy | 2 |
| Lec 6 | Sources of financing for entrepreneurial activities. Budget elements. | 2 |
| Lec 7 | Selection of taxation forms. Basic financial statements and factors. | 2 |
| Lec 8 | Insurance and social security in running a business | 2 |
| Lec 9 | Material and financial investments | 2 |
| Lec 10 | Business plan structure | 2 |
| Lec 11 | Business plan examples | 2 |
| Lec 12 | Business risk management | 2 |
| Lec 13 | Electronic business security | 2 |
| Lec 14 | Intellectual property protection | 2 |
| Lec 15 | Final test | 2 |
| | Total hours | 30 |

**TEACHING TOOLS USED**

N1. multimedia presentation
N2. presentation of sub-tasks
N3. discussion

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming during semester), P – concluding (at semester end) | Learning outcomes code | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEK_W01, PEK_W02,PEK_U01, PEK_U02, | Measuring creative thinking by participating in a discussion during the class (lecture) |
| F2 | PEK_W01, PEK_W02,PEK_U01, PEK_U02, | Knowledge measurement by final test |
| F3 | PEK_K01 | Measuring knowledge by preparing a business essay |
| | | |

P = 0,25F1 + 0,5F2 + 0,25F3

## PRIMARY AND SECONDARY LITERATURE

**PRIMARY LITERATURE:** **online access from the PWr library**


[1] Bill Aulet, Chris Snyder; Marius Ursache, Disciplined Entrepreneurship Workbook, 2017, Wiley
[2] Karin Berglund, Karen Verduijn, Revitalizing Entrepreneurship Education, 2018, Routledge,
[3] Mathew J. Manimala, Entrepreneurship Education, 2017, Springer Singapore
[4] IB. V. Khandekar, Sameer Phan, Iinnovation, Incubation and Entrepreneurship, 2017, Singapore Springer Singapore


**SECONDARY LITERATURE:** **online access from the PWr library**


[5] Álvaro Cuervo ; Álvaro Cuervo; Domingo Ribeiro; Salvador Roig, Entrepreneurship, 2007, Springer Berlin Heidelberg,
[6] Legge, Entrepreneurship, 2004, Macmillan Education UK,
[7] Entrepreneurship, The AMA Dictionary of Business and Management, 2013, : AMACOM, Publishing Division of the American Management Association
[8] Mehmet Huseyin Danis, Hakan Demir, Ender Can, Ugur Bilgin Country Experiences in Economic Development, Management and Entrepreneurship, 2017, Springer International Publishin


## SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)


Anna Maria Kamińska, PhD. Anna.maria.kaminska@pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish** Wprowadzenie do inżynierii oprogramowania
**Name of subject in English** Basics of Software Engineering
**Main field of study (if applicable):** Applied Computer Science
**Specialization (if applicable):**
**Profile: academic***
**Level and form of studies: 1st *, full-time ***
**Kind of subject: obligatory ***
**Subject code INZ004414**
**Group of courses NO***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | | | 15 | | |
| Number of hours of total student workload (CNPS) | | | 30 | | |
| Form of crediting | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | | | | | |
| Number of ECTS points | | | 1 | | |
| including number of ECTS points for practical (P) classes | | | 1 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | | | 0,6 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge of object-oriented programming paradigm

**SUBJECT OBJECTIVES**

C1 To gain practical skills in requirement specification, domain modeling and software testing.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:

relating to skills:
PEK_U01 student specifies requirements using different techniques
PEK_U02 student develops a user interface prototype
PEK_U03 student develops a system data model with business constraints on the software system
PEK_U04 student defines test cases

| Laboratory | | Number of hours |
|---|---|---|
| Lab 1 | Organizational activities. | 1 |
| Lab 2 | Decision tables. User stories. | 2 |

| | | |
|---|---|---|
| Lab 3 | Use-case diagram. | 2 |
| Lab 4 | Use-case specifications: textual, activity diagrams, acceptance tests. | 2 |
| Lab 5 | User interface prototype. | 2 |
| Lab 6 | Data model. | 2 |
| Lab 7 | OCL. | 2 |
| Lab 8 | Test cases. | 2 |
| | Total hours | 15 |

## TEACHING TOOLS USED

N1. Examples of technical documentation and the UML models used in the software engineering area

## EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1- requirement specification | PEU_U01 | Labs 2-4, each with tasks for 10 points max. |
| F2 – user interface prototype | PEU_U02 | Lab 5 (10 points max). |
| F3 – data model and constraints | PEU_U03 | Labs 6-7, each with tasks for 10 points max. |
| F4 – test cases | PEU_U04 | Lab 7 (10 points max). |
| P1 – final grade | PEU_U01<br>PEU_U02<br>PEU_U03<br>PEU_U04 | P = F1 + F2 + F3 (max. 60 points)<br>P < 50% → 2.0<br>P∈ [50, 60) → 3.0<br>P∈ [60, 70) → 3.5<br>P∈ [70, 80) → 4.0<br>P∈ [80, 90) → 4.5<br>P∈ [90, 96) → 5.0<br>P∈ [96, 100] → 5.5 |
| C | | |

## PRIMARY AND SECONDARY LITERATURE

### PRIMARY LITERATURE:

[1] M. Fowler, UML distilled: a brief guide to the standard object modeling language, Addison-Wesley 2007
[2] Meyer, Software Engineering Springer International Publishing, 2015 (e resources)
[3] B. Hambling, Software Testing, BCS, 2015 (e resources)

### SECONDARY LITERATURE:

[1] Rumpe, Modeling with UML, Springer International Publishing, 2016 (e resources)
[2] Rumpe, Agile Modeling with UML, Springer International Publishing, 2017 (e resources)

## SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Bogumiła Hnatkowska, Bogumila.Hnatkowska@pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish** Wprowadzenie do inżynierii oprogramowania
**Name of subject in English** Basics of Software Engineering
**Main field of study (if applicable):** Applied Computer Science
**Specialization (if applicable):**
**Profile: academic***
**Level and form of studies: 1st *, full-time ***
**Kind of subject: obligatory ***
**Subject code INZ004414**
**Group of courses YES***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 15 | 30 | | | |
| Number of hours of total student workload (CNPS) | 90 | | | | |
| Form of crediting | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 3 | | | | |
| including number of ECTS points for practical (P) classes | - | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,8 | | | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge of object-oriented programming paradigm

**SUBJECT OBJECTIVES**

C1 To obtain basic knowledge about primary notions in software engineering, including life-cycle models, modelling languages and software testing
C2 To gain practical skills in requirement specification, domain modeling and software testing.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEU_W01 Student characterizes software lifecycle models
PEU_W02 Student knows UML and OCL constructs
PEU_W03 Student distinguishes between types of tests and test levels

relating to skills:
PEU_U01 Student prepares a software requirement specification (user stories, use-case PEU_U02 Student develops a data model for a software system (class diagram)
PEU_U03 Student specifies business constraints for a software system (in OCL)
PEU_U04 Student specifies tests for a software system at different levels

| PROGRAM CONTENT | | |
|---|---|---|
| **Lectures** | | **Number of hours** |
| Lec 1 | Introduction do Software Engineering. Life-cycle models. | 2 |
| Lec 2 | Requirement specification. Introduction to UML. Use-case diagrams. User-stories. | 3 |
| Lec 3 | Use-case specifications. Activity diagrams. Acceptance-tests. GUI prototypes. | 2 |
| Lec 4 | Analysis. Class diagrams. | 2 |
| Lec 5 | OCL. | 2 |
| Lec 6 | Testing. | 2 |
| Lec 7 | Software development methodologies - review. Final test. | 2 |
| | Total hours | 15 |
| **Classes** | | **Number of hours** |
| Cl 1 | Course introduction. | 1 |
| Cl 2 | Flowcharts and their transformation to a source code. | 3 |
| Cl 3 | Decision tables. Decision trees. | 2 |
| Cl 4 | Requirements specification: User-stories (epics) | 2 |
| Cl 5 | Requirements specification: Use-case diagrams. | 2 |
| Cl 6 | Textual use-case specifications. Activity diagrams. Acceptance-tests. | 4 |
| Cl 7 | Intermediate test. | 2 |
| Cl 8 | Glossary. Class diagrams. Transformation to source code. | 4 |
| Cl 9 | OCL. | 4 |
| Cl 10 | Testing. | 4 |
| Cl 11 | Final test. | 2 |
| | Total hours | 30 |

| TEACHING TOOLS USED |
|---|
| N1. Examples of technical documentation and the UML models used in the software engineering area<br>N2. Materials prepared by the lecturer |

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 – intermediate test (classwork) | PEU_U01 | Classwork - written work (tasks to solve) checking the trained skills.<br>maxF1 – maximal number of points for F1 |
| F2 – final test (classwork) | PEU_U01<br>PEU_U02<br>PEU_U03<br>PEU_U04 | Classwork – written work (tasks to solve) checking the trained skills.<br>maxF2 – maximal number of points for F2 |
| F3 – activity points | PEU_U02<br>PEU_U03<br>PEU_U04 | Number of points for student's activity during classes<br>maxF3 = 10% (maxF1 + maxF2) |

| | | |
|---|---|---|
| P1 – final evaluation of classwork | PEU_U02<br>PEU_U03<br>PEU_U04 | P = (F1 + F2 + F3)/(maxF1 + maxF2 + maxF3)<br>P < 50% → 2.0<br>P∈ [50, 60) → 3.0<br>P∈ [60, 70) → 3.5<br>P∈ [70, 80) → 4.0<br>P∈ [80, 90) → 4.5<br>P∈ [90, 96) → 5.0<br>P∈ [96, 100] → 5.5 |
| P2 – final evaluation of lecture | PEU_W01<br>PEU_W02<br>PEU_W03 | Colloquium - written work (theoretical problems) checking the gained knowledge from lecture scope. The work is given a positive evaluation, if the student scores at least 50% of the maximum number of points. The final evaluation of the lecture is determined on the basis of this mark.<br>The specific rule is the same as for P1 |
| P – final grade | All | P = 0,7 * P1 + 0,3 * P2 |

## PRIMARY AND SECONDARY LITERATURE

### PRIMARY LITERATURE:

[1] M. Fowler, UML distilled: a brief guide to the standard object modeling language, Addison-Wesley 2007
[2] Meyer, Software Engineering Springer International Publishing, 2015 (e resources)
[3] B. Hambling, Software Testing, BCS, 2015 (e resources)

### SECONDARY LITERATURE:

[1] Rumpe, Modeling with UML, Springer International Publishing, 2016 (e resources)
[2] Rumpe, Agile Modeling with UML, Springer International Publishing, 2017 (e resources)

## SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Bogumiła Hnatkowska, Bogumila.Hnatkowska@pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Programowanie w chmurze**
**Name of subject in English: Cloud programming**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable): ……..**
**Profile: academic / practical***
**Level and form of studies: 1st~~/ 2nd~~ level, ~~uniform magister studies~~*, full-time ~~/ part-time studies~~***
**Kind of subject: ~~obligatory~~ / optional ~~/ university-wide~~***
**Subject code: INZ004470**
**Group of courses YES**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 60 | | 60 | | |
| Form of crediting | ~~Examination /~~ crediting with grade* | Examination / crediting with grade* | ~~Examination /~~ crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 2 | | | 2 | |
| including number of ECTS points for practical (P) classes | | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,2 | | | 1,2 | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Programming skills in Java / Kotlin
2. Basic knowledge of databases
3. Programming skills to create applications for the Android platform

**SUBJECT OBJECTIVES**

C1 To familiarize students with various models of cloud computing, offered services and learn about good practices of programming and implementing applications to the cloud.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEU_W01 - knows various models of cloud computing and the types of services offered.
PEU_W02 - lists and describes Infrastructure as Code tools
PEU_W03 - lists and describes tools for the orchestration of cloud services
relating to skills:
PEU_U01 - implements applications in the cloud using various types of data services, computing services, application services, serverless services.

**PROGRAM CONTENT**

| Lectures | | Number of hours |
|---|---|---|
| Lec 1 | Introduction to the subject, course program description, organization of classes and rules of passing. Introduction of basic concepts, evolution and standardization in the field of cloud computing | 1 |
| Lec 2 | Cloud security | 2 |
| Lec 3 | Basic AWS services | 2 |
| Lec 4 | Docker and Packer | 2 |
| Lec 5 | Infrastructure as Code tools | 4 |
| Lec 6 | Cloud service orchestration | 4 |
| Lec 7 | Cloud data storage | 2 |
| Lec 8 | Serverless architecture | 2 |
| Lec 9 | Design and implementation of a cloud application | 4 |
| Lec 10 | Continuous integration tools | 2 |
| Lec 11 | Good practices in cloud solutions | 2 |
| Lec 12 | Test | 2 |
| | Total hours | **30** |

| Laboratory | | Number of hours |
|---|---|---|
| Lab 1 | Preview, health and safety course. Presentation of the scope and principles of evaluation. | 2 |
| Lab 2 | Design and implementation of a web application - task 1 | 6 |
| Lab 3 | Design and implementation of a mobile application - task 2 | 6 |
| Lab 4 | Dockerization of designed applications - task 3 | 2 |
| Lab 5 | Implementation of the cloud infrastructure using Terraform - task 4 | 4 |
| Lab 6 | Orchestration of the designed application - task 5 | 4 |
| Lab 7 | Application implementation in serverless architecture - task 6 | 4 |
| Lab 8 | Summary and survey of laboratory classes; issuing grades | 4 |
| | Total hours | 30 |

## TEACHING TOOLS USED

N1. An informative lecture with elements of a problem lecture, supported by multimedia presentations.

N2. Integrated development environment supporting application development on AWS platform.

N3. Student's own work - literature studies.

## EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 – task 1 | PEU_U01 | Assessment of the solution of the task 1 on a scale of 0..10 or traditional |

| | | |
|---|---|---|
| F2 – task 2 | PEU_U01 | Assessment of the solution of the task 1 on a scale of 0..10 or traditional |
| F3 – task 3 | PEU_U01 | Assessment of the solution of the task 1 on a scale of 0..10 or traditional |
| F4 – task 4 | PEU_U01 | Assessment of the solution of the task 1 on a scale of 0..10 or traditional. |
| F5 – task 5 | PEU_U01 | Assessment of the solution of the task 1 on a scale of 0..10 or traditional |
| F6 – task 6 | PEU_U01 | Assessment of the solution of the task 1 on a scale of 0..10 or traditional |
| P1 - partial evaluation (laboratory) | PEU_U01 | A pass mark is awarded from the laboratory if the student obtains at least 50% of the maximum number of points. Later, the rating is increased by 0.5 every 10%. |
| P2 - partial evaluation (lecture) | PEU_W01, PEU_W02, PEU_W03 | Test - written, containing open and test questions, checking the knowledge and skills of the lecture. The test is passed if the student obtains at least 50% of the maximum number of points. Later, the rating is increased by 0.5 every 10%. (condition: P1 is positive). |
| P – final evaluation | | The P3 final score is calculated from the 70% P1 score and 30% of the P2 final score. The final grade P3 is positive when both component assessments are positive. |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE (FOR ORACLE DBMS):**


[1] https://docs.aws.amazon.com/, AWS documentation.

[2] Sequeira, Anthony J. AWS Certified Cloud Practitioner (CLF-C01) Cert Guide. Pearson IT Certification, 2019.

[3] Anthony, Albert. AWS: Security Best Practices on AWS: Learn to secure your data, servers, and applications with AWS. Packt Publishing Ltd, 2018.


**SECONDARY LITERATURE:**


[4] Golden, Bernard. Amazon web services for dummies. John Wiley & Sons, 2013.


**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**


**Rafał Palak, rafal.palak@pwr.edu.pl**

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Architektura komputerów**
**Name of subject in English: Computer Architecture**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: academic / practical***
**Level and form of studies: 1st level / full-time**
**Kind of subject: obligatory**
**Subject code INZ004404**
**Group of courses NO**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 60 | | 60 | | |
| Form of crediting | Crediting with grade* | Examination / crediting with grade* | Crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | | | | | |
| Number of ECTS points | **2** | | **2** | | |
| including number of ECTS points for practical (P) classes | **0** | | **2** | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | **1,2** | | **1,2** | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Basic knowledge of computer systems organization and design of combinational and sequential circuits.
2. Programming skills at a basic level

**SUBJECT OBJECTIVES**

C1 Acquainting students with the architecture of modern computers, including the memory organization, and evaluation of their performance
C2 Acquisition of skills to design and construct simple combinational and sequential circuits
C3 Acquisition of programming skills in assembly language of selected processor at a basic level

**SUBJECT EDUCATIONAL EFFECTS**

Relating to knowledge:

PEK_W01 Knows different computer architectures including the architecture of the parallel computers
PEK_W02 Knows the computer memory organization, especially memory cache
PEK_ W03 Knows the basics of pipeline processing, including how to solve the problems associated with this type of processing

PEK_W04 Knows the basic methods of evaluating the performance of parallel computers

Relating to skills:

PEK_U01 Is able to write simple programs in assembly language of selected processor

PEK_U02 Can design and build simple combinational and sequential circuits

**PROGRAM CONTENT**

| | **Lectures** | **Number of hours** |
|---|---|---|
| Lec 1 | Introduction to computer architecture, taxonomy of computer architectures, Harvard, Princeton and Harvard-Princeton architectures, Instruction Set Architecture (ISA). | 2 |
| Lec 2 | Data representation in computer systems, integer and floating point coding, IEEE 754 standard, Little and Big Endian. | 2 |
| Lec 3 | RISC vs CISC architecture, similarities, differences, exemplary realizations of them. Architecture and organization of the chosen RISC processor. | 2 |
| Lec 4 | Introduction to low-level programming. Compilation, assembling, linking. Program organization in assembler. | 2 |
| Lec 5 | Programming in assembly language I. | 2 |
| Lec 6 | Programming in assembly language II. | 2 |
| Lec 7 | Organization of the stack in RISC architecture. | 2 |
| Lec 8 | Advanced assembly programming techniques. | 2 |
| Lec 9 | Memory organization, memory hierarchy, cache memory – methods if it's realization (associative, direct mapped, set-associative) – examples, virtual memory – paging, segmentation. | 2 |
| Lec 10 | Organization of RISC computers: pipeline processing, hardware control unit. Delay branches, branch prediction schemas. | 2 |
| Lec 11 | Security of computer architectures, buffer overflow attacks. Multiprocessor and multicomputer systems – distributed and shared memory, vector processors. | 2 |
| Lec 12 | Parallel systems evaluation: performance metrics, scalability of parallel system. | 2 |
| Lec 13 | Static and dynamic interconnection networks, used topologies, routing mechanisms. | 2 |
| Lec 14 | Final test. | 2 |
| Lec 15 | New trends in computer architecture. | 2 |
| | Total hours | 30 |

| | **Laboratory** | **Number of hours** |
|---|---|---|
| Lab 1 | Presentation of lab scope, presentation of grading principles, training from health and safety at work. Familiarization with laboratory tool used for the realization of combinational and sequential circuits. | 2 |
| Lab 2 | Introductory laboratory - the analysis of the chosen circuit. | 2 |
| Lab 3 | Designing of combinational circuits I. | 2 |
| Lab 4 | Designing of combinational circuits II. | 2 |
| Lab 5 | The analysis of systems with static hazard. | 2 |

| | | |
|---|---|---|
| Lab 6 | The analysis of the synchronous circuit. | 2 |
| Lab 7 | The synthesis of the synchronous circuit. | 2 |
| Lab 8 | Introduction to the lab in assembly language programming, familiarization with the working environment. | 2 |
| Lab 9 | Implementation of a simple program in assembler, running it in different execution modes, observing the contents of the registers during program execution. | 2 |
| Lab 10 | Implementation of a program that uses conditional branches. | 2 |
| Lab 11 | Familiarization with the implementation of different iteration instructions in assembly language. | 2 |
| Lab 12 | Familiarization with arrays implementation in assembly language. | 2 |
| Lab 13 | Familiarization with procedures implementation in assembly language. | 2 |
| Lab 14 | Implementation of a program that used nested procedures. | 2 |
| Lab 15 | Implementation of a program with floating point operations. | 2 |
| | Total hours | 30 |

**TEACHING TOOLS USED**

N1. Lecture supported by multimedia presentations (slideshow)
N2. SPIM and MIPS32 Simulator - http://pages.cs.wisc.edu/ ~ Larus / spim.html
N3. MARS (MIPS Assembler and Runtime Simulator) - http://courses.missouristate.edu/KenVollmar/MARS/
N4. Mounting plates allowing realization of combinational and sequential circuits

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 – (lecture) | PEK_W01<br>PEK_W02<br>PEK_W03<br>PEK_W04 | Quizzes during the lecture, student activity during the lecture, students answering on questions during lecture |
| F2 – (switching theory laboratory) - (Lab1- Lab7) | PEK_U01 | Checking of student preparation for exercise realization, assessment (points allocated) the reports of the exercises |
| F3 – (assembly programming laboratory) - (Lab8- Lab15) | PEK_U02 | Evaluation of the quality of submitted by students' programs, implementation during the laboratory additional tasks formulated during the laboratory (on-line programing |
| P - credits: independent for F1 and combined F2 / F3. The condition for passing the laboratory part is obtaining at least 40% of points from each activity: F2, F3. | | |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

[1] D. Patterson, J. Hennessy, Computer Organization and design, Elsevier
[2] D. Harris, S. Harris „Digital Design and Computer Architecture", Morgan Kaufman, 2012

**SECONDARY LITERATURE:**

[1] D. Patterson, J. Hennessy, "Computer Architecture – a Quantitave Approach", Elsevier, 2012
[2] G. Ifrah, "The Universal History of Computing: From the Abacus to the Quantum Computer", Wiley, 2002

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

**Jan Kwiatkowski, jan.kwiatkowski@pwr.wroc.pl**
**Radosław Michalski, radoslaw.michalski@pwr.edu.pl**

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish Grafika komputerowa**
**Name of subject in English Computer Graphics**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: academic ***
**Level and form of studies: 1st, uniform magister studies, full-time**
**Kind of subject: optional**
**Subject code INZ004437**
**Group of courses YES**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 120 | | | | |
| Form of crediting | Crediting with grade | Examination / crediting with grade* | Crediting with grade | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 4 | | | | |
| including number of ECTS points for practical (P) classes | 2 | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 2,4 | | | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knows elementary notions and computational methods of linear algebra and geometry in 2D and 3D
2. Is fluent in Java programming and knows basic general purpose algorithms and data types
3. Knows one of popular development environments for C++ or Java

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**SUBJECT OBJECTIVES**

C1 The students should know and understand the methods of 2D image rendering and 3D visualization, deeply understand how they work and what are their features and limitations.
C2 The students should know how to use practically standard software components supporting 2D and 3D CG application development in Java environment
C3 The students should be able to select appropriate methods and software components according to the particular needs related to the CG application domain and build CG application that renders plain image or 3D scene view using these software components

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEK_W01 Knows color spaces used in CG and understands differences between them
PEK_W02 Knows principles of transformation composition in homogenous coordinates
PEK_W03 Understands principles of curves modeling in 2D

PEK_W04 Knows properties of commonly used 3d rendering methods
PEK_W05 Knows and understands stages of typical 3D rendering pipeline

relating to skills:
PEK_U01 Can implement procedural pattern rendering of regular 2D using raster and vector approach
PEK_U02 Is able to design and implement graphical UI using standard software components available in Java
PEK_U03 Can construct the transformation matrix in homogenous coordinates corresponding to visually specified transformation
PEK_U04 Can implement simple CG applications for 3D rendering based on OpenGL usage

| PROGRAMME CONTENT | | |
|---|---|---|
| **Form of classes - lecture** | | **Number of hours** |
| Lec 1 | Introduction, defining the scope of computer graphics, relation to other computer engineering domains, basic definitions and notions, raster graphics and vector graphics | 2 |
| Lec 2 | CG program architecture, components for GUI building in Java2D and Swing | 2 |
| Lec 3 | Color spaces in CG | 2 |
| Lec 4 | Transformations in homogenous coordinates, general principles and advantages, affine transformation, derivation of transformation matrices for scaling rotation and translation | 2 |
| Lec 5 | Derivation of transformation matrix for compound transformations in homogenous transformations, transformation superposition, examples | 2 |
| Lec 6 | Bilinear interpolation of image attributes, application in image transformations, Gouraud shading | 2 |
| Lec 7 | Curves modeling in 2D, Lagrange and Bezier curves, piecewise defined curves, B-splines | 2 |
| Lec 8 | Introduction to 3D image synthesis, basic notions, scene description elements, lighting model, local and global illumination | 2 |
| Lec 9 | 3D scene geometry description, boundary representation, CSG, implicit surfaces, metaballs, volumetric representations, lighting models, Phong lighting model | 2 |
| Lec 10 | Rendering pipeline, geometric transformations in 3D, observer coordinate system, projections from 3D to 2D | 2 |
| Lec 11 | Visibility analysis methods, algorithms based on face sorting z-buffer algorithm, displaying transparent objects with z-buffer | 2 |
| Lec 12 | OpenGL library, core functionality, rendering program organization for OpenGL, examples of visual effects available in OpenGL programs | 2 |
| Lec 13 | Providing geometry to OpenGL, defining geometric transformations, application of transformation matrix stack, defining observer parameters, analysis of exemplary programs | 2 |
| Lec 14 | Other 3D rendering component packages review: Direct3D and Java3D. | 2 |

| | | |
|---|---|---|
| Lec 15 | Brief review of advanced 3D rendering methods, backward ray tracing, radiosity, photon mapping | 2 |
| | Total hours | **30** |

| **Form of classes - laboratory** | | **Number of hours** |
|---|---|---|
| Lab1 | Lab scope safety regulations grading policy presentation, installation of IDE, short introduction to CG packages in Java | 2 |
| Lab2 | Procedural rendering of 2D patterns using BufferedImage class | 2 |
| Lab3 | Vector graphics components usage in interactive graphics, simple animation using vector graphics components | 2 |
| Lab4 | GUI implementation using Swing components | 2 |
| Lab5 | Image composition using affine transformations | 4 |
| Lab6 | Bilinear and bicubic color interpolation, application to image scaling | 2 |
| Lab7 | Implementation of Gouraud shading - displaying polygons with Gouraud shading | 2 |
| Lab8 | Simple rendering of 3D scenes with Phong lighting model | 2 |
| Lab9 | 3D shape modeling by curve rotation and translation - conversion to triangle mesh, implementation of wireframe display of triangle meshes | 4 |
| Lab10 | Scene rendering program based on OpenGL or java3D | 2 |
| Lab11 | 3D visualization program with observer interactive setting | 4 |
| Lab12 | Summary, final grading | 2 |
| | Total hours | 30 |

## TEACHING TOOLS USED

N1. Multimedia presentation used in lectures
N2. Compilers and development environment for Java and C++
N3. Freeware and open source programs for 3D scene modeling
N4. E-learning system used to publish presentations, documents and other data related to the lecture and lab assignments

## EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

| **Evaluation**(F – forming (during semester), P – concluding (at semester end) | Educational effect number | Way of evaluating educational effect achievement |
|---|---|---|
| F1 - Lab2 | PEK_U01 | Each assignment Lab2-Lab11 will be evaluated in the scale 2.0 - 5.0. The elements being evaluated: conformance with the assignment specification, ability to make small extensions and modifications to home-prepared code, relevance of used methods, efficiency, ability to predict results of processing of specified input data set , code clarity |
| F2 - Lab3 | PEK_U01<br>PEK_U02 | As in the case of grading of assignment in Lab2 |
| F3 - Lab4 | PEK_W02<br>PEK_U02 | As in the case of grading of assignment in Lab2 |
| F4 - Lab5 | PEK_W01<br>PEK_W02<br>PEK_U03 | As in the case of grading of assignment in Lab2, scoring: 0 – 3. |

| | | |
|---|---|---|
| F5 - Lab6 | PEK_W01<br>PEK_U02 | |
| F6 - Lab7 | PEK_W04<br>PEK_W05 | As in the case of grading of assignment in Lab2, scoring: 0 – 3. |
| F7 - Lab8 | PEK_W01<br>PEK_W04<br>PEK_W05 | As in the case of grading of assignment in Lab2 |
| F8 - Lab9 | PEK_W03<br>PEK_U04 | As in the case of grading of assignment in Lab2 |
| F9 - Lab10 | PEK_W04<br>PEK_W05<br>PEK_U02<br>PEK_U04 | As in the case of grading of assignment in Lab2 |
| F10 - Lab11 | PEK_W04<br>PEK_U02<br>PEK_U04 | As in the case of grading of assignment in Lab2, scoring: 0 – 3. |

P1 – final laboratory grade computed according to the following scale
0.00 - 8.99 - unsatisfactory
8.00 – 9.99 - satisfactory
10.00 – 11.99 - satisfactory plus
12.00 - 13.99 - good
10.00 - 14.99 - good plus
14.99 - 16.00 - very good

P2 – final lecture grade will be based on written exam results. The exam consists in solving a number of test queries and computational problems. Each query is assigned a number of scores. The final grade is based on total scores percentage according to the following scale
0 - 50% - unsatisfactory
51 - 60% - satisfactory
61 - 70% - satisfactory plus
80 - 89% - good
90 - 95% - good plus
96 - 100% - very good

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

[1] Foley J.D. et al. Computer Graphics, Principles and Practice, Third Edition, Addition-Wesley, 2013
[2] Klawonn F., Introduction to Computer Graphics: Using Java 2D and 3D, Second edition, Springer 2012
[3] Shreiner D. et al., OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.3 (8th Edition)

**SECONDARY LITERATURE:**

[1] Ammerall L., Zhang K., Computer Graphics for Java Programmers, John Wiley & Sons, 2007
[2] McReynolds T., Blythe D., Advanced Graphics Programming Using OpenGL, Elsevier 2005

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

**Jerzy Sas, jerzy.sas@pwr.wroc.pl**

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Sieci komputerowe**
**Name of subject in English: Computer Networks**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: academic ***
**Level and form of studies: 1st/ ~~2nd~~ level~~, uniform magister studies~~*, full-time / ~~part-time~~ studies***
**Kind of subject: obligatory / ~~optional~~ / ~~university-wide~~***
**Subject code INZ004407**
**Group of courses ~~YES~~ / NO***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 45 | | 30 | | |
| Number of hours of total student workload (CNPS) | 110 | | 90 | | |
| Form of crediting | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | | | | | |
| Number of ECTS points | 4 | | 3 | | |
| including number of ECTS points for practical (P) classes | | | 3 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 2,4 | | 1,8 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. K1INF_W01 - Has basic knowledge in the field of linear algebra, analytical geometry and mathematical analysis, necessary to solve computational problems of engineering character from technical and non-technical disciplines
2. K1INF_W02 - Has basic knowledge in the field of discrete mathematics, mathematical logic, probability theory and mathematical statistics, necessary to solve IT engineering problems.
3. K1INF_W07 - Has basic knowledge in the field of computer structure, organization and architecture.

**SUBJECT OBJECTIVES**

C1. - Acquiring knowledge in the field of layered computer networks, construction and functionality of network protocols, principles of network protocols cooperation in the stacks.

C2. - Acquiring knowledge in the field of architectures, operations, construction and services of computer networks.

C3. - Acquiring basic skills of network devices configuration, as well as analysis of their operation and detection of errors in computer networks.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:

PEK_W01 - Has basic and systematic knowledge in the field of layered computer networks, structure and functionality of network protocols, principles of cooperation of network protocols in stacks.

PEK_W02 - Has basic knowledge in the field of architectures, operations, construction and services of computer networks.

relating to skills:

PEK_U01 - Has basic skills in the configuration of network devices, as well as analysis of their operation and detection of basic errors in computer networks.

**PROGRAM CONTENT**

| | **Lectures** | **Number of hours** |
|---|---|---|
| Lec1 | Plan of the lecture. Explanation of the assessment method.<br>Introduction to computer networks. The benefits and threats of global digitization and unlimited communication.<br>The physical layer of the ISO-OSI model. Physical media.<br>Description of the construction and use of passive and active devices.<br>Description of purpose, arrangement and numbering of different interfaces.<br>Description of tools for testing and making computer cables. | 3 |
| Lec2 | Data link layer of the ISO-OSI model. Ethernet protocol. | 3 |
| Lec3 | Network layer of the ISO-OSI model. IPv4 and IPv6 protocols. | 3 |
| Lec4 | Network layer of the ISO-OSI model. Addressing, subnetting with fixed and variable mask length. | 3 |
| Lec5 | The transport layer of the ISO-OSI model. TCP and UDP protocols. | 3 |
| Lec6 | Network devices architecture. Introduction to the configuration of network devices. | 3 |
| Lec7 | Introduction to administration in computer networks. Security, configuration management, network operating system management, connection encryption. | 3 |
| Lec8 | Static routing. | 3 |
| Lec9 | Dynamic routing on example of RIP protocol. | 3 |
| Lec10 | Basic operation and configuration of the switch. | 3 |
| Lec11 | VLANs and trunk connections. | 3 |
| Lec12 | Routing between VLANs. | 3 |
| Lec13 | DHCP service in IPv4 and IPv6 networks. | 3 |
| Lec14 | NAT and PAT service. | 3 |
| Lec15 | Other services supporting the operation of computer networks. Traffic management. Basic access control lists.<br>Directions of computer network development. New generations of computer networks. New concepts of management and network configuration. | 3 |

| | Total hours | 45 |
|---|---|---|
| **Laboratory** | | **Number of hours** |
| Lab1 | Organizational classes.<br>Explanation of the assessment method.<br>Principles of health and safety.<br>Presentation of the network topology in the laboratory and the deployment of network devices.<br>Presentation of various types of media, passive devices and tools for making cables. Construction of active devices, description of interfaces. | 2 |
| Lab2 | Physical media.<br>Communication media.<br>Sockets, terminals, patch panels, shielding.<br>Making cables: straight, crossover, console. | 2 |
| Lab3 | Data link layer:<br>Types of interfaces.<br>Laboratory topology.<br>Basic IP configuration.<br>Connection tests between computers.<br>Wireshark application.<br>Ethernet frame.<br>Arp protocol.<br>Additional: check for mac addresses table on the switch. | 2 |
| Lab4 | Network layer:<br>IPv4, IPv6 addressing.<br>Special addresses.<br>Subnetting with fixed mask.<br>Subnetting with variable mask – VLSM. | 2 |
| Lab5 | Network layer:<br>IP configuration in Windows and Linux.<br>Connections between computers.<br>ICMP protocol.<br>Tracking network path (tracert, traceroute, pathping).<br>Analysis of response times.<br>DNS address, nslookup command. | 2 |
| Lab6 | Transport layer:<br>TCP (FTP).<br>UDP protocol (TFTP, DNS, DHCP).<br>Wireshark.<br>The netstat command. | 2 |
| Lab7 | Architecture of active devices:<br>Differentiation of interfaces.<br>Console connection.<br>Network connection.<br>CLI interface.<br>Basic configuration.<br>IPv4 and IPv6 configuration.<br>Communication tests.<br>Remote configuration via telnet. | 2 |

| | | |
|---|---|---|
| Lab8 | Securing devices against unauthorized access, configuration management and operating system:<br>Router protection.<br>Switch protection.<br>Analysis of the telnet and SSH connection in Wireshark:<br>Collecting information about the network.<br>Configuration backup (Startup, TFTP, USB, Terminal).<br>Password recovery procedure on the router.<br>Password recovery procedure on the switch. | 2 |
| Lab9 | Static routing:<br>Deafult Gateway.<br>Cisco IPv4 routers.<br>Cisco IPv6 routers.<br>Detection of configuration errors (troubleshooting).<br>Additional: routing using Windows and Linux systems. | 2 |
| Lab10 | Dynamic routing:<br>RIPv1.<br>RIPv2.<br>Network summation, passive interfaces.<br>RIPv2 IPv6. | 2 |
| Lab11 | Configuration of advanced switch options:<br>Protecting the switch.<br>Change of the management VLAN.<br>Port configuration and securing. | 2 |
| Lab12 | VLAN networks:<br>VLAN.<br>Trunk (connection options).<br>Routing between VLANs:<br>Routing through dedicated ports.<br>Routing using a trunk connection.<br>Additional: Analysis of the 802.1Q Ethernet frame. | 2 |
| Lab13 | Configuration of the DHCP server:<br>DHCP on the local router.<br>DHCP on the remote router.<br>DHCP on the switch.<br>DHCP IPv6: SLAAC, stateless (SLAAC + DHCPv6), statefull (DHCPv6). | 2 |
| Lab14 | NAT:<br>Static NAT.<br>Dynamic NAT.<br>PAT. | 2 |
| Lab15 | Ancillary services:<br>CDP, LLDP.<br>NTP.<br>Syslog. | 2 |
| | Total hours | 30 |
| **TEACHING TOOLS USED** | | |

N1. - Lecture supported by multimedia presentations and a simulator.
N2. - Various types of network software.
|N3. - Simulator enabling creation, configuration and testing of various topologies of computer networks.
N4. - Quizzes and knowledge tests.
N5. - A real environment for creating, configuring and testing various topologies of computer networks.

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1-F14 - partial grades obtained at labs La2-15 | PEK_U01 | Student's presence.<br>Theoretical preparation for the lab (quiz, test, other) on a point, percentage or traditional scale.<br>Evaluation of the lab tasks on a point or traditional scale. |
| P1 – concluding lab grade | PEK_U01 | An average of the F1-14 forming grades |
| F15 - forming lecture grade | PEK_W01, PEK_W02 | Observation of student activity. Solving sample problems and tasks. |
| P2 – concluding lecture grade | PEK_W01, PEK_W02 | Exam – in form of computer test, containing questions of various types (multiple and single choice, computational, open, other) checking knowledge in the field of lecture. The test is given a positive evaluation, if the student scores at least 51% of the maximum number of points. Later, the rating is increased by 0.5 every 10%. A positive P2 rating can be adjusted by rating F15.<br>The condition for obtaining a positive P2 rating is to obtain a positive P1 rating. |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**


[1] Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks, 5th Edition", Published by Pearson, Sep 27, 2010
[2] J. Woźniak, K. Nowicki, „Sieci LAN, MAN i WAN - protokoły komunikacyjne", Wydawnictwo - FPT, Kraków 2000
[3] Training materials of the Cisco Network Academy
[4] Wendell Odom, "CCENT/CCNA ICND1 100-105 Official Cert Guide:, Cisco Systems; Auflage: Har/Dvdr (17. Mai 2016)
[5] Wendell Odom, "CCNA Routing and Switching ICND2 200-105 Official Cert Guide: Official Cert Guid / Learn, prepare, and practice for exam success", Cisco Systems; Auflage: Har/Cdr (4. Juli 2016)


**SECONDARY LITERATURE:**


[1] http://www.freebookcentre.net/Networking/Free-Computer-Networking-Books-Download.html
[2] CCNA Exploration Companion Guide books


**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**


Kamil Nowak, kamil.nowak@pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Organizacja Systemów Komputerowych (GK)**
**Name of subject in English: Computer System Organization (GK)**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable): not applicable**
**Profile: academic ~~/ practical*~~**
**Level and form of studies: 1st~~/ 2nd level, uniform magister studies*~~, full-time ~~/ part-time studies*~~**
**Kind of subject: obligatory ~~/ optional / university-wide*~~**
**Subject code INZ004400**
**Group of courses YES ~~/ NO*~~**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | 15 | | | |
| Number of hours of total student workload (CNPS) | 30 | 60 | | | |
| Form of crediting | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 1 | 2 | | | |
| including number of ECTS points for practical (P) classes | 0 | 0 | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 0,6 | 1,2 | | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. The student lists and describes the basic computer components.
2. The student defines the basic functional characteristics of the computer.

**SUBJECT OBJECTIVES**

C1. Knowledge of ways of representing fixed-point numbers and the basics of arithmetic for these numbers.
C2. Understanding methods for simplifying Boolean expressions.
C3. Knowledge of simple combinational and sequential circuits.
C4. Acquiring basic knowledge in the field of designing simple digital circuits.

**SUBJECT EDUCATIONAL EFFECTS**

**relating to knowledge:**

PEK_W01 A student knows ways of representing numbers in fixed-point systems, methods of number conversion and ways of implementing arithmetic operations.
PEK_W02 A student knows the basic methods for simplifying Boolean expressions,
PEK_W03 A student knows basic combinational and sequential circuits,
PEK_W04 A student knows the basic principles of designing the simplest digital circuits.

**relating to social competences:**

PEU_K01 A student is aware of the importance of non-technical aspects of the activity of the engineer-computer scientist; understands the need to ensure high quality and availability of IT systems, taking into account the needs of different user groups.

| PROGRAM CONTENT | | |
|---|---|---|
| **Lectures** | | **Number of hours** |
| Lec 1 | Introduction. Basic concepts. Structure and computer architecture. A brief history of computers - evolution, performance, and computer compatibility. Analog and digital signals; bit, byte, | 2 |
| Lec 2 | Computer arithmetic, number systems: binary, octal, hexadecimal, Natural Binary Code. | 2 |
| Lec 3 | Representation of natural numbers and integers, sign-module system, two's complement, number conversions. | 2 |
| Lec 4 | Arithmetic of integers (binary) - negation, addition and subtraction, multiplication, division. | 2 |
| Lec 5 | Arithmetic of integers (decimal) - negation, addition and subtraction, multiplication, division. | 2 |
| Lec 6 | Floating-point representation, IEEE 754-2008 Standard, Floating-point arithmetic | 2 |
| Lec 7 | Boole's algebra, truth table, Boolean Algebraic Identities, De Morgan's laws, Boolean functions | 2 |
| Lec 8 | Logic Gates | 2 |
| Lec 9 | Minimization of combinational functions (logic) - A formal transformation method, Karnaugh map and Quine–McCluskey Method (prime implicants). | 2 |
| Lec 10 | Examples of connections and applications of logic gate, definition of a combination circuit, simple combinational circuits, arithmetic circuits: adders, comparators | 2 |
| Lec 11 | Combinational Logic Circuits, Transistor Transistor Logic (TTL) Circuits | 2 |
| Lec 12 | Sequential Logic Circuits: definition, types of flip-flops, excitation table, state diagram | 2 |
| Lec 13 | Designing combinational circuits - a way to design a combinational system, static gambling. | 2 |
| Lec 14 | Designing synchronous sequential circuits - definition of a sequential circuit (Mealy and Moore Machines), additionally designing counters. | 2 |
| Lec 15 | Colloquium | 2 |
| | **Total hours** | **30** |
| **Classes** | | **Number of hours** |
| Cl 1 | Discussion of the organization and the program of activities. Introduction to the issues of exercises - basic arithmetic operations in positional numerical systems. | 1 |
| Cl 2 | Numerical conversion methods for various fixed-point number systems. | 2 |
| Cl 3 | Ways of coding numbers. Binary, BCD and complement codes, | 2 |

| | | |
|---|---|---|
| Cl 4 | Fixed-point arithmetic of binary numbers, BCD and in the complement notation. | 2 |
| Cl 5 | Test | 2 |
| Cl 6 | Fixed-point arithmetic - multiplication and division of numbers. | 2 |
| Cl 7 | Basics of Boole's algebra. Methods for simplifying Boolean expressions. | 2 |
| Cl 8 | Test | 2 |
| | Total hours | 15 |

**TEACHING TOOLS USED**

LECTURE:
N1. Informative lecture with elements of the problem lecture, supported by multimedia presentations.
EXERCISES:
N2. Exercises at the blackboard.

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEK_W01<br>PEK_W02<br>PEK_W03 | Colloquium in written or oral form |
| F2 | PEK_W01<br>PEK_W02 | Exercises and tests |
| P = F1 + F2 | | |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

[1] C. Zieliński: Podstawy projektowania układów cyfrowych, Wydawnictwo Naukowe PWN, 2012
[2] B. Pochopień: Arytmetyka systemów cyfrowych, WPŚ, Gliwice 2002.

**SECONDARY LITERATURE:**

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

Dr hab. inż. Leszek Borzemski, prof. PWr, leszek.borzemski@pwr.edu.pl
Dr inż. Krzysztof Billewicz, krzysztof.billewicz@pwr.edu.pl
Dr inż. Mariusz Fraś, Mariusz.fras@pwr.edu.pl
Dr inż. Ziemowit Nowak, ziemowit.nowak@pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name in Polish** Cyberbezpieczeństwo
**Name in English** Cybersecurity
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Level and form of studies: 1st/ ~~2nd~~* level, full-time / ~~part-time~~***
**Kind of subject: obligatory / ~~optional~~ / ~~university-wide~~***
**Subject code INZ004418**
**Group of courses ~~YES~~ / NO***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 90 | | 60 | | |
| Form of crediting | Examination / ~~crediting with grade~~* | Examination / crediting with grade* | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | | | | | |
| Number of ECTS points | **3** | | 2 | | |
| including number of ECTS points for practical (P) classes | | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,8 | | 1,2 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Probability theory
2. Discrete mathematics
3. Computer networks.

**SUBJECT OBJECTIVES**

C1Understanding the current problems related to data security and information systems
C2 Understanding the methods and examples of solutions related to guaranteeing a high level of security.
C3 Understanding the methods of security design for information systems.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEK_W01 Has knowledge about security threats
PEK_W02 Has knowledge of selected issues in cryptology
PEK_W03 Has knowledge about methods of ensuring security
relating to skills:
PEK_U01 Is able to identify threats to IT security
PEK_U02 Is able to identify needs in the field of IT systems protection
PEK_U03 Is able to choose protection methods to ensure IT security

relating to social competences:
PEK_K01 Understand the need to protect IT systems
PEK_K02 Understand the impact of IT security threats on the functioning of the electronic economy

**PROGRAM CONTENT**

| | **Lectures** | **Number of hours** |
|---|---|---|
| Lec 1 | Introduction to cybersecurity. Basic terms and notions. | 2 |
| Lec 2 | Basic problems related to cryptology | 2 |
| Lec 3 | Symmetrical encryption algorithms | 2 |
| Lec 4 | Elements of cryptanalysis | 2 |
| Lec 5 | Stream ciphers | 2 |
| Lec 6 | Asymmetric algorithms | 2 |
| Lec 7 | Cryptographic hash functions and electronic signature | 2 |
| Lec 8 | Authentication | 2 |
| Lec 9 | Vulnerabilities and threats in network communication | 2 |
| Lec 10 | Secure communication protocols | 2 |
| Lec 11 | Anonymity and privacy in the Internet | 2 |
| Lec 12 | Security in Web networks | 2 |
| Lec 13 | Security in IoT and mobile systems | 2 |
| Lec 14 | Cybersecurity in the electronic economy | 2 |
| Lec 15 | Current problems in cybersecurity and repetition | 2 |
| | Total hours | 30 |

| | **Laboratory** | **Number of hours** |
|---|---|---|
| Lab 1 | Introduction. Requirements and the lab environment configuration. | 2 |
| Lab 2 | Historical ciphers | 2 |
| Lab 3 | Cryptanalysis of historical algorithms | 2 |
| Lab 4 | Modern symmetric algorithms | 2 |
| Lab 5 | Asymmetric algorithms | 2 |
| Lab 6 | Passwords security | 2 |
| Lab 7 | Secure communication –VPN | 2 |
| Lab 8 | Detection of security incidents - IDS systems | 2 |
| Lab 9 | Network traffic filters - firewall systems | 2 |
| Lab 10 | Detection of vulnerabilities in systems | 2 |
| Lab 11 | Operating system level security | 2 |
| Lab 12 | Security of web systems | 2 |
| Lab 13 | Examples of attack scenarios | 2 |
| Lab 14 | Open source intelligence | 2 |
| Lab 15 | Repetition and consolidation of knowledge acquired during the semester. | 2 |
| | Total hours | 30 |

**TEACHING TOOLS USED**

N1.Lectures
N2.Labs

| N3.Own Work |
|---|

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEK_W01, PEK_W02, PEK_W03, PEK_K01, PEK_K02. | Assessment of the degree of preparation for the laboratory exercises |
| F2 | PEK_U01, PEK_U02, PEK_K03. | Evaluation of laboratory tasks |
| P | PEK_W01, PEK_W02, PEK_W03, PEK_K01, PEK_K02. | Final exam |
| C | | |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**


[1] Schneier, Bruce. Applied cryptography: protocols, algorithms, and source code in C. john wiley & sons, 2007.

[2] Stallings, William. Cryptography and network security: principles and practice. Pearson Education India, 2003.

[3] Anderson, Ross. Security engineering. John Wiley & Sons, 2008.

[4] Ferguson, Niels, Bruce Schneier, and Tadayoshi Kohno. Cryptography engineering: design principles and practical applications. John Wiley & Sons, 2011.


**SECONDARY LITERATURE:**


[5] Katz, Jonathan, et al. Handbook of applied cryptography. CRC press, 1996.

[6] Boneh, Dan, and Victor Shoup. "A graduate course in applied cryptography." http://cryptobook. net (2008).

[7] Smart, Nigel P. Cryptography Made Simple. Heidelberg: Springer, 2016.

[8] OWASP : https://www.owasp.org/

[9] ENISA · Publications : http://www.enisa.europa.eu

[10] NIST · Special Publications (NIST-SP) : http://www.nist.gov/publication-portal.cfm


**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**


**Grzegorz Kołaczek, Grzegorz.Kolaczek@pwr.edu.pl**

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Danologia**
**Name of subject in English: Data Science**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable): ……..**
**Profile: academic / practical***
**Level and form of studies: 1st~~/ 2nd level, uniform magister studies*,~~ full-time ~~/ part-time studies*~~**
**Kind of subject: ~~obligatory~~ / optional / ~~university-wide*~~**
**Subject code INZ002040**
**Group of courses YES ~~/ NO*~~**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 120 | | | | |
| Form of crediting | Crediting with grade | Examination / crediting with grade* | Crediting with grade | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 5 | | | | |
| including number of ECTS points for practical (P) classes | 3 | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 3 | | | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge of the basics of mathematical statistics.
2. Basic programming skills

**SUBJECT OBJECTIVES**

C1 Students are familiarized with methods of design and development of advanced data analysis processes.
C2 Students are familiarized with methods and tools of statistical data analysis, data mining, machine learning.
C3 Students are familiarized with methods and tools to analyse large data sets, ensure and verify data quality and social media analysis.

**SUBJECT EDUCATIONAL EFFECTS**

Related to knowledge:
PEK_W01 A student knows and describes the methods and tools of statistical data analysis, data mining, machine learning.
PEK_W02 A student knows and describes the methods and tools for the analysis of large data sets, ensuring and verifying the quality of data and social media analyses.

relating to skills:

PEK_U01 Student is able to design and develop advanced data analysis processes.
PEK_U02 Student is able to apply methods of statistical data analysis, data mining, machine learning.
PEK_U03 Student is able to apply methods of analysis of large data sets, assurance and verification of data quality and social media analysis.

**PROGRAM CONTENT**

| Lectures | | Number of hours |
|---|---|---|
| Lec1 | Introduction to Data Science<br>1. Lecture plan and grading policy<br>2. Basic concepts and relations between them: data science, data mining, machine learning, statistics<br>3. Big data – characteristics and main challenges. Data science and Big data<br>4. Structured and unstructured data. Network data<br>5. Interdisciplinary of data science. The influence of data science on other sciences | 3 |
| Lec2 | Mathematical foundations of data processing<br>1. Representation of signals<br>- classical approaches: time series and frequency responses<br>- time-frequency representation<br>2. Signal analysis<br>- data sources (sensors, google analytics)<br>- sampling theorem | 3 |
| Lec3 | Machine learning methods<br>1. Statistical foundations of machine learning<br>- maximum likelihood method<br>- the Bayes method<br>- linear regression<br>- k-NN classifier, linear classifier, neural classifier<br>2. Model selection<br>- criteria AIC, BIC<br>- cross-validation | 3 |
| Lec4 | Computational<br>Computational Network Science<br>1. Graph theory and basic concepts. Random graphs. Network models. Random walk. Scale-free networks. Small words.<br>2. Groups/communities in networks. Network motifs.<br>3. Applications | 3 |
| Lec5 | Association rules generation – market basket analysis<br>1. Market basket analysis – introduction, the role of human-understandable knowledge in KDD processes, applications<br>2. Basic concepts<br>3. Frequent patterns and evaluation measures (support, confidence, lift, Conviction)<br>4. Apriori algorithm<br>5. Market basket analysis | 3 |

| | | |
|---|---|---|
| | 6. Practical samples | |
| Lec6 | Social media analysis<br>1. Characteristics of social media: sample from basics to business values.<br>2. Social media systems, e.g. Wikipedia, Facebook, Opineo, Twitter<br>3. Methods of collecting and processing of social media data. | 3 |
| Lec7 | Data science in software Engineering<br>1. Data science in software engineering - example applications<br>2. Case Study<br>3. Introduction to R (RStudio) for the purposes of the case study | 3 |
| Lec8 | Big data<br>1. Characteristics of big data vs traditional data bases<br>2. Storage and processing methods, Dedicated file systems.<br>3. Parallel processing. Map-Reduce model | 3 |
| Lec9 | Data Quality<br>1. Data providing and validating (quality monitoring, data scoring).<br>2. Data integration and cleaning, aggregation and reduction, metadata<br>3. Data quality metrics<br>4. Detecting anomalies (outliers), inconsistency, error propagation, error detection and correction | 3 |
| Lec10 | Invited lecture | 3 |
| | Total hours | **30** |

| **Laboratory** | | **Number of hours** |
|---|---|---|
| La1 | Setting up the data processing environment<br>1. Grading policy<br>2. Installation and configuration of laboratory environment<br>3. Python fundamentals<br>4. R fundamentals | 3 |
| La2 | Mathematical foundations of data processing<br>1. The *scipy.signal* library<br>2. Signal analysis<br>- period and non-period signals<br>- noisy data | 3 |
| La3 | Machine learning methods<br>1. Python fundamentals<br>- the *Scikit learn* library<br>2. Regression and classification<br>- fitting data with generalized linear models<br>- classification using k-NN method | 3 |
| La4 | Computational Network Science<br>1. Introduction to Python and R modules<br>- NetworkX package<br>- graph-tool package<br>- igraph package<br>2. Generation of networks according to models<br>- random networks, small world, power-law | 3 |

| | | |
|---|---|---|
| | - networks based on real data<br>3. Working with real data sets<br>- network creation and network properties analysis<br>- visualization | |
| La5 | Association rules generation – market basket analysis<br>1. Introduction to PYTHON or R modules<br>2. Introduction to sample data and its preparation<br>3. Association rules generation with different minSupport and minConfidence values.<br>4. Visualization of results | 3 |
| La6 | Social media analysis<br>1. Basics API for social platforms<br>2. Import of data and creation of data structures for processing, usage of Pandas module<br>3. Clustering, classification, prediction in graphs and social media data | 3 |
| La7 | Data science in software engineering<br>1. Predictive models in R and their empirical evaluation - a case study Data science in software Engineering | 3 |
| La8 | Big data<br>1. Setting up a testing environment for big data processing<br>2. Running sample project of data analyses<br>3. Developing adjustments to the sample project in Map-Reduce<br>4. Running, saving and evaluation of results of the analysis | 3 |
| La9 | Data Quality<br>1. Data Integration and cleaning methods<br>2. Quality data report | 3 |
| La10 | Presentation and discussion of best solutions developed as part of laboratory classes. | 3 |
| | Total hours | **30** |

**TEACHING TOOLS USED**

N1. Lectures, lecture notes
N2. Consultations
N3. Student's independent work
N4. Exercises on laboratory
N5. R/Python modules

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F01..F08 – laboratory | PEK_U01, PEK_U02, PEK_U03 | Evaluation of exercises from La2 to La9. |
| P01 – lecture | PEK_W01, PEK_W02 | Written test. The test is given a positive evaluation, if the student scores at least 50% of the maximum |

| | | |
|---|---|---|
| | | number of points. Optional for students with positive laboratory grades. |
| P02 - laboratory | PEK_U01,<br>PEK_U02,<br>PEK_U03,<br>PEK_W01,<br>PEK_W02 | Average of F01 .. F08. |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**


[1] Field Cady: The Data Science Handbook, Wiley, 2017.
[2] Brian Steele, John Chandler, Swarna Reddy: Algorithms for Data Science. Springer, 2016
[3] Marek Gągolewski, Programowanie w języku R Analiza Danych. Obliczenia. Symulacje, wyd.2, 2016
[4] Max Kuhn, Kjell Johnson, Applied Predictive Modeling. Springer 2013.
[5] Przemysław Biecek, Wizualizacja i modelowanie, Uniwersytet Warszawski, 2015. Ebook http://www.biecek.pl/R/#Analiza
[6] Data Mining Concepts and Techniques. Third Edition. Jiawei Han, Micheline Kamber, Jian Pei. Morgan Kaufmann Pub., Elsevier, 2012.
[7] Jose Unpingco - "Python for Probability, Statistics, and Machine Learning", Springer 2016
[8] Koronacki J., Cwik J., Statystyczne systemy uczące się., EXIT, Warszawa, 2008
[9] Albert-László Barabási: Network Science. Cambridge University Press, 2016. http://barabasi.com/networksciencebook/
[10] Anjana Gosain, Heena, Literature Review of Data Model Quality Metrics of Data Warehouse, Procedia Computer Science, Volume 48, 2015, Pages 236-243.


**SECONDARY LITERATURE:**


[11] Advances in Knowledge Discovery and Data Mining (American Association for Artificial Intelligence) Paperback – February 1, 1996, by Usama M. Fayyad (Editor), Gregory Piatetsky-Shapiro (Editor), Padhraic Smyth (Editor)
[12] Benjamin S. Baumer, Daniel T. Kaplan, Nicholas J. Horton: Modern Data Science with R. CRC Press, 2017
[13] Joel Grus: Data Science from Scratch: First Principles with Python. O'Reilly, 2015.
[14] Hadley Wickham: R for Data Science. O'Reilly, 2017
[15] Cole Nussbaumer Knaflic: Storytelling with Data. Wiley, 2015.
[16] Cathy O'Neil: Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy. Crown Publishers, 2016.


**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**


**dr inż. Artur Wilczek, artur.wilczek@pwr.wroc.pl**

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Struktury Danych i Algorytmy**
**Name of subject in English: Data Structures and Algorithms**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: academic / practical***
**Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister studies~~*, full-time / ~~part-time~~ studies***
**Kind of subject: obligatory / ~~optional~~ / ~~university-wide~~***
**Subject code INZ004403**
**Group of courses YES / ~~NO~~***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | 15 | 30 | | |
| Number of hours of total student workload (CNPS) | 90 | 30 | 90 | | |
| Form of crediting | Examination / ~~crediting with grade~~* | Examination / ~~crediting with grade*~~ | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 4 | | 2 | | |
| including number of ECTS points for practical (P) classes | | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 2.4 | | 1.2 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge of a programming language (Java).
2. Knowledge of object programming basics

**SUBJECT OBJECTIVES**

C1. Gaining basic knowledge on abstract data types and dynamic data structures and their implementation.
C2. Knowledge of how to evaluate and compare algorithms and knowledge of basic algorithms from various application areas.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:

PEK_W01. Knows abstract data types and dynamic data structures.
PEK_W02. Understands the asymptotic notation and knows basic algorithms from various areas of algorithmics.

relating to skills:

| |
|---|
| PEK_U01. He can create an implementation of abstract data types and algorithms from various areas of algorithms. |

| PROGRAM CONTENT | | |
|---|---|---|
| **Lectures** | | **Number of hours** |
| Lec1 | Complexity (1/4), iterators. | 2 |
| Lec2 | Complexity (2/4), linked lists. | 2 |
| Lec3 | Complexity (3/4), stack and FIFO queues. | 2 |
| Lec4 | Complexity (4/4), problem solving techniques | 2 |
| Lec5 | Comparators, simple sortings. | 2 |
| Lec6 | Effective sorting. Binary Heap. | 2 |
| Lec7 | Linear and binary searches, priority queues, hash tables. | 2 |
| Lec8 | Dictionary, binary search tree (BST). | 2 |
| Lec9 | Red black tree, B-Tree. | 2 |
| Lec10 | Interval tree, binomial heap, forest of disjoint sets. | 2 |
| Lec11 | Graph algorithms. | 4 |
| Lec12 | Pattern matching, the unification algorithm. | 2 |
| Lec13 | Huffman codes, knapsack problems, selected geometrical algorithms. | 2 |
| Lec14 | Complexity classes: P, NP,NPC | 2 |
| | Total hours | **30** |

| **Classes** | | **Number of hours** |
|---|---|---|
| Cl1 | Defining simple classes and interfaces. | 1 |
| Cl2 | Iterators. | 2 |
| Cl3 | Lists, heaps, queues. | 2 |
| Cl4 | Iterative and recursive list processing. | 2 |
| Cl5 | Sorting – algorithms analysis and comparison. | 2 |
| Cl6 | BST tree and hash tables processing. | 2 |
| Cl7 | B-trees and hash tables. | 2 |
| Cl8 | Graphs. | 2 |
| | Total hours | 15 |

| **Laboratory** | | **Number of hours** |
|---|---|---|
| Lab1 | Creation and use of own iterators. | 4 |
| Lab2 | An implementation using dynamic data structures – lists, heaps, | 6 |
| Lab3 | Implementation and testing of selected sorting algorithms. | 4 |
| Lab4 | Implementation and use of hash tables and binary trees. | 4 |
| Lab5 | Implementation of binomial heap, forest of disjoint sets | 4 |

| | | |
|---|---|---|
| Lab6 | Implementation of graph algorithms. | 4 |
| Lab7 | Implementation of pattern matching algorithms | 4 |
| | Total hours | 30 |

| TEACHING TOOLS USED |
|---|
| N1. Multimedia lecture.<br>N2. Blackboard for a written presentation of solutions.<br>N3. Computer didactic laboratory with development environment.<br>N4. An e-learning system used for the publication of teaching materials, tests and communication |

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 - final score of the classes | PEK_U01 | The condition for admission to the exam is participation in the exercises - one unjustified absence is allowed and a minimum of 5 points is obtained. A maximum of 25 points can be earned. |
| F2 - exam score | PEK_W01,PEK_W02 | Scoring in the range [0,90] is issued based on the results of the exam. |
| P=Min(100,F1+F2) | | Grade based on scores:<br>[0; 50) - 2.0<br>[50; 62) - 3.0<br>[62; 73) - 3.5<br>[73; 84) - 4.0<br>[84; 95) - 4.5<br>[95; 100] - 5.0 |
| PL - laboratory | PEK_U01 | Implementation of tasks indicated by the teacher. Final grade depends of partial scores. |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

[1] Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, “Introduction in algorithms”. The MIT Press; 2 edition (September 1, 2001), 1184 pages,
[2] Kenneth A. Berman, Jerome L. Paul, “Algorithms: Sequential, Parallel, and Distributed”, Course Technology; 1 edition (October 11, 2004), 992 pages.
[3] Robert Sedgewick “Algorithms in Java, Parts 1-4”, Addison-Wesley Professional; 3 edition (August 2, 2002), 768 pages.

**SECONDARY LITERATURE:**

[1] Harel D., Algorithmics. The Spirit of Computing, Addison Wesley, 2004.
[2] Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, Data Structures and Algorithms, Addison-Wesley, 1983.

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

Dariusz Konieczny (dariusz.konieczny@pwr.edu.pl)

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name in Polish Hurtownie Danych**
**Name in English Data Warehouses**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Level and form of studies: 1st level, full-time**
**Kind of subject: obligatory**
**Subject code INZ002031**
**Group of courses NO**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 60 | | 60 | | |
| Form of crediting | Examination | Examination / crediting with grade* | crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | | | | | |
| Number of ECTS points | 2 | | 2 | | |
| including number of ECTS points for practical (P) classes | 0 | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,2 | | 1,2 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Basic knowledge of database system, with a particular focus on the relational model.
2. At least basic knowledge of SQL query language

**SUBJECT OBJECTIVES**

C1. Has basic knowledge and skills of using SQL grouping operators, and SQL aggregation and grouping functions.
C2. Has basic knowledge and skills in the area of transaction oriented processing (OLTP) and analytic oriented processing (OLAP).
C3. Has basic knowledge and skills of using data warehouses.
C4. Knows basics of MS PowerPivot, MS SQL Analysis Services, MS SQL Integration Services and MS SQL Reporting Services.
C5. Has basic knowledge and skills in data integration, reporting and visualization.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEK_W01 has basic knowledge on data warehouse usage and data warehouse organization – logical and physical
PEK_W02 has basic knowledge on ETL process, reporting and data analysis

relating to skills:

| |
|---|
| PEK_U01 can use SQL grouping operators and SQL grouping and aggregating functions<br>PEK_U02 can design and implement a ETL process<br>PEK_U03 can design and implement a simple data warehouse and use it to generate basic reports, using different data visualization methods<br>PEK_U05 can use basic MDX queries |

| PROGRAMME CONTENT | | |
|---|---|---|
| **Form of classes - lecture** | | **Number of hours** |
| Lec 1 | Course details. Introduction to Business Intelligence. | 2 |
| Lec 2 | SQL grouping operators. SQL aggregating and grouping functions. | 2 |
| Lec 3 | Transaction vs analytic needs, processes and data sources | 2 |
| Lec 4 | Multidimensional data model – logical organization | 2 |
| Lec 5 | Data warehouses – basics | 2 |
| Lec 6 | ETL proces | 2 |
| Lec 7 | Data warehouse – logical organisation | 2 |
| Lec 8 | Data warehouses – architecture | 2 |
| Lec 9 | MDX queries | 2 |
| Lec 10 | MDX queries | 2 |
| Lec 11 | Multidimensional data model – physical organisation | 2 |
| Lec 12 | Reporting | 2 |
| Lec 13 | Data visualisation | 2 |
| Lec 14 | Data warehouse – design basics | 2 |
| Lec 15 | Web dashboards | 2 |
| | Total hours | 30 |
| **Form of classes - laboratory** | | **Number of hours** |
| Lab 1 | Course details (Health and Safety Training, Course requirements). MS PowerPivot; pivot tables and pivot graphs | 2 |
| Lab 2 | SQL aggregation and SQL grouping functions. SQL grouping operators | 2 |
| Lab 3 | MS SQL Integration Services – data cleansing | 2 |
| Lab 4 | MS SQL Integration Services – data integration | 2 |
| Lab 5 | MS SQL Analysis Services – basics | 2 |
| Lab 6 | MS SQL Analysis Services – design and implementation | 2 |
| Lab 7 | MS SQL Analysis Services – advanced topics | 2 |
| Lab 8 | MS SQL Analysis Services – MDX basics | 2 |
| Lab 9 | MS SQL Analysis Services – advanced MDX | 2 |
| Lab 10 | MS SQL Reporting Services – simple reporting | 2 |
| Lab 11 | MS SQL Reporting Services – advanced reporting | 2 |
| Lab 12 | Business Intelligence applications – web dashboard systems (QlikView) | 2 |
| Lab 13 | Business Intelligence applications – ETL tools, OLAP servers (group presentation) | 2 |
| Lab 14 | Business Intelligence applications – reporting tools (group presentation) | 2 |

| | | |
|---|---|---|
| Lab 15 | Test | 2 |
| | Total hours | 30 |

## TEACHING TOOLS USED

N1. Lecture – traditional method with multimedia content
N2. Consultations
N3. To get to know with basic items and expanded literature by the student
N4. Project exercises in the computer laboratory
N5. Student's own work - preparation for laboratory classes
N6. Develop reports of project

## EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Educational effect number | Way of evaluating educational effect achievement |
|---|---|---|
| F- laboratory | PEK_U01 – PEK_U04 | Student assessment – individual discussion including result presentation, conclusions, etc. |
| P - lecture | PEK_W01 PEK_W02 | Exam |
| P - laboratory | PEK_U01 – PEK_U04 | Average note from part notes |

## PRIMARY AND SECONDARY LITERATURE

### PRIMARY LITERATURE:

1. Jensen C.S., Pedersen T.B., Thomsen C., Multidimensional Databases and Data Warehousing, Morgan & Claypool Publishers series SYNTHESIS LECTURES ON DATA MANAGEMENT, 2010
2. Rainardi V., Building a Data Warehouse With Examples in SQL Server, Apress, 2008
3. Harinath S., Pihlgren R., Lee D.G.-Y., Sirmon J., Bruckner R.M., PROFESSIONAL MICROSOFT® SQL SERVER® 2016 ANALYSIS SERVICES WITH MDX AND DAX, John Wiley & Sons, Inc., 2016
4. Microsoft SQL Server 2012 Integration Services, APN Promise, 2012
5. Inmon W., Building the Data Warehouse, John Wiley & Sons, New York 2002
6. Kimball R., Caserta J., The Data Warehouse ETL Toolkit, Wiley Publishing, Inc, 2004

### SECONDARY LITERATURE:

1. Aspin A., SQL Server 2012 Data Integration Recipes, Apress, 2012
2. Leonard A., Masson M., Mitchell T., Moss J.M., Ufford M., SQL Server 2012 Integration Services Design Patterns, Apress, 2012
3. Claudia Imhoff, Nicholas Galemmo, Jonathan G. Geiger, Mastering Data Warehouse Design, Wiley Publishing, Inc., 2003
4. MacLennan J., Tang ZH., Crivat B., Data Mining with SQL Server 2008, Wiley Publishing, Inc, 2009

## SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Bernadetta Maleszka, bernadetta.maleszka@pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Programowanie baz danych**
**Name of subject in English: Database programming**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: academic**
**Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister studies~~*, full-time / ~~part-time studies~~***
**Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~***
**Subject code INZ004470**
**Group of courses YES**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 15 | | | 30 | |
| Number of hours of total student workload (CNPS) | 30 | | | 90 | |
| Form of crediting | ~~Examination /~~ crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | ~~Examination /~~ crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 2 | | | 2 | |
| including number of ECTS points for practical (P) classes | | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,2 | | | 1,2 | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge of the rules of the projecting and building relation databases.
2. Skill in defining simple SQL queries.
3. Competences in the field of the structural and object-oriented programming paradigm.

**SUBJECT OBJECTIVES**

C1. Gain basic knowledge of programming environment of the chosen relational database.
C2. Gain basic knowledge of SQL language.
C3. Gain basic knowledge about the advanced SQL queries.
C4. Gain basic knowledge of database programming language on server side.
C5. Gain basic knowledge of the object-oriented extensions of relational database.
C6. Acquiring basic programming skills in the use of the programming environment of the chosen relational database.
C7. Acquiring basic programming skills in the use of SQL language.
C8. Acquiring basic skills in the use of advanced SQL queries.
C9. Acquiring basic programming skills in the use of database programming language on the server side.

C10. Acquiring basic programming skills in the use of relational database object-oriented extensions for the database schema and for the programming on the database server side.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:

PEU_W01 He has a basic knowledge about the programming environment of the chosen relational database.
PEU_W02 He has knowledge of the basics of the SQL language.
PEU_W03 He has knowledge necessary for building advanced SQL language queries.
PEU_W04 He knows the structures of database programming language on the server side.
PEU_W05 He has knowledge of object-oriented relational database extensions.

relating to skills:

PEU_U01 He can navigate in the programming environment of the chosen relational database
PEU_U02 He can construct basic SQL language queries.
PEU_U03 He can construct advanced SQL language queries.
PEU_U04 He can program the database on the server side.
PEU_U05 He can use the object-oriented extensions of the relational database, both in the definition of database scheme as well as programming on the server side.

**PROGRAM CONTENT**

| | **Lectures** | **Number of hours** |
|---|---|---|
| Lec 1 | Preliminary information on the chosen DBMS. | 1 |
| Lec 2 | SQL language – basic queries. | 2 |
| Lec 3 | SQL language - advanced queries. | 2 |
| Lec 4 | Programming language on the server side - commands and their syntax. | 2 |
| Lec 5 | Advanced mechanisms of programming language on the server side. | 2 |
| Lec 6 | Object-oriented extensions of the relational database. | 2 |
| Lec 7 | Test. | 2 |
| Lec 8 | Repeating test. | 2 |
| Lec 9 | Security mechanisms of the relational database, query optimization and optimizers - materials provided by the teacher. | |
| | Total hours | **15** |

| | **Project** | **Number of hours** |
|---|---|---|
| Proj 1 | Preview, health and safety course, introduction to the chosen DBMS programming environment. | 2 |
| Proj 2 | Discussion and pass a project list No. 1 concerning the basic SQL queries. | 2 |
| Proj 3 | Consultation to the project list No. 1 and its implementation. | 2 |
| Proj 4 | Consulting to the project list No. 1, its implementation and reception. | 2 |
| Proj 5 | Discussion and pass a project list No. 2, concerning advanced SQL queries. | 2 |
| Proj 6 | Consultation to the project list No. 2 and its implementation. | 2 |
| Proj 7 | Consulting to the project list No. 2, its implementation and reception. | 2 |
| Proj 8 | Discussion and pass a project list No. 3, concerning database programming language on the server side. Test No. 1 concerning advanced SQL queries. | 2 |
| Proj 9 | Consultation to the project list No. 3 and its implementation. | 2 |
| Proj 10 | Consulting to the project list No. 3, its implementation and reception. | 2 |

| | | |
|---|---|---|
| Proj 11 | Discussion and pass a project list No. 4 concerning the object-oriented extensions of the relational database. Test No. 2 concerning database programming language on the server side. | 2 |
| Proj 12 | Consultation to the project list No. 4 and its implementation. | 2 |
| Proj 13 | Consultation to the project list No. 4 and its implementation | 2 |
| Proj 14 | Consulting to the project list No. 4, its implementation and reception. | 2 |
| Proj 15 | Reception of arrears. Credits. | 2 |
| | Total hours | **30** |

## TEACHING TOOLS USED

N1. Lecture using the projector.
N2. Projects as a project task lists.
N3. Consultation.
N4. Student's own work - preparation of project tasks lists and self-refer to the topics identified by the teacher.
N5. Test (project).
N6. Test (lecture).

## EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEU_W01,PEU_W02, PEU_U01, PEU_U02 | Subject effects are achieved through the implementation of project list No. 1 confirmed by the oral answer.<br>Criteria for the diversification of evaluation:<br>– Implementation of project list No. 1. Point scale - up to 15% of the total number of points which one can obtain during the whole project. |
| F2 | PEU_W03, PEU_U03 | Subject effects are achieved through the implementation of project list No. 2 confirmed by the oral answer.<br>Criteria for the diversification of evaluation:<br>– Implementation of project list No. 2. Point scale - up to 15% of the total number of points which one can obtain during the whole project.<br>– Test No. 1. Point scale - up to 20% of the total number of points which one can obtain during the whole project. |
| F3 | PEU_W04, PEU_U04 | Subject effects are achieved through the implementation of project list No. 3 confirmed by the oral answer<br>Criteria for the diversification of evaluation:<br>– Implementation of project list No. 3. Point scale - up to 15% of the total |

| | | |
|---|---|---|
| | | number of points which one can obtain during the whole project.<br>– Test No. 2. Point scale - up to 20% of the total number of points which one can obtain during the whole project. |
| F4 | PEU_W05, PEU_U05 | Subject effects are achieved through the implementation of project list No. 3 confirmed by the oral answer.<br><br>Criteria for the diversification of evaluation:<br>– Implementation of project list No. 4. Point scale - up to 15% of the total number of points which one can obtain during the whole project. |
| P1 - partial evaluation (lecture) | PEU_W02,PEU_W03, PEU_W04,PEU_W05, PEU_U02, PEU_U03, PEU_U04, PEU_U05 | Subject effects are achieved by earning at least a half points for the test.<br><br>Evaluation determined on the basis of the number of points gained (the percentage of the total number of points available) according to the formula:<br>< 0%, 50%) → ndst (2.0)<br><50%, 60%> → dst (3.0)<br>( 60%, 70%> → dst+ (3.5)<br>( 70%, 80%> → db (4.0)<br>( 80%, 90%> → db+ (4.5)<br>( 90%, 100%> → bdb (5.0) |
| P2 - partial evaluation (project) | PEU_W01,PEU_W02, PEU_W03,PEU_W04, PEU_W05, PEU_U01, PEU_U02, PEU_U03, PEU_U04, PEU_U05 | Subject effects are achieved through the implementation of all project lists.<br><br>A prerequisite for obtaining credit (rating 3.0 and higher) is achieving all of subject effects. Otherwise, the student gets a failing grade (rating 2.0). Higher rating is determined on the basis of the total number of points scored in the evaluations forming F1, F2, F3 and F4 (the percentage of the total number of points to obtain the project) according to the formula:<br><0%, 68%> → dst (3.0)<br>( 68%, 76%> → dst+ (3.5)<br>( 76%, 84%> → db (4.0)<br>( 84%, 92%> → db+ (4.5)<br>( 92%, 100%> → bdb (5.0) |
| P – final evaluation | PEU_W01,PEU_W02, PEU_W03,PEU_W04, PEU_W05, PEU_U01, PEU_U02, PEU_U03, PEU_U04, PEU_U05 | Subject effects are achieved through obtaining a positive partial evaluation (at least 3.0) of both P1 and P2.<br><br>The final evaluation is the arithmetic average of the partial evaluations P1 and P2. |
| **PRIMARY AND SECONDARY LITERATURE** | | |

**PRIMARY LITERATURE (FOR ORACLE DBMS):**

[1] J. Price, Oracle Database 12c i SQL. Programowanie, Wydawnictwo Helion, Gliwice 2015.
[2] L. Barney, M. McLaughlin, Oracle Database 12c. Programowanie w języku PL/SQL, Wydawnictwo Helion, Gliwice 2015.
[3] K. Loney, Oracle Database 11g. Kompendium administratora, Wydawnictwo Helion, Gliwice 2010.
[4] A. Pelikant, Programowanie serwera Oracle 11g SQL i PL/SQL. eBook, Wydawnictwo Helion, Gliwice 2012.
[5] F. Steven, Oracle PL/SQL. Najlepsze praktyki, Wydawnictwo Naukowe PWN, Warszawa 2009.
[6] Materials provided by the lecturer.

**SECONDARY LITERATURE:**

[1] T. Connolly, C. Begg, Systemy baz danych, T. 1 i 2, Wydawnictwo RM, Warszawa 2004.
[2] H. Ladanyi, SQL, Księga eksperta, Wydawnictwo Helion, Gliwice 2000.

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

**Zbigniew Staszak, zbigniew.staszak@pwr.edu.pl**

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish Projektowanie baz danych**
**Name of subject in English Database Design**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: academic / practical***
**Level and form of studies: 1st level, full-time ***
**Kind of subject: optional**
**Subject code INZ004424**
**Group of courses YES**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 15 | | | 30 | |
| Number of hours of total student workload (CNPS) | 30 | | | 90 | |
| Form of crediting | crediting with grade* | | | crediting with grade* | |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 4 | | | | |
| including number of ECTS points for practical (P) classes | 2 | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 2,4 | | | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Completed the „Databases" course.

**SUBJECT OBJECTIVES**

C1 Introduce the methods of databases design and implementation to students
C2 Gather knowledge of available databases design and implementation tools
C3 Applying the acquired knowledge during the design of relational and object databases

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEK_W01 Student has a basic knowledge of methods and available tools for databases design
PEK_W02 Student is able to present all phases of databases design

relating to skills:
PEK_U01 Student is able to prepare all phases of databases design
PEK_U02 Student is able to implement a database
PEK_U03 Student is able to choose proper tools for databases design

relating to social competences:
PEK_K01 Student is able to search and reuse the primary and secondary literature listed below and is able to gather the proper knowledge
PEK_K02 Student understands the need for systematic and individual work in order to cover the scope of the course

| PROGRAM CONTENT | | |
|---|---|---|
| **Lectures** | | **Number of hours** |
| Lec 1 | Introduction to database system design methodology | 1 |
| Lec 2 | Selected elements of UML | 1 |
| Lec 3 | Entity-relationship schemas design | 2 |
| Lec 4 | Relational schemas design | 2 |
| Lec 5 | Conceptual model of a database | 2 |
| Lec 6 | Logical model of a database | 2 |
| Lec 7 | Physical model of a database | 2 |
| Lec 8 | An overview of available tools for database design | 1 |
| Lec 9 | Types and specification methods of integrity constraints | 1 |
| Lec 10 | Test | 1 |
| | Total hours | **15** |
| **Project** | | **Number of hours** |
| Proj 1 | Introduction to database design (Power Designer, Visio) | 2 |
| Proj 2 | Relational model: conceptual model of a database | 2 |
| Proj 3 | Relational model: logical model of database | 2 |
| Proj 4 | Relational model: physical model of database | 2 |
| Proj 5 | Relational model: integrity constraints | 2 |
| Proj 6 | Relational model: interface and report design, constraints | 2 |
| Proj 7 | Object model: class diagrams | 2 |
| Proj 8 | Object model: description of methods | 2 |
| Proj 9 | Implementation of a database schema | 4 |
| Proj 10 | Implementation of integrity constraints | 4 |
| Proj 11 | Implementation of an interface | 4 |
| Proj 12 | Implementation of reports, evaluation of projects | 2 |
| | Total hours | **30** |

| TEACHING TOOLS USED |
|---|
| N1. Traditional lecture<br>N2. Labs<br>N3. One-to-one consultancy during stuff hours<br>N4. Student self-study |

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|

| | | |
|---|---|---|
| concluding (at semester end) | | |
| P- project | PEK_U01-PEK_U03, PEK_K01-PEK_K02 | Evaluation of the prepared tasks during labs, oral test |
| P- lecture | PEK_W01-PEK_W02<br>PEK_K01-PEK_K02 | Test |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**


[1] Beynon-Davies P., *Systemy baz danych*. WNT, W-wa, 2003
[2] Connolly T., Begg C., *Systemy baz danych*. RM 2004. T2
[3] Date C.J., *Wprowadzenie do baz danych*. WNT, W-wa, 2000.
[4] Szeląg A., *PHP, Microsoft IIS, SQL Server : projektowanie i programowanie baz danych*. Helion 2008
[5] Ullman J.D., *Systemy baz danych*. WNT, W-wa, 2003.
[6] Wrembel R., *Oracle : projektowanie rozproszonych baz danych : wiedza niezbędna do projektowania oraz zarządzania bazami danych*. Helion 2003.


**SECONDARY LITERATURE:**

[1]

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**


Prof. dr hab. inż Ngoc Thanh Nguyen, Ngoc-Thanh.Nguyen@pwr.wroc.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Inżynieria systemów baz danych**
**Name of subject in English: Database Systems Engineering**
**Main field of study (if applicable): Applied Computer science**
**Specialization (if applicable):**
**Profile: academic / ~~practical~~**
**Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister studies~~, full-time / ~~part-time~~ studies**
**Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~**
**Subject code INZ004422**
**Group of courses YES**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 15 | | | 30 | |
| Number of hours of total student workload (CNPS) | 30 | | | 90 | |
| Form of crediting | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 4 | | | | |
| including number of ECTS points for practical (P) classes | 2 | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 2,4 | | | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

(1) Designated database knowledge
(2) Designated design skills for dedicated database
(3) Competences: communication skills, ability to identify and correct mistakes

**SUBJECT OBJECTIVES**

C1. Acquaintance with the selected database management system.
C2. Improvement of data modeling and relational database design skills.
C3. Designing ergonomic forms, menus and reports.
C4. Creating database queries in SQL language.
C5. Implementation of database transactions.
C6. Designing, implementing and documenting a dedicated database system.

**SUBJECT EDUCATIONAL EFFECTS**

**relating to knowledge:**

PEK_W01 – knows the selected methodology of designing databases and database systems
PEK_W02 – has knowledge of the possibilities of database management systems

PEK_W03 – knows the rules of designing ergonomic forms, menus and reports
PEK_W04 – has knowledge of the database transactions and their implementation in a selected environment
PEK_W05 – knows syntax of basic SQL language commands
PEK_W06 – knows the selected relational database management system
PEK_W07 – has knowledge about creating macros
PEK_W08 – has knowledge of the types of tests and how to carry them out
PEK_W09 – knows issues related to database security
PEK_W10 – has knowledge of documenting a database project
PEK_W11 – has knowledge of how to assess the utility and functional quality of the database system
PEK_W12 – knows legal aspects of implementation and operation of database systems

**relating to skills:**
PEK_U01 – can correctly use terminology related to database systems
PEK_U02 – can see the area that requires designing a database system
PEK_U03 – can design a database for a selected section of reality
PEK_U04 – can design a database application for a selected field
PEK_U05 – can implement a designed database
PEK_U06 – can implement a simple database application
PEK_U07 – can implement ergonomic forms and application menus
PEK_U08 – can develop readable reports
PEK_U09 – can see the need to use transactions and implement them
PEK_U10 – has the ability to create necessary macros
PEK_U11 – can test the system in a systematic and planned way
PEK_U12 – can prepare technical and operational documentation of the system in compliance with the requirements
PEK_U13 – can formulate queries in SQL language
PEK_U14 – can create and manage user accounts
PEK_U15 – can provide secure access to the database

**relating to social competences:**
PEK_K01 – can work in a team (of 2–3 people)

## PROGRAM CONTENT

| Lectures | | Number of hours |
|---|---|---|
| Lec 1 | Basic concepts and terminology of database systems. Design and implementation of a database. | 1 |
| Lec 2 | Sorting and indexing. Searching for data. Advanced queries. SQL language. | 2 |
| Lec 3 | Data deletion and updating. Transaction processing. Forms. | 2 |
| Lec 4 | Macros. Reports. Communication with the user. Menus, toolbars. | 2 |
| Lec 5 | Data security in database systems. | 2 |
| Lec 6 | Testing, and documenting the database system.<br>Evaluation of the utility and functional quality of the database system.<br>Legal aspects of implementation and exploitation of database systems. | 2 |
| Lec 7 | Final test | 2 |

| | | |
|---|---|---|
| Lec 8 | Retake | 2 |
| | Total hours | **15** |

| **Form of classes – Project** | | **Number of hours** |
|---|---|---|
| Pr1 | H&S training. Presentation of the Relational Database Management System | 2 |
| Pr2 | Business modeling. Identification of the functionality of the designed database application, database modeling in a selected project environment, selection of the database system architecture and implementation environment. | 2 |
| Pr3 | Correct database design for a selected section of reality. | 2 |
| Pr4 | Implementation of the database project in DBMS and filling in the sample data. Integrity of the database. | 2 |
| Pr5 | Design and implementation of advanced forms. | 2 |
| Pr6 | Design and implementation of the main application menu. | 2 |
| Pr7 | Design of ergonomic user interface, implementation of applications using graphical tools, macros and database languages. Procedures, stored functions, and triggers. | 2 |
| Pr8 | Implementation of advanced queries. Query optimization. | 2 |
| Pr9 | Transaction processing. Transaction management. | 2 |
| Pr10 | Design and implementation of advanced reports. | 2 |
| Pr11 | Data security in the database application, user accounts, giving permissions and authorizing access to data. | 2 |
| Pr12 | Testing database application, assessment of the utility and functional quality of the database system, legal aspects of the implementation and operation of database systems | 2 |
| Pr13 | Preparing the final documentation of the database system. | 2 |
| Pr14 | Presentation of database applications. | 2 |
| Pr15 | Credit for the project | 2 |
| | Total hours | **30** |

| **TEACHING TOOLS USED** |
|---|
| N1. Demo versions of examples of correct and incorrect database systems<br>N2. Examples of system documentation |

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation**<br>F – forming (during semester),<br>P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 – **attendance** | PEK_K09 | Checking the implementation of the curriculum |
| F2 – **grade on the activity in the class** | PEK_U01 – PEK_U15 and PEK_K01 – PEK_K09 | Recording activity |

| | | |
|---|---|---|
| F3 – **grade on the database system** | PEK_U01 – PEK_U15 | Grade on the database system |
| F4 – **grade on the system documentation** | PEK_U01 – PEK_U15 | Grade on the documentation |
| F5 – **grade on the test** | PEK_W01 – PEK_W12 | Grade on the test |
| P1 – grade on the lecture credit – **grade on the test (F5)** | | |
| P2 – grade on the project – **weighted average grade at the end of classes calculated from the formulating grades (F1 – F4)** | | |

## PRIMARY AND SECONDARY LITERATURE

**PRIMARY LITERATURE:**


[1] Mazur H., Mazur Z.: Projektowanie relacyjnych baz danych. Oficyna Wydawnicza Politechniki Wrocławskiej, 2004.
[2] Date C.J.: Wprowadzenie do systemów baz danych. WNT, Warszawa, 2000.
[3] Date C.J., Darwen H.: SQL. Omówienie standardu języka. WNT, Warszawa, 2000
[4] Ullman J, D.: Podstawowy wykład z systemów baz danych. WNT, Warszawa, 2004
[5] Garcia-Molina H., Ullman J.D., Widom J.: Systemy baz danych. Pełny wykład. WNT, Warszawa, 2006.


**SECONDARY LITERATURE:**


[1] Pelikant A.: Bazy danych – pierwsze starcie. Helion, 2009.
[2] Jakubowski A.: Podstawy SQL – ćwiczenia praktyczne. Helion, 2001.
[3] Allen S.: Modelowanie danych. Helion, 2006.


**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**


**dr hab. Zygmunt Mazur, prof. WUST, *zygmunt.mazur@pwr.edu.pl***

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Bazy danych**
**Name of subject in English: Databases**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: academic / practical***
**Level and form of studies: 1st, full-time**
**Kind of subject: obligatory**
**Subject code INZ002023**
**Group of courses YES (Lecture, Classes), NO (Laboratory)**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | 15 | 15 | | |
| Number of hours of total student workload (CNPS) | 115 | | 60 | | |
| Form of crediting | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 4 | | 2 | | |
| including number of ECTS points for practical (P) classes | | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 2,4 | | 1,2 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. None

**SUBJECT OBJECTIVES**

C1 Gaining the basic knowledge about databases, data models and their implementation in a DBMS
C2 Acquisition of the ability to define and process data stored in databases

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEK_W01 Describes the principles of data modeling at different levels of abstraction
PEK_W02 Presents basic transformation rules of data models and their verification
PEK_W03 Describes implementation rules of data models in a DBMS
PEK_W04 Presents the role and possibilities of using the SQL standard in a DBMS systems
PEK_W05 Defines the rules for defining architecture of database systems

relating to skills:
PEK_U01 Defines a conceptual data model using the UML
PEK_U02 Transforms conceptual data model into a physical model, taking into account the business rules and domain constraints

PEK_U03 Removes anomalies of data using the normalization process
PEK_U04 Defines queries using DML database languages and their implementation in a DBMS for searching and processing of data in databases
PEK_U05 Knows and applies safety rules of working

**PROGRAM CONTENT**

| | **Lectures** | **Number of hours** |
|---|---|---|
| Lec 1 | Introduction - General Course Information – Concepts and Architecture | 2 |
| Lec 2 | Data modeling at different levels of abstractions - aims, properties, languages of specifications | 2 |
| Lec 3 | The Relational Data Model – definition, properties, constraints | 2 |
| Lec 4 | The Relational Algebra | 2 |
| Lec 5 | Functional Dependencies - Normal Forms - Normalization Process | 2 |
| Lec 6 | Normalization Process cont. | 2 |
| Lec 7 | Introduction to Data Definition Language (DDL) | 2 |
| Lec 8 | Implementation of conceptual data models using the SQL standard DDL - basic information | 2 |
| Lec 9 | DDL – Implementation of constraints | 2 |
| Lec 10 | Introduction to Data Manipulation Language (DML), Transactions | 2 |
| Lec 11 | DML - Data Modification (INSERT, UPDATE, DELETE) | 2 |
| Lec 12 | DML Query - Joins, Subquery, Set Operations, Views | 2 |
| Lec 13 | DML - Common Table Expressions, Stored Procedure, Triggers | 2 |
| Lec 14 | NoSQL Databases | 2 |
| Lec 15 | Test | 2 |
| | Total hours | 30 |

| | **Classes** | **Number of hours** |
|---|---|---|
| Cl 1 | Introduction – Data - Data Models - DBMS | 2 |
| Cl 2 | Data modeling – UML/ERD- (P01) | 2 |
| Cl 3 | Examples of simple databases, Basic rules of transformation of data models | 2 |
| Cl 4 | The Relational Algebra Operations - (P02) | 2 |
| Cl 5 | Normalization process – 1NF, 2NF, 3NF - (P03) | 2 |
| Cl 6 | Normalization process – BCNF, 4NF - (P03) | 2 |
| Cl 7 | Transactions – Concurrency Control Technics - (P04) | 2 |
| Cl 8 | Test | 1 |
| | Total hours | 15 |

| | **Laboratory** | **Number of hours** |
|---|---|---|
| Lab 1 | Health and safety training. Conditions of the course. Organization of work, Introduction to DBMS (P08) | 2 |
| Lab 2 | Analysis of exemplary databases | 2 |
| Lab 3 | DDL – creating simple database –"Our University" (Student, Course, Teacher, etc.) – (P05) | 2 |

| | | |
|---|---|---|
| Lab 4 | DML - INSERT, UPDATE, DELETE – (P06) | 2 |
| Lab 5 | DML Query - Joins, Subquery, Set Operations, Views (P06) | 2 |
| Lab 6 | DML - Common Table Expressions (P06) | 2 |
| Lab 7 | Programming - Stored Procedure, Triggers, User Defined Functions (UDF) – (P07) | 2 |
| Lab 8 | Test | 1 |
| | Total hours | 15 |

**TEACHING TOOLS USED**

N1. Lecture informative with elements of problem domains, supported by multimedia presentations and examples of solutions
N2. Database management systems
N3. E-learning system used for the publication of teaching materials and messages, and evaluate student work

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 – laboratory grade | PEK_U01 - 05 | Grade from laboratory exercises from within scale 0..100% |
| F2 – classes grade | PEK_U01 – 05 | Grade from classes exercises from within scale 0..100% |
| F3 – lecture grade | PEK_W01 - 05 | Grade from final test from within scale 0..100% |
| P1 – course final grade (lecture,classes) based on F2 and F3 (while F1 >=50%) | | |
| P2 – laboratory final grade based on F1 | | |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

[1] Connolly T., Begg C., Database Systems. A Practical Approach to Design, Implementation, and Management 4th ed., Addison Wesley, 2005
[2] Celko J., SQL for Smarties. Advanced SQL Programming, 3th ed., Elsevier, 2005
[3] Elmasri R., Navathe S., Fundamentals of Database Systems 5th ed., Addison Wesley, 2007
[4]Kifer M., Bernstein A., Lewis P., Database Systems. An Application-Oriented Approach 2nd ed., Addison Wesley, 2006

**SECONDARY LITERATURE:**

[1] Ben-Gan I., Microsoft SQL Server 2008, T-SQL Fundamentals, Microsoft Press, 2009
[2] The educational materials prepared by the teacher course on the basis of the documentation MS SQL, Oracle, and Internet resources

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

Marek Kopel marek.kopel@pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Aplikacje webowe na platformę .NET**
**Name of subject in English: Developing Web Applications with .NET**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: ~~academic~~ / practical***
**Level and form of studies: 1st/ ~~2nd~~ level~~, uniform magister studies~~*, full-time / ~~part-time~~ studies***
**Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~***
**Subject code INZ002028**
**Group of courses YES / ~~NO~~***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 60 | | 60 | | |
| Form of crediting | ~~Examination~~ / crediting with grade* | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | **4** | | | | |
| including number of ECTS points for practical (P) classes | 2 | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 2,4 | | | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Ability to object-oriented programming in Java.

**SUBJECT OBJECTIVES**

C1 The ability to develop an advanced web applications in C# and .NET Framework using Visual Studio IDE

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:

PEK_W01: Students could list and describe the basic software components used in the implementation of desktop applications with the console on .NET platform

PEK_W02: Students could list and describe the basic software components used in the implementation of an advanced web applications on .NET platform.

relating to skills:

| |
|---|
| PEK_U01: Student is able to analyze and select the proper types and language constructs to support object-oriented programming paradigm on .NET platform.<br>PEK_U02: Student is able to implement a desktop application with a console interface.<br>PEK_U03: Student obtains information from various sources and is able to choose the right technology to implement an advance web application. |

| PROGRAM CONTENT | | |
|---|---|---|
| **Lectures** | | **Number of hours** |
| Lec 1 | An introduction to the course and the principles of assessment. Basics of .NET Framework and Visual Studio IDE | 2 |
| Lec 2 | Basics of C# - part 1: basic data types, variables, methods, value and reference types, operators, flow control | 2 |
| Lec 3 | Basics of C# - part 2: classes, structs, members, interfaces, enumerated types, types and partial methods | 2 |
| Lec 4 | Basics of C# - part 3: generics, collections | 2 |
| Lec 5 | Basics of C# - part 4: inheritance, object lifetime, exceptions | 2 |
| Lec 6 | Basics of C# - part 5: delegates, lambdas and events | 2 |
| Lec 7 | Test 1 | 2 |
| Lec 8 | MVC pattern in ASP.NET, annotations. | 2 |
| Lec 9 | Routing, controllers, data binding | 2 |
| Lec 10 | Razor language and mechanisms for CSHTML page views | 2 |
| Lec 11 | ADO .Net, Entity Framework Code-First, the basics of Fluent API | 2 |
| Lec 12 | LINQ language, Entity Framework Base-First, Model-First | 2 |
| Lec 13 | Authorization management, session, application publication | 2 |
| Lec 14 | MS Cloud Azure | 2 |
| Lec 15 | Test 2 | 2 |
| | Total hours | 30 |

| **Laboratory** | | **Number of hours** |
|---|---|---|
| Lab 1 | Organizational classes. Presentation of the scope and principles of evaluation. To familiarize students with the principles of health and safety. Define and run demo applications in the Visual Studio environment | 2 |
| Lab 2 | Define and run demonstration projects of console applications in the Visual Studio environment | 2 |
| Lab 3 | Console applications using structures and classes. | 2 |
| Lab 4 | Console applications using generic collections | 2 |
| Lab 5 | Console applications with generic types | 2 |
| Lab 6 | Console applications with collections | 2 |
| Lab 7 | Console applications with inheritance | 2 |
| Lab 8 | Console applications with lambda expressions and events | 2 |
| Lab 9 | A simple web application with the MVC pattern. | 2 |

| | | |
|---|---|---|
| Lab 10 | Web application with data binding and own routing | 2 |
| Lab 11 | Web application with Razor pages and own templates | 2 |
| Lab 12 | Web application with a database using EF Code-First | 2 |
| Lab 13 | Web application with a database using LINQ / Fluent API | 2 |
| Lab 14 | Web application with a database with permissions and a session. | 2 |
| Lab 15 | Grading and the questionnaire of the course | 2 |
| | Total hours | 30 |

| **TEACHING TOOLS USED** |
|---|
| N1. Multimedia lecture.<br>N2. Computer didactic laboratory with development environment.<br>N3. An e-learning system used for the publication of teaching materials, tests and communication |

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| FL – points from laboratory | PEK_U01<br>PEK_U02<br>PEK_U03 | Implementation of tasks indicated by the teacher. The final score in the range [0; 50] |
| FW – points from classes | PEK_W01<br>PEK_W02 | Solving tasks from two tests. The final score in the range [0; 50] |
| P=FL+FW,<br>Final grade according to the scale:<br>[0;50) - 2.0<br>[50;62) - 3.0<br>[62;73) - 3.5<br>[73;84) - 4.0<br>[84;95) - 4.5<br>[95;100] - 5.0 | | |

| **PRIMARY AND SECONDARY LITERATURE** |
|---|
| **PRIMARY LITERATURE:** |
| [1] J. Albahari, B. Albahari. C# 7.0 w pigułce. Wydanie VII. Helion 2018<br>[2] K. Żydzik, T. Rak. C# 6.0 i MVC 5. Tworzenie nowoczesnych portali internetowych, Helion 2015 |
| **SECONDARY LITERATURE:** |
| [1] Ch. Nagal. Professional C# 6 and .NET Core 1.0. John Wiley & Sons, Inc., Indianapolis, 2016 |
| **SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)** |
| Dr inż. Dariusz Konieczny (dariusz.konieczny@pwr.edu.pl) |

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Techniki przetwarzania mediów cyfrowych**
**Name of subject in English: Digital Media Processing Techniques**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable): no specialization**
**Profile: academic / ~~practical~~***
**Level and form of studies: 1st/~~ 2nd level, uniform magister studies~~*, full-time / ~~part-time~~ studies***
**Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~***
**Subject code INZ004439**
**Group of courses YES / ~~NO~~***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 2 | | 2 | | |
| Number of hours of total student workload (CNPS) | 60 | | 60 | | |
| Form of crediting | Crediting with grade* | Examination / crediting with grade* | Crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 2 | | 2 | | |
| including number of ECTS points for practical (P) classes | | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,2 | | 1,2 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge of Discret Fourier Transform, Discret Cosine Transform and reverse transformations
2. Basic knowledge in acoustics: nature of acoustic waves, parameters describing the wave.
3. Basic knowledge in optics

**SUBJECT OBJECTIVES**

C1 Acquiring knowledge on digitalization of analog multimedia information and methods of digital media processing for typical applications
C2 Acquiring skills of creating, processing and mixing digital media using specialized software.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEU_W01 Student is able to list and describe a proces of digitalisation of analog multimedia information, he/she knows distortions that occure in this proces and the methods of removing them
PEU_W02 Student knows selected methods of multimedia compression
PEU_W03 Student knows the methods od digital sound processing

PEU_W04 Student i s able to list and describe selected methods of sound synthesis; he/she has basic knowledge about MIDI system
PEU_W05 Student is able to list and describe models and color systems, he/she knows the difference between vector graphics and raster image
PEU_W06 Student can list and desribe typical operations used in digital image porcessing, he/she knows their applications
relating to skills:
PEU_U01 Student is able to use specialized software to create, edit and mix digital media

**PROGRAM CONTENT**

| | **Lectures** | **Number of hours** |
|---|---|---|
| Lec 1 | Intorduction. Nature of sound. Parameters of accoustic wave. Basics of psychoacoustics. | 2 |
| Lec 2 | Digitalization of sound: steps, parameters, distortions: reasons, prevention and removing | 2 |
| Lec 3 | Sound images in the time and frequency domain | 1 |
| Lec 4 | Basic methods of digital sound processing. | 3 |
| Lec 5<br>Lec 6 | Coding and compression of sound data: lossless methods, perceptual coding, MPEG compression algorithm, transmission codes | 4 |
| Lec 7 | Sound synthesis | 2 |
| Lec 8 | Basics of the MIDI system | 2 |
| Lec 9 | Human perception of images. Models and color systems. Vector and raster images. Aquisition of digital images: steps, parameters and distortions | 2 |
| Lec 10 | Digital image processing: context free operations, their applications | 2 |
| Lec 11 | Digital image processing: context operations, linear and non linear filters, their applications | 2 |
| Lec 12 | Feature detection in digital images | 2 |
| Lec 13 | Digital image processing: morphological operations | 2 |
| Lec 14 | Digital image processing: segmentation and tresholding | 2 |
| Lec 15 | Digital image compression | 2 |
| | Total hours | |

| | **Laboratory** | **Number of hours** |
|---|---|---|
| Lab 1 | Organization of laboratory: introduction, organization and time table, conditions of passing the subject, OSH training | 2 |
| Lab 2,<br>Lab 3 | Simple edition of a sound file: recording own voice, removing noise, format conversion, cutting, pasting and mixing recordings, volume adjustment | 4 |
| Lab 4,<br>Lab 5,<br>Lab 6 | Advanced edition of a sound file: use special effects (e.g. chorus, reverb etc.) to create full sound panorama. Modifications of own voice to get the voicw of another person. | 6 |
| Lab 7,<br>Lab 8 | Simple edition of digital image on the example of retouching an old photo | 4 |
| Lab 9,<br>Lab10,<br>Lab 11 | Advanced edition of digital images on the example of photomontage of the face and the whole character. | 6 |

| | | |
|---|---|---|
| Lab 12, Lab 13, Lab 14 | Design and implementation of the final task involving preparation of a multimedia presentation combining processed image and sound (for example instructional material on a given topic) | 6 |
| Lab 15 | Presentation of the final task | 2 |
| | Total hours | 30 |

## TEACHING TOOLS USED

N1. Traditional lecture supported by the presentation
N2. E-learning – materials for the lecture
N3. E-learning: organization of laboratory, sharing exercise instructions and teaching aids, transfer of taks results and laboratory documentation (reports), use of forum, chat and e-mail to communicate with the teacher and other members of the group
N4. – E-learning – exam in the form of an electronic test

## EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEU_U01 | Average marks for the implementation of individual exercises |
| F2 | PEU_U01 | Average marks for reports |
| F3 | PEU_U01 | Evaluation for the final task |
| P - Laboratory | PEU_U01 | The final laboratory grade is the weighted average of the forming grades: `0,3*F1+0,3*F2+0,4*F3` |
| P - Lecture | PEU_W01 – PEU_W06 | Exam result: to pass the exam it is necessary to get at least 50% of points that are possible to get in the test |

## PRIMARY AND SECONDARY LITERATURE

**PRIMARY LITERATURE:**


[1] Chapman N., Chapman J., Digital Multimedia, Third Edition, John Wiley & Sons, Ltd., Chichester, 2009
[2] Malina W., Smiatacz M., Cyfrowe przetwarzanie obrazów, Warszawa: Akademicka Oficyna Wydawnicza EXIT, 2008.
[3] Gonzales R.,Woods R., Digital Image Processing, Prentice–Hall, New Jersey, 2001.
[4] Czyżewski A., Dźwięk Cyfrowy: wybrane zagadnienia teoretyczne, technologia, zastosowania, Wyd. 2, Warszawa: Akademicka Oficyna Wydawnicza EXIT, 2015.
[5] Nowak W., Homan W., Midi: muzyczny standard dla komputerów, Kraków: Wydawnictwo DMM, 1994.


**SECONDARY LITERATURE:**


[1] Petrou M., Petrou C., Image Processing: The Fundamentals, 2nd ed., Chichester: John Wiley & Sons, 2010.
[2] Goodall, D. P., Haas, O. C. L., Signal and Image Processing, Wrocław: Wrocław University of Technology ; Łódż : PRINTPAP, 2011.
[3] Speech and audio processing in adverse environments, Eds. Hänsler E., Schmidt G., Berlin ; Heidelberg : Springer-Verlag, cop. 2010.
[4] Zolzer U., Digital audio signal processing, Chichester: John Wiley and Sons, 1997.
[5] Pavlidis T., Grafika i przetwarzanie obrazów, WNT, Warszawa, 1987.
[6] Skarbek W., Metody reprezentacji obrazów cyfrowych, PLJ, Warszawa, 1993.
[7] Tadeusiewicz R., Korohoda P., Komputerowa analiza i przetwarzanie obrazów, FPT, Kraków, 1997.

| SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS) |
| --- |
| Dr inż. Elżbieta Kukla, e.kukla@pwr.edu.pl |

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish Matematyka Dyskretna**
**Name of subject in English Discrete Mathematics**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):** *not applicable*
**Profile: academic**
**Level and form of studies: 1st level, full-time**
**Kind of subject: obligatory**
**Subject code INZ004406**
**Group of courses YES**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | 30 | | | |
| Number of hours of total student workload (CNPS) | 60 | 90 | | | |
| Form of crediting | crediting with grade | | | | |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 2 | 3 | | | |
| including number of ECTS points for practical (P) classes | | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 3 | | | | |

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Basic knowledge of set theory.
2. Basic knowledge of formal logic (propositional logic and first-order logic).

**SUBJECT OBJECTIVES**

C1. A student is supposed to obtain fundamental knowledge of discrete mathematics understood as a set of formal tools needed to define and solve simple problems in the areas of knowledge representation and processing, discrete optimization, and information retrieval in the context of computer science.

**SUBJECT EDUCATIONAL EFFECTS**

Relating to knowledge:

PEK_W01 A student knows and understands basic concepts of discrete mathematics applicable to the construction and understanding of simple tasks of information and knowledge processing in the context of computer – based systems.

PEK_W02 A student knows and understands basic concepts of discrete mathematics applicable to the construction and understanding of simple tasks of information retrieval in the context of computer – based systems.

PEK_W03 A student knows and understands basic concepts of discrete mathematics applicable to the construction and understanding of simple problems of discrete optimization in the context of computer – based systems.

| **PROGRAMME CONTENT** | | |
|---|---|---|
| **Form of classes - lecture** | | **Number of hours** |
| Lec01 | Introduction. Set, union and intersection of sets, relative and absolute complement of a set, symetric difference of sets. Set algebra laws. Power set. | 2 |
| Lec02 | Cartesian product. Properties of cartesian product. Introduction to the mathematical theory of relations. Binary relations. | 2 |
| Lec03 | Application of first-order predicate calculus to defining and verifying properties of binary relations. | 2 |
| Lec04 | Basic tasks of knowledge processing in discrete universe of objects with macrostructure (representation choice, object grouping, object retrieval). | 2 |
| Lec05 | The universe of binary relations | 2 |
| Lec06 | Directed graphs and binary relations. Operations on binary relations. Transitive reduct and transitive completion. | 2 |
| Lec07 | The universe of sets. | 2 |
| Lec08 | The universe of equivalence relations. | 2 |
| Lec09 | Approximation space and rough sets. | 2 |
| Lec10 | Information system - basic concepts. Rough Sets Descriptions. Decision tables | 2 |
| Lec11 | The universe of tolerance (similarity) relations and the universes of orders. | 2 |
| Lec12 | Introduction to the theory of multisets. The theory of fuzzy sets. Linguistic variables. | 2 |
| Lec13 | Discrete models of semantic relations in knowledge processing systems and wordnets. Classical and extended thesauri for information retrieval tasks. | 2 |
| Lec14 | An overview of alternative universes of complex discrete objects. | 2 |
| Lec15 | Final test | 2 |
| | Total hours | 30 |

| Form of classes - class | | Number of hours |
|---|---|---|
| Tut01 | Sets, operations on sets (union and intersection of sets, relative and absolute complement of a set, symetric difference of sets). Power set. Characteristic function of the set. | 2 |
| Tut02 | Proving the set algebra theorems | 2 |
| Tut03 | Cartesian product. Representation of binary relations. | 2 |
| Tut04 | Application of first-order predicates to defininig and verifying of properties of binary relations. Types of binary relations. | 2 |
| Tut05 | The tasks of representation choice, object grouping, and object retrieval in the universe of objects with macrostructure. | 2 |
| Tut06 | The tasks of knowledge processing, optimization and object retrieval in the universe of binary relations. | 2 |
| Tut07 | Operation in the universe of Binary relations. Algorithms of determinantion of transitive reduct and transitive completion of binary relations. | 2 |
| Tut08 | Test 1. | 2 |
| Tut09 | Similarity and distance functions in the universe of sets - definitions and applications. | 2 |
| Tut10 | Similarity and distance functions in the universe of equivalence relations - definitions and applications. | 2 |
| Tut11 | Set-based information retrieval language in information systems. Approximation space and functional dependency of information system attributes. | 2 |
| Tut12 | Rough sets and decision tables. | 2 |
| Tut13 | Binary relations in the universes of complex discrete objects. | 2 |
| Tut14 | Test 2. | 2 |
| Tut15 | Final test. | 2 |
| | Total hours | 30 |

| TEACHING TOOLS USED |
|---|
| N1. Traditional lecture.<br>N2. Self study – literature studies.<br>N3. Self study – problem solving.<br>N4. Group tutorials – group problem solving and discussions of complex cases during regular meetings. |

## EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Educational effect number | Way of evaluating educational effect achievement |
|---|---|---|
| F1 | PEK_W01<br>PEK_W02<br>PEK_W03 | Total point score F1 of the task completion obtained on the basis of the first written test planned in the schedule of tutorial classes, supplemented with a point-based assessment of any additional and documented achievements. Supplementary score may |

| | | |
|---|---|---|
| | | result from solving of additional computational tasks, and active and substantively correct participation in solving tasks during tutorial classes. The first test is claimed to be credited after obtaining a minimum of 50% of the maximum number of $F_{MAX1}$ points assigned to the first test. |
| F2 | PEK_W01<br>PEK_W02<br>PEK_W03 | Total point score F2 of the task completion obtained on the basis of the second written test planned in the schedule of tutorial classes, supplemented with a point-based assessment of any additional and documented achievements. Supplementary score may result from solving of additional computational tasks, and active and substantively correct participation in solving tasks during tutorial classes. The second test is is claimed to be credited after obtaining a minimum of 50% of the maximum number of $F_{MAX1}$ points assigned to the second test. |
| F3 | PEK_W01<br>PEK_W02<br>PEK_W03 | Provided that the conjunctive condition $F1 \geq ½F_{MAX1}$ and $F2 \geq ½F_{MAX2}$ is fulfilled, the total point score F3 is given as F3 = F1+F2. Provided that the conjunctive condition $F1 \geq ½F_{MAX1}$ and $F2 \geq ½F_{MAX2}$ is not fulfilled, the total point score F3 is obtained on the basis of the final written test planned in the schedule of tutorial classes. The final test is claimed to be credited after obtaining a minimum of 50% of the maximum number of points $F_{MAX3} = F_{MAX1} + F_{MAX2}$. |
| W | PEK_W01<br>PEK_W02<br>PEK_W03 | Total point score W obtained on the basis of obtained on the basis of a written test planned in the schedule of lectures. |

P2. The obligatory condition for obtaining a positive final grade is getting a pass of the exercise. If the condition is met, the basis for obtaining the assessment is the number F = W1 + F3. The assessment is based on the table:

| $[F/F_{MAX}]$ % | 40% | 60% | 70% | 80% | 90% |
|---|---|---|---|---|---|
| Grade | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 |

where: $F_{MAX} = W_{MAX} + F_{MAX3}$ and $W_{MAX}$ is the maximum number of points possible to obtain on the basis of the test planned for in the schedule of lectures.

## PRIMARY AND SECONDARY LITERATURE

**PRIMARY LITERATURE:**


1. Ross K.A., Wright Ch., *Matematyka Dyskretna.* PWN, Warszawa 2006.
2. Rasiowa H., *Wstęp do matematyki współczesnej.* PWN, Warszawa 2003.
3. Czogała E., Pedrycz W., *Elementy i metody teorii zbiorów rozmytych.* PWN, Warszawa 1985.


**SECONDARY LITERATURE:**


1. Bolc L., Borodziewicz W., Wójcik M., *Podstawy przetwarzania informacji niepewnej i niepełnej.* PWN, Warszawa 1991.
2. Daniłowicz C., *Modele systemów wyszukiwania informacji uwzględniające preferencje użytkowników końcowych.* Wydawnictwo Politechniki Wrocławskiej, Wrocław 1992.
3. Daniłowicz C., Nguyen N. T., Jankowski Ł., *Metody wyboru reprezentacji stanu wiedzy agentów w systemach multiagenckich.* Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2002.
4. Hand D., Mannila H., Smyth P., *Eksploracja danych.* WNT, Warszawa 2005.
5. Kuratowski K., *Wstęp do Teorii Mnogości i Topologii*. Państwowe Wydawnictwo Naukowe, Warszawa, 1982.
6. Lipski W., *Kombinatoryka dla programistów.* WNT, Warszawa 1982.
7. Lipski W., Marek W., *Analiza kombinatoryczna.* PWN, Warszwa 1986.
8. Majewski W., Albicki A., *Algebraiczna teoria automatów.* WNT, Warszawa 1980.
9. Mazur Z., *Modele i modyfikacje rozproszonych systemów wyszukiwania informacji opartych na tezaurusach z wagami.* Wydawnictwo Politechniki Wrocławskiej, Wrocław 1989.
10. Graham R. L., Knuth D. E., Patashnik O., *Matematyka Konkretna*. PWN, Warszawa 1996.
11. Reinglod E. M., Nievergelt J., Deo N., *Algorytmy kombinatoryczne*. PWN, Warszawa 1985.
12. Zadrożny S., *Zapytania nieprecyzyjne i lingwistyczne podsumowania baz danych.* Akademicka Oficyna Wydawnicza EXIT, Warszawa 2006.
13. Zakrzewski M., *Markowe Wykłady z Matematyki - matematyka dyskretna.* Oficyna Wydawnicza GiS s.c., Wrocław 2014.


**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**


**Radosław Katarzyniak, PhD, DSc, University Prof., radosław.katarzyniak@pwr.wroc.pl**

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Rozproszone systemy informatyczne**
**Name of subject in English: Distributed computer systems**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: academic / practical***
**Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister studies~~*, full-time / ~~part-time studies~~***
**Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~***
**Subject code INZ002035**
**Group of courses YES / ~~NO~~***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 30 | | 90 | | |
| Form of crediting | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 2 | | 2 | | |
| including number of ECTS points for practical (P) classes | | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,2 | | 1,2 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Basic knowledge about the operation of computer operating systems.
2. Basic knowledge about the operation of computer networks.
3. Basic knowledge of programming in Java, C/C++, C#.

**SUBJECT OBJECTIVES**

C1. Obtaining basic knowledge in the field of architecture of distributed systems, as well as technologies and techniques used in distributed systems.

C2 Acquiring the ability to implement applications for selected distributed processing environments.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:

PEU_W01 Knows the basic basic architectures of distributed computer systems and examples of such systems.

PEU_W02 Describe selected technologies and techniques for implementing applications for a distributed processing environment.

relating to skills:
PEU_U01 Is able to implement basic applications in a distributed computing environment in selected technologies.

| PROGRAM CONTENT | | |
|---|---|---|
| **Lectures** | | **Number of hours** |
| Lec 1 | Presentation of the course organization and program. Introduction to the subject: basic features, purpose and design assumptions of multiprocessor and distributed systems. | 2 |
| Lec 2 | Middleware services - mechanisms and selected remote procedure call (RPC) techniques. | 2 |
| Lec 3 | Middleware services - distributed objects (DO). Selected implementation technique and universal worker model. | 2 |
| Lec 4 | Web Services - concepts of SOA, REST, Web API, AJAX. | 2 |
| Lec 5 | Application programming in the SOA concept. | 2 |
| Lec 6 | Application programming in the REST and Web API concept. | 2 |
| Lec 7 | Programming web clients of RIA type applications. | 2 |
| Lec 8 | Microservices and component services (SCA architecture). | 2 |
| Lec 9 | Streaming in distributed systems - selected application implementation techniques. | 2 |
| Lec 10 | Selected problems of distributed processing - point-to-point communication, collective communication and communication costs. | 2 |
| Lec 11 | Selected problems of distributed processing - coordination of processes in distributed systems. | 2 |
| Lec 12 | Selected problems of distributed processing - distributed transactions. | 2 |
| Lec 13 | Selected problems of distributed processing - reliability of processing in distributed systems. | 2 |
| Lec 14 | Peer-to-Peer (P2P) systems. | 2 |
| Lec 15 | Passing test. | 2 |
| | Total hours | **30** |
| **Laboratory** | | **Number of hours** |
| Lab 1 | Discussion of the organization and program of classes. OSH training. Presentation of teaching tools. | 2 |
| Lab 2 | Programming RPC applications using XML RPC and/or JSON RPC standards. | 2 |
| Lab 3 | Programming RPC applications using the gRPC framework. | 2 |
| Lab 4 | Programming distributed applications using Java RMI. | 2 |
| Lab 5 | Distributed applications in service-oriented architecture using Microsoft WCF - part 1 basics of programming. | 2 |
| Lab 6 | Distributed applications in service-oriented architecture using Microsoft WCF - part 2. Asynchronous procedures and streaming. | 2 |
| Lab 7 | Application programming under the SCA concept. Docker environment - part I. | 2 |

| | | |
|---|---|---|
| Lab 8 | Application programming under the SCA concept. Docker environment - part II. | 2 |
| Lab 9 | REST style web services - part I. | 2 |
| Lab 10 | REST-style web services - part II. | 2 |
| Lab 11 | REST web application with a fat client. | 2 |
| Lab 12 | Application using the WebSocket protocol. | 2 |
| Lab 13 | Application implementing selected control mechanisms in a distributed system - part I. | 2 |
| Lab 14 | Application implementing a selected control mechanisms in a distributed system - part II. | 2 |
| Lab 15 | Summary and discussion of classes. Final passing the class and issuing grades. | 2 |
| | Total hours | **30** |

**TEACHING TOOLS USED**

N1. Informative lecture supported by multimedia presentations.
N2. Printed or electronic laboratory exercises.
N3. Development software for implementing distributed applications for selected environments..
N4. An e-learning system for publishing teaching materials, tasks and announcements, and collecting and assessing student work, as well as for carrying out knowledge tests.

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), C – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 – La2 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷3. |
| F2 – La3 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| F3 – La5 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| F4 – La6 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| F5 – La8 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| F6 – La9 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| F7 – La10 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| F8 – La11 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| F9 – La12 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| F10 – La14 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |

| | | |
|---|---|---|
| C1 – final evaluation from the laboratory | PEK_U01 | The grade is determined on the basis of sum of points from the grades F1 to F10 according to the formula:<br>- below 50% of points – ndst (2.0)<br>[50%, 60%) – dst (3.0)<br>[60%, 70%) – dst+ (3.5)<br>[70%, 80%) – db (4.0)<br>[80%, 90%) – db+ (4.5)<br>[90%, 100%) – bdb (5.0)<br>100% - discretionary (e.g. additional task) |
| C2 – final evaluation from the lecture | PEK_W01, PEK_W02. | Knowledge test - written or electronic test using an e-learning system.<br>Grade based on the score obtained from the test. Rating scale as for C1. |
| C3 – final evaluation from the lecture | The final grade C3 is calculated on the basis of 50% of C1 and 50% of C2. The condition for obtaining a positive grade C3 is obtaining a positive grade for both C1 and C2 components. | |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**


[1] Tanenbaum A. S., van Steen M.: Distributed systems : principles and paradigms, Pearson Prentice Hall, 2007.
[2] M. P. Papazoglou: Web Services & SOA. Principles and Technology, Pearson Education Limited, 2012.
[3] Richardson L., Ruby S.: RESTful Web Services, O'Reilly Media, Inc., 2007.
[4] Buford J. Yu H., Lua E.K.: P2P Networking and Applications, Morgan Kaufman 2009
[5] Curry E.: Message-Oriented Middleware, Middleware Communications, 2004.
[6] Löwy J., Montgomery M.: Programming WCF Services. Design and Build Maintainable Service-Oriented Systems, O'Reilly Media, Inc., 2016.
[7] Krochmalski J.: Docker : projektowanie i wdrażanie aplikacji, Helion, 2017.
[8] Oracle electronic documentation - materials for the considered techniques, http://www.oracle.com


**SECONDARY LITERATURE:**


[9] Coulouris G., Dollimore J., Kindberg T.: Distributed systems : concepts and design, Addison-Wesley, 2005.
[10] Hasan J.: Expert Service-Oriented Architecture in C#: Using the Web Services Enhancements 2.0, Apress, 2004.
[11] Allamaraju S.: RESTful Web Services Cookbook, O'Reilly Media, Inc., 2010.
[12] R. Steinmetz, K. Wehrle: Peer-to-Peer Systems and Applications, LNCS 3485, Springer, 2005.
[13] Nagel C.: Professional C# 7 and .NET Core 2.0, John Wiley & Sons, 2018.
[14] Kane S. P., Matthias K.: Docker : praktyczne zastosowania, Helion, 2017.
[15] IBM Redbooks electronic documentation - materials for the considered techniques, http://www.ibm.com/redbooks


**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**


Mariusz Fraś, mariusz.fras@pwr.edu.pl

**FACULTY** of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Techniki efektywnego programowania**
**Name of subject in English: Effective programming techniques**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: academic ***
**Level and form of studies: 1st/ ~~2nd level, uniform magister studies*,~~ full-time / ~~part-time studies*~~**
**Kind of subject: obligatory / ~~optional / university-wide*~~**
**Subject code: INZ004408**
**Group of courses ~~YES~~ / NO***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | **15** | | **30** | | |
| Number of hours of total student workload (CNPS) | **60** | | **90** | | |
| Form of crediting | ~~**Examination /**~~ **crediting with grade*** | Examination / crediting with grade* | ~~**Examination /**~~ **crediting with grade*** | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | | | | | |
| Number of ECTS points | **2** | | **3** | | |
| including number of ECTS points for practical (P) classes | | | **3** | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | **1,2** | | **1,8** | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Basic programming skills.
2. Basic knowledge of data structures and algorithms.
3. The ability to object-oriented programming in the basic level.

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**SUBJECT OBJECTIVES**

C1 To familiarize students with the object-oriented programming paradigm in languages that require manual memory management.
C2 To familiazize students with memory addressing techniques and the practical use of pointers.
C3 Acquiring the skill of writing programs with manual memory management.
C4 Acquiring the skills of addressing memory and practical use of indicators.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEK_W01 Knows object-oriented programming mechanisms in languages requiring manual memory management
PEK_W02 Knows memory addressing techniques and the practical use of pointers.
Relating to skills:

| | |
|---|---|
| PEK_U01 Is able to write effective programs in accordance with the object-oriented programming paradigm in languages requiring manual memory management.<br>PEK_U02 Is able to address memory and use the mechanisms offered by pointers in practice. | |

| PROGRAM CONTENT | | |
|---|---|---|
| **Lectures** | | **Number of hours** |
| Lec 1 | Object-oriented programming languages. Introduction to C ++, differences and benefits of using languages that allow you to manually manage your memory. | **2** |
| Lec 2 | Dynamic memory allocation and deallocation - basics, pointers, tables. | **2** |
| Lec 3 | Constructors and destructors, operator overloading, and memory management. | **2** |
| Lec 4 | Advanced methods of object oriented programming. Polymorphism in C ++, important features of the template mechanism in C ++. | **2** |
| Lec 5 | Advanced methods of object oriented programming. Inheritance and Multiply inheritance in C++. | **2** |
| Lec 6 | Advanced methods of object oriented programming. Exemption handling. | **2** |
| Lec 7 | Advanced methods of object oriented programming. Containers. | **2** |
| Lec 8 | Test. | **1** |
| | Total hours | **15** |
| **Classes** | | **Number of hours** |
| Cl 1 | | |
| | Total hours | **0** |
| **Laboratory** | | **Number of hours** |
| Lab 1 | Getting know with the teaching program, way of programs evaluation, health and safety training. Getting know the developer environment. | **2** |
| Lab 2 | Allocation and deallocation of simple types, pointers, multiple pointers. Introductory exercise. | **2** |
| Lab 3 | Static and dynamic allocation, constructors and destructors. Introductory exercise. | **2** |
| Lab 4 | Static and dynamic allocation, constructors and destructors. Introductory exercise. | **2** |
| Lab 5 | Error handling. Introductory exercise. | **2** |
| Lab 6 | Relations between classes and objects, tree processing. Introductory exercise. | **2** |
| Lab 7 | Using templates in C ++. Introductory exercise. | **2** |
| Lab 8 | Implementation of smart pointer. Introductory exercise. | **2** |
| Lab 9 | Chosen extensions C ++ 11 and C ++ 14. Introductory exercise. | **2** |
| Lab 10 | Implementation of chosen classes that will be support a practical computational problem during following classes. A practical task. | **2** |
| Lab 11 | Implementation of the optimization method. A practical task. | **2** |
| Lab 12 | Implementation of the optimization method. A practical task. | **2** |

| | | |
|---|---|---|
| Lab 13 | Program optimization – searching and removing the bottlenecks. The introductory exercise. | **2** |
| Lab 14 | Program optimization – searching and removing the bottlenecks. The extended program with modification. | **2** |
| Lab 15 | The use of object-oriented mechanisms and memory management to implement the program on a given topic. | **2** |
| | Total hours | **30** |

**TEACHING TOOLS USED**

N1. Lecturer's presentation at a blackboard, supported by a multimedia presentation using a laptop and a projector.
N2. MSVC programming environment
N3. STL library
N4. C++11 and C++14 libraries

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1(lecture) | PEK_W01<br>PEK_W02 | Test during the lecture, the result obtained in the object-oriented programming competition, laboratory grade. |
| F2(laboratory) | PEK_U01<br>PEK_U02 | Evaluation of students' preparation for the exercise, evaluation of the quality of the program presented, implementation of additional tasks formulated during the laboratory (on-line programming), result obtained in the object-oriented programming competition. |

P - the final grade of the lecture will be issued based on the results of the test and the grade from the laboratory as follows. A student who has obtained at least 4.5 from the laboratory may request that it be rewritten as a lecture grade. Students who have received a lower grade from the laboratory, and all students who want to take part in the test as final grade will received grade from the test.
The final grade from the laboratory will be issued on the basis of partial grades (points) obtained from individual exercises.
Each grade (from the lecture and laboratory) can be raised by 0.5 if the student is one of the winners of the competition held as part of the lecture. Participation in the competition is voluntary. If the student did not get a credit, participation in the competition does not change this fact.

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

[1] B. Stroustrup, The C++ Programming language, Addison-Wesley Pub. 1993
[2] H.M. Deitel, P.J. Deitel, C++ How to program, Prentice Hall 2003
[3] B. Eckel, Thinking in C++, Pearson Education 2000.
[4] Documentation of the STL library

**SECONDARY LITERATURE:**

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

**Jan Kwiatkowski, jan.kwiatkowski@pwr.edu.pl**

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish** Programowanie gier
**Name of subject in English** Game programming
**Main field of study (if applicable):** Applied Computer Science
**Specialization (if applicable):**
**Profile: academic / practical***
**Level and form of studies: 1st level, full-time**
**Kind of subject: optional**
**Subject code INZ004376**
**Group of courses YES**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 50 | | 60 | | |
| Form of crediting | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 2 | | 2 | | |
| including number of ECTS points for practical (P) classes | | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,2 | | 1,2 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Basic knowledge of C# language

**SUBJECT OBJECTIVES**

1 Using existing engins for programming 2D and 3D video games

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEU_W01 Naming basic ideas used in design and development of video games

relating to skills:
PEU_U01 Programming a simple 2D/3D game using a chosen engine

**PROGRAM CONTENT**

| | Lectures | Number of hours |
|---|---|---|
| Lec 1 | History and classification of video games | 2 |
| Lec 2 | Game engines. Introduction to Unity. First 2D game. | 2 |

| | | |
|---|---|---|
| Lec 3 | 2D mechanics and animations | 2 |
| Lec 4 | Game prototyping. GDD | 2 |
| Lec 5 | Game level design | 2 |
| Lec 6 | Supporting tools, e.g. Blender | 2 |
| Lec 7 | Lighting, textures, materials. First 3D game. | 2 |
| Lec 8 | Artificial intelligence in games. | 2 |
| Lec 9 | Terrain modeling. Terrain generation. Blend trees. | 2 |
| Lec 10 | Loading/saving data. Network communication | 2 |
| Lec 11 | Designing games for different platforms. | 2 |
| Lec 12 | Virtual Reality, VR support in Unity | 2 |
| Lec 13 | Game testing | 2 |
| Lec 14 | Optimization in Unity. Test | 2 |
| Lec 15 | Test | 2 |
| | Total hours | **30** |

| **Laboratory** | | **Number of hours** |
|---|---|---|
| La1 | Introduction. Credit rules. | 2 |
| La2-3 | First 2D game. | 4 |
| La4-5 | 2D mechanics. | 4 |
| La6-7 | Level design. | 4 |
| La8-9 | 3D game. Graphics assets. | 4 |
| La10-11 | 3D game. Navigation and character animation. Managing object states. Artificial intelligence. | 6 |
| La12-14 | Loading/saving data. User authentication. Network communication | 4 |
| La15 | Spare class | 2 |
| | Total hours | 30 |

**TEACHING TOOLS USED**

N1. Information lecture with elements of problem lecture, supported with multimedia presentations.
N2. Unity Engine, supporting tools, e.g. Blender
N3. E-learning system used for publishing teaching resources and announcements, submitting and grading student work.

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| Fi | PEK_U01 | Grade from laboratory exercises from within scale 0..10 (there shall be at least 6 exercises) |
| F1 – laboratory final grade | PEK_U01 | Grade calculated as percentage of points from grades Fi<br>< 50 → 2.0 |

| | | |
|---|---|---|
| | | [50-60) → 3.0<br>[60-70) → 3.5<br>[70-80) → 4.0<br>[80-90) → 4.5<br>[90-98) → 5.0<br>[99-100] → 5.5 |
| F2 – lecture final grade | PEK_W01 | Writing exam composed of open questions, test questions, 'fill-in the gap' questions, verifying knowledge on lecture topics. Positive grade is obtained by student who scores at least 50% of maximum total points. Consecutive grades rise with every 10% of the points. |
| P – course final grade | PEK_U01<br>PEK_W01 | Grade calculated with formula:<br>P = 0.4 * F2 + 0.6 * F1 |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

[1] M. Geig, Unity 2018 Game Development in 24 Hours, Pearson 2018
[2] J. Hocking, Unity in Action. Multiplatform Game Development in C#, Manning Publications Co., 2015

**SECONDARY LITERATURE:**

[1] http://www.appwikia.com/
[2] Teaching resources prepared by course teacher.

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

**Dr inż. Bogumiła Hnatkowska, Bogumila.Hnatkowska@pwr.wroc.pl**
**Dr inż. Marek Kopel, Marek.Kopel@pwr.edu.pl**

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish Interakcja Człowiek-Komputer**
**Name of subject in English Human-Computer Interaction**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable): ……..**
**Profile: academic / ~~practical~~***
**Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister studies*, full-time / part-time studies~~***
**Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~***
**Subject code INZ002043**
**Group of courses ~~YES~~ / NO***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 60 | | 90 | | |
| Form of crediting | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | | | | | |
| Number of ECTS points | 2 | | 3 | | |
| including number of ECTS points for practical (P) classes | | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | | | | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

None

**SUBJECT OBJECTIVES**

C1 Acquainting with practical knowledge in the area of Human-Computer Interaction.
C2 Getting practice in application of usability and User Experience (User Experience) methods.
C3 To familiarize students with the methodology of user-oriented design.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:

PEK_W01 student has practical knowledge in the field of Human-Computer Interaction
PEK_W02 student knows methods and tools for designing interactive systems
PEK_W03 student knows methods used for user modeling methods, personalization and adaptation of information systems
PEK_W04 student has knowledge in the field of UX testing methods, usability and accessibility of interactive systems

relating to skills:

PEK_U01 student is able to analyze the context of the use of the IT system
PEK_U02 student has the ability to plan and monitor the process of the user interface development
PEK_U03 student can design a user interface
PEK_U04 student is able to plan the process of usability and availability assessment, conduct it and develop conclusions regarding changes in the system under examination

relating to social competences:
PEK_K01 student is able to cooperate in a project group in which the roles of members responsible for UX have been defined
PEK_K02 student is aware of the impact of the IT system on the work and life environment of users and understands the importance of usability, UX and the accessibility of an IT system in this context

**PROGRAM CONTENT**

| | **Lectures** | **Number of hours** |
|---|---|---|
| Lec 1 | The problems of the research in Human-Computer Interaction area and the applications of the user interface | 3 |
| Lec 2 | Philosophy, psychology and ethics of User Experience (UX) | 3 |
| Lec 3 | Aesthetics and UX design | 3 |
| Lec 4 | User-oriented systems design | 3 |
| Lec 5 | Usability assurance methods used for requirements determination and system design | 3 |
| Lec 6 | Usability assurance methods used for prototyping and testing interactive systems | 3 |
| Lec 7 | Designing graphic interfaces | 3 |
| Lec 8 | Standards for the design of mobile interfaces | 3 |
| Lec 9 | Voice interfaces | 3 |
| Lec 10 | Directions of future development and the latest trends in ICK | 3 |
| | Total hours | 30 |

| | **Laboratory** | **Number of hours** |
|---|---|---|
| Lab 1 | Organizational classes and introduction to the subject of the course | 3 |
| Lab 2 | Examples of user interfaces and heuristic analysis of the selected system | 3 |
| Lab 3 | Formulation of a project task, which will be the thematic axis for further exercises and the selection of tools | 3 |
| Lab 4 | Defining target users with Persona | 3 |
| Lab 5 | Defining the functionality of the system with the use of user stories and use cases | |
| Lab 6 | Design sprint for selected views | 3 |
| Lab 7 | Development and testing of a paper user interface prototype | 3 |
| Lab 8 | Development and testing of the first version of a clickable user interface prototype using design patterns | 3 |
| Lab 9 | Presentation of the final version of the prototype and a report on the tests carried out | 3 |
| Lab 10 | Summary of classes and retrospection from the realized project task | 3 |

| | | |
|---|---|---|
| | Total hours | 30 |

**TEACHING TOOLS USED**

N1. Lecture using slide presentations
N2. Consultations
N3. Familiarizing students with basic and extended literature
N4. Laboratory exercises in a computer lab
N5. Student's own work and in a group - preparation for laboratory classes
N6. Preparation of reports on laboratory tasks in digital form
N7. Selection tests carried out using the e-portal

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F | PEK_U01-PEK_U04, PEK_K01 | Implementation of laboratory exercises and preparation of reports on their implementation |
| P | PEK_W01-PEK_W04 PEK_K02 | Final test |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**


[1] Marcin Sikorski, Interakcja Człowiek-Komputer. Wydawnictwo PJWSTK 2010.
[2] Chapman N., Chapman J., Digital media. Third edition. Ontario: John Wiley & Sons Ltd., 2009.
[3] International Standard ISO 9241 (1,2,10-17, 210) Ergonomic requirements for office work with visual display terminals (VDTs).
[4] Galitz W.O. Essential Guide to User Interface Design. Wiley Comp. Pub. 2007.
[5] Nielsen J. Projektowanie funkcjonalnych serwisów internetowych. Helion, 2003.
[6] Lazar, Jonathan, Jinjuan Heidi Feng, and Harry Hochheiser. Research methods in human-computer interaction. Morgan Kaufmann, 2017.
[7] Turner, Phil. *A psychology of user experience: Involvement, affect and aesthetics*. Springer, 2017.


**SECONDARY LITERATURE:**


[1] Mark Pearrow, Funkcjonalność stron internetowych. Gliwice: HELION 2002.
[2] Lull, Dave, Discussions in User Experience. Apress, Berkeley, CA, 2017.
[3] Federici S, Borsci S., Usability evaluation: models, methods, and applications. In: JH Stone, M Blouin, editors. International Encyclopedia of Rehabilitation, 2010


**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**


Janusz Sobecki, janusz.sobecki@pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish** **Podstawy Internetu Rzeczy**
**Name of subject in English** **Introduction to IoT**
**Main field of study (if applicable):** **Applied Computer Science**
**Specialization (if applicable): -**
**Profile: academic / ~~practical~~***
**Level and form of studies: 1st/ ~~2nd level, uniform magister studies~~*, full-time / ~~part-time studies~~***
**Kind of subject: obligatory / ~~optional / university-wide~~***
**Subject code INZ002027**
**Group of courses YES / ~~NO~~***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 60 | | 90 | | |
| Form of crediting | Examination / ~~crediting with grade~~* | ~~Examination / crediting with grade~~* | ~~Examination~~ / crediting with grade* | ~~Examination / crediting with grade~~* | ~~Examination / crediting with grade~~* |
| For group of courses mark final course with (X) | | | | | |
| Number of ECTS points | 2 | | 3 | | |
| including number of ECTS points for practical (P) classes | 0 | | 3 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,2 | | 1,8 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

The following academic courses are passed or the equivalent to them knowledge and skills are possessed:
1. Structural and Object Oriented Programming,
2. Computer Architecture,
3. Computer Networks.

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**SUBJECT OBJECTIVES**

C1. Acquiring basic knowledge about the theoretical foundations of the Internet of Things and programming devices functioning in it.
C2. Acquiring basic practical skills in the programming of Internet of Things devices.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge a student:

PEK_W01 - acquires basic knowledge about the theoretical foundations of the Internet of Things and programming devices functioning in it.

relating to skills:

PEK_U01 - acquires basic practical skills in the programming of Internet of Things devices.

**PROGRAM CONTENT**

| | **Lectures** | **Number of hours** |
|---|---|---|
| Lec 1 | Introduction to Internet of Things (IoT).<br>Devices in Internet of Things: sensors, actuators, smart devices and embedded systems. | 2 |
| Lec 2 | High-level languages in programming IoT devices and microcontrollers.<br>Introduction to programming of microcontrollers in IoT devices:<br>architecture, programming interfaces (JTAG, etc.), CPU, memory and access to memory. | 2 |
| Lec 3 | Introduction to programming of microcontrollers in IoT devices:<br>events, system clock, power management, startup and boot modes, system control and reset, watchdog timer (WDT), interrupts and programmable interrupt controllers, I/O ports, timers, real time counter (RTC). | 2 |
| Lec 4 | Introduction to programming of microcontrollers in IoT devices:<br>cryptographic engine, cyclic redundancy check (CRC) generator, analog to digital converter (ADC), digital to analog converter (DAC), analog comparator, embedded sensors (temperature, etc.). | 2 |
| Lec 5 | Input and output devices: LED and LCD displays, programmable RGB LEDs, buttons, keyboard, potentiometers and quadrature encoders, etc. | 2 |
| Lec 6 | Sensors of light, motion, ultrasonic, temperature, humidity, real time clocks, etc.<br>Signaling elements and actuators: servomechanisms, relays, electronic switching circuits, etc. | 2 |
| Lec 7 | Local communication interfaces and buses of Internet of Things devices: USB, UART, RS232, RS458, I2C, 1Wire, CAN, etc. | 2 |
| Lec 8 | Wireless technologies for Internet of Things: Bluetooth, IEEE 802.15.4, IEEE 1901.2a, IEEE 802.11ah, LoRaWAN, NB-IoT, etc. | 2 |
| Lec 9 | The IP protocol in the network layer of Internet of Things. | 2 |
| Lec 10 | Architecture and design of Internet of Things. | 2 |
| Lec 11 | Application protocols in Internet of Things. | 2 |
| Lec 12 | Acquiring, storing and analyzing large amounts of data generated by Internet of Things devices. | 2 |
| Lec 13 | Security and privacy in Internet of Things. | 2 |
| Lec 14 | Internet of Things in practice - examples (part I). | 2 |
| Lec 15 | Internet of Things in practice - examples (part II). | 2 |
| | Total hours | **30** |

| Laboratory | | Number of hours |
|---|---|---|
| Lab 1 | Introduction to the laboratory. OSH training. | 2 |
| Lab 2 | Introduction to Arduino programming. | 2 |
| Lab 3 - Lab6 | Selected input and output devices.<br>Selected sensors, signaling and executive elements<br>Communication using selected communication interfaces. | 4 x 2 |
| Lab 7 - Lab 8 | Introduction to microcontroller programming in professional programming environments. | 2 x2 |
| Lab 9 | Communication using computer networks based on the IP protocol (part I). | 2 |
| Lab 10 | Communication using computer networks based on the IP protocol (part II). | 2 |
| Lab 11 | Communication using wireless technology. | 2 |
| Lab 12 | Programming for Internet of Things - programming task (part I). | 2 |
| Lab 13 | Programming for Internet of Things - programming task (part II). | 2 |
| Lab 14 | Programming for Internet of Things - programming task (part III). | 2 |
| Lab 15 | Presentation of the results of the programming task.<br>Final grading. | 2 |
| | Total hours | **30** |

| TEACHING TOOLS USED |
|---|
| N1. Traditional lecture.<br>N2. Laboratories.<br>N3. Consultations for students.<br>N4. Own work - preparation for laboratories.<br>N5. Own work - learning of theoretical foundations. |

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| C (lecture) | PEK_W01 | To get credit for the lecture (pass), a student should be given more than half of the points for the theoretical exam.<br>If the above is met, then the grading scale is as follows:<br>P - the sum of obtained points in percent.<br>Range P : Grade<br>100 - 91%: 5.0 (very good)<br>90 - 81%: 4.5 (good plus)<br>80 - 71%: 4.0 (good)<br>70 - 61%: 3.5 (satisfactory plus)<br>60 - 51%: 3.0 (satisfactory)<br>50 - 0%: 2.0 (unsatisfactory) |
| F1 (laboratory) | PEK_U01 | Knowledge tests in the field of theoretical preparation for the laboratory and practical skills obtained at the laboratory. |
| F2 (laboratory) | PEK_U01 | Evaluation of the effects of the programming task. |

| | | |
|---|---|---|
| C (laboratory) | | To get credit for the laboratory (pass), a student should be given more than half of the points possible to get on tests (F1) and for programming task (F2).<br><br>The student’s absences may constitute the grounds for not crediting the course. The number of student's absences must not exceed the limit given by the lecturer.<br><br>If the above are met, then the grading scale is as follows:<br>P = F1 + F2 - the sum of points in percent.<br>Range P : Grade<br>100 - 91%: 5.0 (very good)<br>90 - 81%: 4.5 (good plus)<br>80 - 71%: 4.0 (good)<br>70 - 61%: 3.5 (satisfactory plus)<br>60 - 51%: 3.0 (satisfactory)<br>50 - 0%: 2.0 (unsatisfactory) |

## PRIMARY AND SECONDARY LITERATURE

**PRIMARY LITERATURE:**

1] Rob Barton, Gonzalo Salgueiro, David Hanes: IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, 2017, ISBN: 9780134307091.
[2] Perry Lea: Internet of Things for Architects, Packt Publishing, 2018, ISBN: 9781788470599.
[3] Arvind Ravulavaru: Enterprise Internet of Things Handbook, Packt Publishing, 2018, ISBN: 9781788838399.
[4] Andrew Minteer: Analytics for the Internet of Things (IoT), Packt Publishing, 2017, ISBN: 9781787120730.
[5] Agus Kurniawan: Smart Internet of Things Projects, Packt Publishing, 2016, ISBN: 9781786466518.
[6] Amir Vahid Dastjerdi, Rajkumar Buyya: Internet of Things, Morgan Kaufmann, 2016, ISBN: 9780128093474.
[7] Elliot Williams: Make: AVR Programming, Maker Media, Inc, 2014, ISBN: 9781449355784,
in Polish: Programowanie układów AVR dla praktyków, Helion, 2014, ISBN: 97888324695010.
[8] Tomasz Francuz: Język C dla mikrokontrolerów AVR, Helion, 2015, (in Polish) ISBN: 9788324698141.

**SECONDARY LITERATURE:**

[1] Technical documentation of devices and microcontrollers used in the course on the websites of producers and distributors.

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

Krzysztof Chudzik, Krzysztof.Chudzik @ pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish … Wprowadzenie do zarządzania projektami informatycznymi**
**Name of subject in English … Introduction to IT Projects Management**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: academic / ~~practical*~~**
**Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister~~ studies*, full-time ~~/ part-time~~ studies***
**Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~***
**Subject code INZ002032**
**Group of courses YES / ~~NO~~***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 1 | | 2 | | 1 |
| Number of hours of total student workload (CNPS) | 30 | | 60 | | 30 |
| Form of crediting | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | ~~Examination~~ / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 4 | | | | |
| including number of ECTS points for practical (P) classes | | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 2,4 | | | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

C1 To develop an awareness of the need for project planning and management
C2 To apply professional attitudes and techniques to managing a project

**SUBJECT OBJECTIVES**

C1 Introduction to basic notions of management

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:

PEK_W01 Explain the stages in the project development lifecycle; explain of key components of a project plan
PEK_W02 Understanding of steps needed to build a project plan, scheduling and cost estimation as well as the responsibility of the key staff of project
PEK_W03 Explain the procedures needed to monitor, control and report upon an IT development project

relating to skills:

PEK_U01 demonstrate an ability to prepare a project charter of simple project
PEK_U02 apply basic project planning techniques and resource assigning to project tasks

PEK_U03 apply basic project cost estimation techniques
PEK_U04 demonstrate an ability to analyze and to report project progress
PEK_U05 demonstrate ability to prepare a presentation and essay on given subject…

## PROGRAM CONTENT

| Lectures | | Number of hours |
|---|---|---|
| Lec 1 | Basic notions in project management. Feasibility study | 1 |
| Lec 2 | Project planning and scheduling techniques for plan driven methods | 2 |
| Lec 3 | Project planning and scheduling techniques for agile driven methods | 2 |
| Lec 4 | Project resources;examples. Team management (organization and decision-making, roles and responsibilities in a software team). | 2 |
| Lec 5 | Project cost estimation techniques | 2 |
| Lec 6 | Project monitoring and tracking. Software quality. Software Quality Assurance methods and techniques. | 3 |
| Lec 7 | Methodologies of software project management- review (PRINCE2,DSDM,Scrum..) | 2 |
| Lec 8 | Test | 1 |
| | Total hours | 15 |

| Laboratory | | Number of hours |
|---|---|---|
| Lab 1 | Introductory lab: safety regulation; introduction to MSProject 2016. | 2 |
| Lab2-3 | Project scope definition; requirements specification; Project charter. | 4 |
| Lab 3-4 | Traditional project planning and scheduling | 4 |
| Lab 5-6 | Agile project planning and scheduling | 4 |
| Lab 7-8 | Project Resource definition and assignments | 4 |
| Lab 9-10 | Project cost estimation; | 4 |
| Lab11 | Project task tracking | 2 |
| Lab12 | Using Reports in MsProject 2016 | 4 |
| Lab13 | Reports of own project planning results | 2 |
| | Total hours | 30 |

| Seminar | | Number of hours |
|---|---|---|
| Sem 1 | Introductory seminar; topics assignments | 1 |
| Sem 2 | Conceptualizing and Initializing the IT Project; Developing the Project Charter | 2 |
| Sem3-4 | Developing the Project Plan and Schedule; Resource problems | 4 |
| Sem 5 | The Human Side of Project Management | 2 |
| Sem 6 | Managing Change, Resistance and Conflicts | 2 |
| Sem 7 | Progress monitoring, project control and reporting | 2 |
| Sem 8 | Software quality | 2 |
| | Total hours | 15 |

## TEACHING TOOLS USED

N1. Informative lecture supporting with PowerPoint presentations
N2. Examples of managerial documentation of projects published on e-learning system
N3. Software for software project management
N4. An e-learning system used for the publication of teaching materials and announcements as well as for collecting and assessing student work..

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| Evaluation (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEK_U05 | Grade based on student participation in discussion, prepared MsPowerPoint presentation and essay |
| F2 | PEK_U01-PEK_U04 | Grade based on completeness, on time and quality of laboratory assignments |
| F3 | PEK_W01-PEK_W03 | Grade based on multichoice test result |

Final course grade will be based upon the following weights for categories of assessments:
- Presentation and essay 20% of F1
- laboratory assignments 40% of F2
- Final test 40% of F3

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

[1] Cobb Ch., *Zrozumieć Agile Project Management- Równowaga kontroli i elastyczności*, APN Promise Warszawa 2012
[2] Chatfield C., Johnson T., *MS Project 2013 - Krok po kroku*, APN Promise, Warszawa 2013
[3] Schwaber K., *Sprawne zarządzanie projektami metodą Scrum.* APN Promise, Warszawa, 2005
[4]Żmigrodzki M., *Zarządzanie projektami dla początkujących*, Wyd. II Helion 2018.
[5] Microsoft Project 2016.

**SECONDARY LITERATURE:**

[1] Materiały przygotowane przez prowadzącego kurs.
[2] *PMBOK® Guide:* A Guide to the Project Management Body of Knowledge. Fifth Edition, 2012
[3] Prince2 (materiały z Internetu)

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

Iwona Dubielewicz, iwona.dubielewicz@pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish Problemy społeczne i zawodowe informatyki**
**Name of subject in English IT Social and Professional Problems**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable): ……..**
**Profile: academic / practical***
**Level and form of studies: 1st~~/ 2nd~~ level, ~~uniform magister studies*~~, full-time / part-time studies***
**Kind of subject: obligatory ~~/ optional / university-wide~~***
**Subject code INZ004391**
**Group of courses ~~YES~~ / NO***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | | | |
| Number of hours of total student workload (CNPS) | 60 | | | | |
| Form of crediting | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | | | | | |
| Number of ECTS points | | | | | |
| including number of ECTS points for practical (P) classes | 2 | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | | | | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. None

**SUBJECT OBJECTIVES**

C1. Educating skills in solving social and legal problems related to Computer Science and the profession of Computer Science specialist. Education of competences in the field of copyright, related rights and patent law. Providing knowledge about the nature of copyright law, its subject and object part. The acquisition of practical knowledge in the field of personal and property copyright in relation to products of an information nature.
C2. To educate awareness of the importance and understanding of non-technical aspects and effects of the engineer-computer science, including its legal effects and impact on the environment, and the related responsibility for decisions

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:

PEK_W01 The student has knowledge of the protection of intellectual and industrial property related to the Computer Science product. The student has knowledge of copyright and patent law, with detailed knowledge of solutions in the field of personal and property rights. The student has knowledge in the field of risk assessment related to the

protection of intellectual and industrial property. The student has practical knowledge in the field of implementing protection of Computer Science works created as part of individual and group work. The student has the competence to understand and formulate the license. Has knowledge of the transfer of property copyrights. Understands the essence of fair use and public use.

relating to social competences:

PEK_K01 The student has the ability to see the social aspects of the profession. Has the skills of creative thinking and applying the law in both individual and group work.

**PROGRAM CONTENT**

| | **Lectures** | **Number of hours** |
|---|---|---|
| Lec 1 | Basic concepts. Introduction. | 2 |
| Lec 2 | Preparation, design, manufacturing and exploitation of software in a social and legal context. | 2 |
| Lec 3 | The intellectual property, definitions, legal settlements, examples. | 2 |
| Lec 4 | Object and subject of copyright. Special legal regulations in the field of subjects and entities related to Computer Science. | 2 |
| Lec 5 | Authorship of individual and collective works. Personal copyright, protection method and scope of use. | 2 |
| Lec 6 | Personal copyright. Duration of personal copyrights. Attributes of personal copyright and the scope of their protection. | 2 |
| Lec 7 | Economic part of copyright and its use. Examples in the field of computer product protection. | 2 |
| Lec 8 | Permitted use. Public use. Exclusions from protection. | 2 |
| Lec 9 | Copyright law in scientific and educational institutions. | 2 |
| Lec 10 | Creating software and documentation with respect for copyright. | 2 |
| Lec 11 | Criminal liability for infringement of copyright. Computer crimes. Forensic examinations. | 2 |
| Lec 12 | The right to protect industrial property. Definitions. The scope of application. | 2 |
| Lec 13 | Patents. Trademarks. Registration. Regulations regarding the protection of industrial property in Poland and Europe. Industrial property law and copyright law in an ethical and social context. | 2 |
| Lec 14 | The final test. | 2 |
| Lec 15 | Licenses. Collective management of copyright. Occupational risk. Reliability and legal security of the software. | 2 |
| | Total hours | 30 |

**TEACHING TOOLS USED**

N1. Lecture using the multimedia slide projector.
N2. Consultation.
N3. Own work of the student.
N4. Electronic using educational platforms.

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|

| | | |
|---|---|---|
| F1 | PEK_W01, PEK_K01 | questions and discussion, the final test |
| C=F1 | | |

## PRIMARY AND SECONDARY LITERATURE

### PRIMARY LITERATURE:

[1] Cohen J. E.: Copyright in a global information economy. Aspen Publishers 2010.
[2] Okediji C. L. & Orourke: Copyright Law. Aspen Publishers 2010.
[3] Thies Ch.: Computer Law and Ethics. Mercury Learning & Information 2013.
[4] Ustawa o prawie autorskim z dnia 4 lutego 1994 r. o prawie autorskim i prawach pokrewnych. Dz. U. 1994 nr 24 poz. 83 (z późniejszymi zmianami)

### SECONDARY LITERATURE:

[1] McJohn S. M.: Examples & Explanantions: Copyright. Aspen Publishers 2012.

## SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

**Arkadiusz Liber, PhD**
**Arkadiusz . Liber / at / pwr . edu . pl**

Zał. nr 5 do ZW 16/2020

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish** **Administrowanie serwerami Linux (GK)**
**Name of subject in English** **Linux Server Administration (GK)**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable): -**
**Profile: academic / ~~practical~~***
**Level and form of studies: 1st/ ~~2nd level, uniform magister studies~~*, full-time / ~~part-time studies~~***
**Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~***
**Subject code INZ004415**
**Group of courses YES / ~~NO~~***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 60 | | 60 | | |
| Form of crediting | ~~Examination~~ / crediting with grade* | ~~Examination / crediting with grade~~* | ~~Examination~~ / crediting with grade* | ~~Examination / crediting with grade*~~ | ~~Examination / crediting with grade*~~ |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 2 | | 2 | | |
| including number of ECTS points for practical (P) classes | 0 | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,2 | | 1,2 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge about the principles of the modern operating systems.
2. Knowledge about the principles of the computer networks based on the TCP / IP protocol suite.

**SUBJECT OBJECTIVES**

C1. Acquiring basic knowledge and practical skills in the Linux server and user's workstation administration.
C2. Acquiring basic knowledge and practical skills in the administration of network infrastructure and network services using the Linux system.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge a student:

PEK_W01 - acquires basic knowledge in the administration of Linux server and workstation and basic knowledge in the administration of network infrastructure and network services using Linux.

relating to skills:

PEK_U01 - acquires practical skills in the administration of Linux server and workstation and basic knowledge in the administration of network infrastructure and network services using Linux.

**PROGRAM CONTENT**

| | **Lectures** | **Number of hours** |
|---|---|---|
| Lec 1 | Distributions of the Linux system. System architecture. System installation. | 2 |
| Lec 2 | Text console: shells, basic commands, scripts. | 2 |
| Lec 3 | User and group account management. | 2 |
| Lec 4 | Disks and file system management. | 2 |
| Lec 5 | Data compression. Backup. Scheduling of administrative tasks. | 2 |
| Lec 6 | System update. Installing, updating and uninstalling additional software. Use of installation packages. | 2 |
| Lec 7 | Printing in Linux. Graphic environment - X Window. | 2 |
| Lec 8 | Managing network connections. Routing. | 2 |
| Lec 9 | Firewalls and network traffic management. | 2 |
| Lec 10 | Configuration and management of DHCP and DNS servers. | 2 |
| Lec 11 | Configuration and management of the file server (NFS, Samba, FTP). | 2 |
| Lec 12 | Configuration and management of the web server. Content management systems (CMS). | 2 |
| Lec 13 | Virtualization in Linux systems. | 2 |
| Lec 14 | Securing the server. Remote system administration. The knowledge test (1 term). | 2 |
| Lec 15 | The knowledge test (2 term). | 2 |
| | Total hours | 30 |

| | **Laboratory** | **Number of hours** |
|---|---|---|
| Lab 1 | Introduction to the laboratory. OSH training. | 2 |
| Lab 2 | Installation of the Linux system. | 2 |
| Lab 3 | Text console: shells, basic commands, scripts. | 2 |
| Lab 4 | Practical management of accounts and user groups. | 2 |
| Lab 5 | Practical disk and file system management. | 2 |
| Lab 6 | Performing data compression. Backing up and recovering data. Operations scheduling. | 2 |
| Lab 7 | System upgrade, installation, upgrade and uninstallation of additional software using installation packages and software repositories. | 2 |
| Lab 8 | Configuring printing in the Linux environment. Graphic environment - X Window. Practical test - Management of the server and workstation operating system. | 2 |

| | | |
|---|---|---|
| Lab 9 | Managing network connections. Routing. | 2 |
| Lab 10 | Firewalls and network traffic management. | 2 |
| Lab 11 | Configuration and management of DHCP and DNS servers. | 2 |
| Lab 12 | Configuration and management of the file server (NFS, Samba, FTP). | 2 |
| Lab 13 | Configuration and management of the web server.<br>Content management systems (CMS). | 2 |
| Lab 14 | Configure and run virtual machines on Linux systems.<br>Securing the server. Remote system administration. | 2 |
| Lab 15 | Practical test - Management of the network infrastructure and network services. | 2 |
| | Total hours | 30 |

## TEACHING TOOLS USED

N1. Traditional lecture.
N2. Laboratories with full administrative access to Linux systems.
N3. Consultations for students.
N4. Own work - preparation for laboratories.
N5. Own work - learning of theoretical foundations.

## EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEK_W01 | Test of theoretical knowledge (max 50% of points). |
| F2 | PEK_U01 | Practical test - Management of the server and workstation operating system<br>(max 25% of points). |
| F3 | PEK_U01 | Practical test - Management of the network infrastructure and network services.<br>(max 25% of points). |
| C | To get credit for this group of courses (pass), a student should be given more than half of the points for the theoretical test (F1 > 25%) and over half of the points possible to get on both practical tests (F2 + F3 > 25%).<br><br>The student's absences may constitute the grounds for not crediting the course. The number of student's absence must not exceed the limit given by the lecturer.<br><br>If the above are met, then the grading scale is as follows:<br><br>The sum of points in percent P = F1 + F2 + F3.<br>Range P : Grade<br>100 - 91%: 5.0 (very good)<br>90 - 81%: 4.5 (good plus)<br>80 - 71%: 4.0 (good)<br>70 - 61%: 3.5 (satisfactory plus)<br>60 - 51%: 3.0 (satisfactory)<br>50 - 0%: 2.0 (unsatisfactory) | |

## PRIMARY AND SECONDARY LITERATURE

**PRIMARY LITERATURE:**

[1] William E. Shotts, Jr., Linux Command Line, No Starch Press, 2019.

[2] Osamu Aoki, Debian Reference, https://www.debian.org/doc/manuals/debian-reference/, Retrieved 2018.
[3] Raphaël Hertzog & Roland Mas, https://debian-handbook.info/, Retrieved 2018.

**SECONDARY LITERATURE:**

[4] Brian Ward, How Linux Works, What Every Superuser Should Know, No Starch Press, Second edition, 2014.

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

Krzysztof Chudzik, Krzysztof.Chudzik @ pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

| | |
|---|---|
| **Name in Polish:** | **Logika dla informatyków** |
| **Name in English:** | **Logics for IT Specialists** |
| **Main field of study (if applicable):** | **Applied Computer Science** |
| **Specialization (if applicable):** | **n/a** |
| **Level and form of studies:** | **First level** |
| **Kind of subject:** | **obligatory** |
| **Subject code** | **INZ004402** |
| **Group of courses** | **YES** |

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | 30 | | | |
| Number of hours of total student workload (CNPS) | 150 | | | | |
| Form of crediting | Examination | Crediting with grade* | | | |
| For group of courses mark (X) final course | X | | | | |
| Number of ECTS points | 5 | | | | |
| including number of ECTS points for practical (P) classes | | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 3 | | | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

Knowledge of mathematics at the high school level in the expanded range.

**SUBJECT OBJECTIVES**

C1. Gaining knowledge of the set theory and the classical propositional and predicate calculi.
C2. Gaining knowledge about the usage of classical logic to formally define some elements of programming languages.

**SUBJECT EDUCATIONAL EFFECTS**

Relating to knowledge:

PEK_W01: Students know and understand the concept of a set and operations on sets, the concept of relations and functions.
PEK_W02: Students know and understand the concept of logical syntax and semantics of propositional logic and predicate calculus, and selected proving systems.
PEK_W03: Students know and understand the concept of mathematical induction and structural definition of recursive sets and functions, graphs and methods of their representation.

Relating to skills:

PEK_U01: Students can apply propositional and predicate calculi.
PEK_U02: Students can conduct a simple and moderately difficult proofs by mathematical and structural induction.
PEK_U03: Students can use language of set theory interpreting problems in different areas of mathematics and science.

| |
|---|
| Relating to social competences:<br>PEK_K01: Students can precisely formulate questions to deepen their understanding of the topic and find the missing pieces of reasoning.<br>PEK_K02: Students can independently search the bibliographic databases and study the literature available there.<br>PEK_K03: Students know the limits of their own knowledge and understand the need for further education |

| **PROGRAMME CONTENT** | | |
|---|---|---|
| **Form of classes - lecture** | | **Number of hours** |
| Lec 1 | Basic logical notions: truth and false, simple and compound propositions. Basic set-theoretical notions: a set, definitions of sets, operations on sets. | 2 |
| Lec 2 | Cartesian product, relations and their properties, equivalence and ordering relations. | 2 |
| Lec 3 | Functions, composition of functions. Equinumerosity of sets, cardinal numbers. Sequences and operations on sequences. | 2 |
| Lec 4 | Graphs, formal languages, free-context grammars. | 2 |
| Lec 5 | Accepting finite automata, finite automata with outputs | 2 |
| Lec 6 | Syntax and semantics of propositional calculus. | 2 |
| Lec 7 | Zero-one method of formulas proving. Proving system based on semantic equivalence of formulas. | 2 |
| Lec 8 | Proving system for the propositional calculus based on Gentzen's sequents. | 2 |
| Lec 9 | Complete sets of logical connectives. Meta-logical properties of the propositional calculus – decidability, consistency and completeness of proving systems. | 2 |
| Lec 10 | Syntax of the predicate calculus. | 2 |
| Lec 11 | Semantics of the predicate calculus. | 2 |
| Lec 12 | Proving system for the predicate calculus based on Gentzen's sequents – its consistency and completeness. | 2 |
| Lec 13 | Formulas in canonical forms. | 2 |
| Lec 14 | Proving system based on resolution rule. | 2 |
| Lec 15 | Elements of programming in logic. | 2 |
| | Total hours | 30 |

| **Form of classes - class** | | **Number of hours** |
|---|---|---|
| Cl 1 | Basic logical notions: truth and false, simple and compound propositions. | 2 |

| | | |
|---|---|---|
| Cl 2 | Methods of definitions of sets, operations on sets. | 2 |
| Cl 3 | Cartesian product, relations defining and checking their properties. | 2 |
| Cl 4 | Proving properties of equivalence and ordering relations. | 2 |
| Cl 5 | Checking equinumerosity of sets. Operations on sequences. | 2 |
| Cl 6 | Defining of exemplary formal languages. | 2 |
| Cl 7 | Test 1. | 2 |
| Cl 8 | Many-sorted algebras as models for data types. | 2 |
| Cl 9 | Application of zero-one method and transformational method for formulas proving. | 2 |
| Cl 10 | Application of Gentzen system for proposition formulas proving. | 2 |
| Cl 11 | Informal interpretation of predicate formulas. | 2 |
| Cl 12 | Application of Gentzen system for predicate formulas proving. | 2 |
| Cl 13 | Canonical forms of predicate formulas. | 2 |
| Cl 14 | Test 2. Application of resolution rule for formulas proving. | 3 |
| Cl 15 | Corrective test. | 1 |
| | Total hours | 30 |

**TEACHING TOOLS USED**

N1. Lecturer's presentation at a blackboard, supported by a multimedia presentation using a laptop and a projector.
N2. Individual search and study of literature and Internet sources.
N3. Access to teaching materials published in the local area network.
N4. Individual consultations.

**EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Educational effect number | Way of evaluating educational effect achievement |
|---|---|---|
| F1 | PEK_W01<br>PEK_W02<br>PEK_U01<br>PEK_U02<br>PEK_K01 | During each class students are awarded 1 or 2 points for an individual solution of a task from the announced list of tasks. |
| F2 | PEK_W02<br>PEK_W03<br>PEK_U02<br>PEK_U03<br>PEK_K01 | Students are oblige to participate in two tests at the middle and at the end of a semester.<br>During each test students are awarded up to 10 points. |
| F3 | PEK_W01<br>PEK_W02<br>PEK_W03<br>PEK_U01<br>PEK_U02<br>PEK_U03 | Final mark for the classes is determined on the base of total number of points resulted from activity during classes (F1) and points for the tests (F2).<br>Detailed rules for final mark evaluation are as follows:<br>Let |

$c_i$ the number of points scored for activity during classes in the i-th part of semester, for $i = 1, 2$;
$t_i$ the number of points scored during the i-th test, for $i = 1, 2$;
$t_{popr}$ the number of points scored during corrective test;

$P_i = min(10, c_i + t_i)$ for $i = 1, 2$;

$P = P_1 + P_2$.

For passing classes without corrective test the following condition should be satisfied:

$P \geq 10$ and ($P_i \geq 4$ for $i = 1, 2$).

If the condition is satisfied the mark is calculated according to the table:

| $P$ | 10 | 12 | 14 | 16 | 18 |
|---|---|---|---|---|---|
| Mark | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 |

The students which have passed the classes without corrective test and have got at least mark 4 are exempted from examination with the same mark.

C: The final evaluation of the course is determined based on the results of the examination. The examination lasts two hours and consists of a set of tasks, with the total number of 20 points. The condition for a positive assessment of the final exam is to get 10 points and a positive final evaluation of the exercise.
The final evaluation of the examination is determined in accordance with the following table:

| Points | 10 | 12 | 14 | 16 | 18 |
|---|---|---|---|---|---|
| Mark | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**


[1] HUZAR Z., Elementy logiki i teorii mnogości dla informatyków, Oficyna Wydawnicza Politechniki Wrocławskiej, 2007.
[2] BEN-ARI M., *Logika matematyczna w informatyce*, WNT, 2005.
[3] MAREK W., ONYSZKIEWICZ J., *Elementy logiki i teorii mnogości w zadaniach*, PWN, 2001.


**SECONDARY LITERATURE:**


[1] RASIOWA H., Wstęp do matematyki współczesnej, PWN, 1998.
[2] ŁAWROW I. A., MAKSIMOWA Ł. L., 2004, *Zadania z teorii mnogości, logiki matematycznej i teorii algorytmów*, PWN, 2004.
STANOSZ B., *Ćwiczenia z logiki*, PWN, 2002.


**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**


Zbigniew Huzar, zbigniew.huzar@pwr.edu.pl
Ngoc-Than Nguyen, ngoc-than.nguyen@pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish** **Zarządzanie infrastrukturą IT**
**Name of subject in English** **Managing IT infrastructure**
**Main field of study (if applicable): Applied computer science**
**Specialization (if applicable): -**
**Profile:** **practical**
**Level and form of studies:** **1st level, full-time**
**Kind of subject:** **optional**
**Subject code** **INZ004468Wl**
**Group of courses** **NO**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 60 | | 60 | | |
| Form of crediting | Crediting with grade | | Crediting with grade | | |
| For group of courses mark (X) final course | X | | | | |
| Number of ECTS points | 2 | | 2 | | |
| including number of ECTS points for practical classes (P) | 0 | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,2 | | 1,2 | | |

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge on design of contemporary operating systems.
2. Knowledge on computer networks using TCP/IP protocol stack.

**SUBJECT OBJECTIVES**

C1 Gain knowledge on management of complex, distributed IT environment, including:
- C1.1 single machine administration
- C1.2 using directory services to centralize of administration tasks
- C1.3 administration of network services

C2 Develop the conscience of the value of lifelong self-learning.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:

PEU_W01 knows basic local resources (user accounts, groups, files, printers) and how to manage them

PEU_W02 knows directory services and knows how to use it to centralize administrative efforts

PEU_W03 knows selected services supporting computer networks and network security

relating to skills:

PEU_U01 can configure users' access to local resources

PEU_U02 can administer directory services
PEU_U03 is able to configure selected network services

relating to social competences:
PEU_K01 can search for additional external knowledge sources to extend course content.

**PROGRAMME CONTENT**

| Lecture | | Number of hours |
|---|---|---|
| Lec 1 | Contemporary IT environment. System installation. | 2 |
| Lec 2 | Accounts and group management. | 2 |
| Lec 3 | Disk management. | 2 |
| Lec 4 | Printing | 2 |
| Lec 5 | Scripting administration tasks | 2 |
| Lec 6 | Directory services. | 2 |
| Lec 7 | Centralized management using directory services. | 2 |
| Lec 8 | Distributed environment with directory services. | 2 |
| Lec 9 | System monitoring. | 2 |
| Lec 10 | DHCP and DNS servers. | 2 |
| Lec 11 | Routing and remote access. | 2 |
| Lec 12 | PKI infrastructure. | 2 |
| Lec 13 | Securing network traffic. | 2 |
| Lec 14 | Web server configuration. | 2 |
| Lec 15 | Final test | 2 |
| | **Total hours** | **30** |

| Laboratory | | Number of hours |
|---|---|---|
| Lab 1 | Getting used to lab environment. Safety regulations. | 2 |
| Lab 2 | System installation. | 2 |
| Lab 3 | User accounts and groups administration. | 2 |
| Lab 4 | Disk resources management. | 2 |
| Lab 5 | Scripting administrative tasks. | 2 |
| Lab 6 | Practical test 1. | 2 |
| Lab 7 | Directory services installation. Users and groups in directory. | 2 |
| Lab 8 | Environment administration using directory services. | 2 |
| Lab 9 | Directory services in distributed environment. | 2 |
| Lab 10 | Practical test 2. | 2 |
| Lab 11 | System monitoring. | 2 |
| Lab 12 | DNS and DHCP servers configuration. | 2 |
| Lab 13 | Routing and remote access configuration. | 2 |
| Lab 14 | PKI infrastructure configuration. Web server configuration. | 2 |

| | | |
|---|---|---|
| Lab 15 | Practical test 3. | 2 |
| | **Total hours** | **30** |

## TEACHING TOOLS USED

N1. Lecture.
N2. Laboratory.
N3. Self-learning and studying.
N4. Practical self-learning using virtual machines.

## EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

| **Evaluation** (F – forming during semester), P – concluding (at semester end) | Learning outcomes code | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEK_U01-PEK_U03 | Graded activities on labs. |
| F2 | PEK_U01-PEK_U03 | Graded practical tests on labs. |
| F3 | PEK_W01-PEK_W03 | Graded tests. |
| P (lecture) = F3 | | |
| P (labs) = W1×F1+W2×F2, W1 and W2 weights will be available at the start of the course. | | |

## PRIMARY AND SECONDARY LITERATURE

**PRIMARY LITERATURE:**


[1] T.Limoncelli, C.Hogan, S.Chalup, *The practice of System and Network Administration,* vol. 1., 3rd ed., Addison Wesley, 2017.

[2] J. Krause, *Mastering Windows Server 2019: The complete guide for IT professionals to install and manage Windows Server 2019 and deploy new capabilities*, 2nd ed., Packt Publishing, 2019.


**SECONDARY LITERATURE:**


[1] C. Zacker, *Exam Ref 70-740 Installation, Storage and Compute with Windows Server 2016*, Microsoft Press, Redmond, 2017.

[2] A. Warren, *Exam Ref 70-741 Networking with Windows Server 2016*, Microsoft Press, Redmond, 2017.

[3] A. Warren, *Exam Ref 70-742 Identity with Windows Server 2016*. Microsoft Press, Redmond, 2017.


**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**


**Wojciech Thomas, wojciech.thomas/at/pwr.edu.pl**

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name in Polish Metaheurystyki w rozwiązywaniu problemów.**
**Name in English Metaheuristics in problems solving**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Level and form of studies: 1st/ ~~2nd~~* level, full-time / ~~part-time~~***
**Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~***
**Subject code INZ002042**
**Group of courses ~~YES~~ / NO***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 60 | | 60 | | |
| Form of crediting | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark (X) final course | - | - | - | - | - |
| Number of ECTS points | **2** | | 2 | | |
| including number of ECTS points for practical (P) classes | - | | 2 | - | - |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,2 | | 1,2 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. K1INF_W15 Has basic knowledge about modeling, and knows methods and techniques used in decision supporting systems
2. K1INF_U16 Can effectively use methods and tools of information storing, information processing, information searching and knowledge acquisition

**SUBJECT OBJECTIVES**

C1 To teach students about various approaches and metaheuristics used in machine learning tasks
C2 To get a skill of metaheuristics selection suitable to given task
C3 To get a skill of validation of metaheuristics in real world applications

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEK_W02: Has knowledge of approaches and methods used in machine learning
PEK_W02: Has knowledge of various metaheuristics applications
PEK_W03: Has knowledge of selected data preprocessing techniques
PEK_W04: Has knowledge of metaheuristics results validation
PEK_W05: Has knowledge of effective implementation of metaheuristics

relating to skills:
PEK_U01: Can select a proper metaheuristic for given task
PEK_U02: Can design and implement application
PEK_U03: Can prepare and do an empirical experiments to examine metaheuristics effectiveness and usability
PEK_U04: Can prepare results analysis and do report of done experiments
relating to social competences:
PEK_K01

| **PROGRAMME CONTENT** | | |
|---|---|---|
| **Form of classes - lecture** | **Number of hours** | |
| Lec1 | Introduction to metaheuristics | 2 |
| Lec2 | Introduction to Evolutionary Algorithms (EA) | 2 |
| Lec3 | Solving problems and tasks by metaheuristics – research methodology | 2 |
| Lec4 | Other metaheuristics: HillClimbing (HC), Tabu Search (TS), Simulated Annealing (SA) | 2 |
| Lec5 | Introduction to EA specialization and extensions | 2 |
| Lec6 | Specialization of EA: representation, fitness function and genetic operators | 2 |
| Lec7 | Types and extensions of EA | 4 |
| Lec9 | Hybrid metaheuristics | 2 |
| Lec10 | Selected swarm-based metaheuristics: Ant Colony Optimization, Bee Colony Optimization, Particle Swarm Optimization | 2 |
| Lec11 | Other selected metaheuristics | 4 |
| Lec12 | Methods of metaheuristics efficiency improvement | 4 |
| Lec13 | Summary and recent directions | 2 |
| | Total hours | 30 |

| **Form of classes - laboratory** | **Number of hours** |
|---|---|

| | | |
|---|---|---|
| Lab 1 | Organization issues | 2 |
| Lab 2 | L1. Application of Evolutionary Algorithms to given problem A | 6 |
| Lab 3 | L2 Tabu Search (TS) usage to selected problem A | 4 |
| Lab 4 | L3 Simulated Annealing (SA) application to selected problem A | 4 |
| Lab 5 | L4 Comparison of EA, TS and SA implementation effectivency for selected problem A | 4 |
| Lab 6 | L5 Hybrids EA+SA and EA+TS used for A problem solving | 2 |
| Lab 7 | L6 Selected metaheuristics implementation, e.g. Ant Colony Optimization solving A problem | 8 |
| | Total hours | 30 |

| TEACHING TOOLS USED |
|---|
| N1. Multimedia PowerPoint presentation<br>N2. Laboratory exercises description<br>N3. e-learning system |

**EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Educational effect number | Way of evaluating educational effect achievement |
|---|---|---|
| F1 – L1 realization | PEK_W01;<br>PEK_U01;<br>PEK_U03;<br>PEK_U04; | L1 realization is worth 10 points. For each working week delay penalty -20% is used. In each laboratory, a student can present only one exercise realization. The exercise realization is: exercise specification reading, given method analysis, and implementation, application verification and effectivency research. The whole process is described in the report. There are included implementation details, research methodology, summary results and emerged problems. Such a report is uploaded to the e-learing portal. It is suggested implementation in a non-interpret programming language. Using interpret language (such as Java, python) decreases points -20%. The C/C++ usage is preferred. |
| F2 – L2 realization | PEK_W01;<br>PEK_U02;<br>PEK_U03;<br>PEK_U04; | Like F1 |
| F3 – L3 realization | PEK_W01;<br>PEK_U02;<br>PEK_U03;<br>PEK_U04; | Like F1 |
| F3 – L4 realization | PEK_W01;<br>PEK_U02;<br>PEK_U03;<br>PEK_U04; | Like F1 |

| | | |
|---|---|---|
| F3 – L5 realization | PEK_W01;<br>PEK_U02;<br>PEK_U03;<br>PEK_U04; | Like F1 |
| F3 – L6 realization | PEK_W01;<br>PEK_U02;<br>PEK_U03;<br>PEK_U04; | Like F1 |
| C - summay | PEK_U01;<br>PEK_U02;<br>PEK_U03;<br>PEK_U04;<br>PEK_U01; | The final mark is given as follows:<br>0 – 29 points gives ndst<br>30 - 34 points gives dst<br>35 - 40 points gives dst+<br>41 - 45 points gives db<br>45 - 50 points gives db+<br>51 - 60 points gives bdb<br>No more than 2 absences are allowed. More fails the course. |

## PRIMARY AND SECONDARY LITERATURE

### PRIMARY LITERATURE:


1. Goldberg D. “Algorytmy genetyczne i ich zastosowanie”, WNT 1998.
2. Kwaśnicka H. “Obliczenia ewolucyjne w sztucznej inteligencji”, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 1999.
3. Michalewicz Z. “Algorytmy genetyczne + struktury danych = programy ewolucyjne”, WNT 2010.
4. Michalewicz Z., Fogel D.B. “Jak to rozwiązać, czyli nowoczesna heurystyka”, WNT 2006


### SECONDARY LITERATURE:


[1] Arabas J. “Wykłady z algorytmów ewolucyjnych”, WNT, Warszawa 2004.


## SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)


**Paweł Myszkowski, pawel.myszkowski@pwr.edu.pl**

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Aplikacje mobilne na platformę Android**
**Name of subject in English: Mobile applications for Android platform**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: academic***
**Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister studies~~*, full-time / ~~part-time studies~~***
**Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~***
**Subject code INZ002029**
**Group of courses YES / ~~NO~~***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 30 | | 90 | | |
| Form of crediting | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 2 | | 2 | | |
| including number of ECTS points for practical (P) classes | | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,2 | | 1,2 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge of programming in Java.
2. Basic knowledge about the operation of computer operating systems.

**SUBJECT OBJECTIVES**

C1 Obtaining basic knowledge of the architecture of mobile applications for the Android platform and methods to implement the functionality of typical applications.

C2. Acquiring practical skills in implementing mobile applications for the Android platform.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:

PEU_W01 Knows the basic elements of mobile application architecture for the Android platform.

PEU_W02 Describes how to implement solutions for Android applications regarding the basic functionalities of typical applications.

relating to skills:
PEU_U01 Is able to implement mobile applications for the Android platform in the field of selected basic functionalities implemented in typical applications.

| PROGRAM CONTENT | | |
|---|---|---|
| **Lectures** | | **Number of hours** |
| Lec 1 | Presentation of the course organization and program. Introduction to subject matter. Presentation of the Android platform and development tools. | 2 |
| Lec 2 | Elements of the Android application architecture and the basics of application design. Life cycles of the discussed app components. | 2 |
| Lec 3 | Basics of application graphical interface - layouts, controls for handling interface input events. | 2 |
| Lec 4 | Triggering of actions and data transfer - intentions, interaction of activities, use of system activities. Configuration change support. | 2 |
| Lec 5 | Creating application menu items. | 2 |
| Lec 6 | Interface elements that require a content adapter. | 2 |
| Lec 7 | Fragments - operating principle, management, operating patterns. | 2 |
| Lec 8 | Persistent data support. Built-in database mechanism. | 2 |
| Lec 9 | Advanced interface support - bookmarks, scrolling views, etc. | 2 |
| Lec 10 | Streaming media support in Android. | 2 |
| Lec 11 | Sensor support and location mechanisms. | 2 |
| Lec 12 | Mobile application communication functions. | 2 |
| Lec 13 | Background tasks. Services. | 2 |
| Lec 14 | Applications for non-smartfon devices with the Android environment. | 2 |
| Lec 15 | Passing test. | 2 |
| | Total hours | **30** |
| **Laboratory** | | **Number of hours** |
| Lab 1 | Discussion of the organization and program of classes. OSH training. Presentation of teaching tools. | 2 |
| Lab 2 | Configuration of the Android production environment. Creating a basic application project. | 2 |
| Lab 3 | Application I - activities (windows), graphic layouts and controls. Triggering activity. | 2 |
| Lab 4 | Application II - advanced interface elements - part I. | 2 |
| Lab 5 | Application II - advanced interface elements - part II. | 2 |
| Lab 6 | Application III - application menu. | 2 |
| Lab 7 | Application IV - fragments and bookmarks - part I. | 2 |
| Lab 8 | Application IV - fragments and bookmarks - part II. | 2 |
| Lab 9 | Application VI - support for selected streaming media. | 2 |
| Lab 10 | Application V - sensors and location. | 2 |
| Lab 11 | Application VII - background tasks. | 2 |
| Lab 12 | Application VIII - communication functions. | 2 |

| | | |
|---|---|---|
| Lab 13 | Application IX - programming the application for a selected non-smartphone/tablet device (e.g. Android TV) - part I. | 2 |
| Lab 14 | Application IX - programming the application for a selected non-smartphone/tablet device (e.g. Android TV) - part II. | 2 |
| Lab 15 | Summary and discussion of classes. Final passing the class and issuing grades. | 2 |
| | Total hours | **30** |

**TEACHING TOOLS USED**

N1. Informative lecture supported by multimedia presentations.
N2. Printed or electronic laboratory exercises.
N3. Development software for the Android platform.
N4. Devices (smartphones, tablets) and emulators to run developed applications.
N5. An e-learning system for publishing teaching materials, tasks and announcements, and collecting and assessing student work, as well as for carrying out knowledge tests.

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), C – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 – La2 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷3. |
| F2 – La3 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| F3 – La5 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| F4 – La6 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| F5 – La8 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| F6 – La9 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| F7 – La10 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| F8 – La12 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| F9 – La13 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| F10 – La14 | PEK_U01 | Assessment of completeness and quality of task solution. Point scale 0÷10. |
| C1 – final evaluation from the laboratory | PEK_U01 | The grade is determined on the basis of sum of points from the grades F1 to F10 according to the formula:<br>- below 50% of points – ndst (2.0)<br>[50%, 60%) – dst (3.0)<br>[60%, 70%) – dst+ (3.5)<br>[70%, 80%) – db (4.0)<br>[80%, 90%) – db+ (4.5)<br>[90%, 100%) – bdb (5.0) |

| | | |
|---|---|---|
| | | 100% - discretionary (e.g. additional task) |
| C2 – final evaluation from the lecture | PEK_W01, PEK_W02. | Knowledge test - written or electronic test using an e-learning system.<br>Grade based on the score obtained from the test. Rating scale as for C1. |
| C3 – final evaluation from the lecture | The final grade C3 is calculated on the basis of 50% of C1 and 50% of C2. The condition for obtaining a positive grade C3 is obtaining a positive grade for both C1 and C2 components. | |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**


[1] Phillips, B.: Programowanie aplikacji dla Androida, Helion 2018.
[2] Annuzzi, J.: Android: wprowadzenie do programowania aplikacji, Helion, 2016.
[3] Deitel, P. J.: Android 6 dla programistów: techniki tworzenia aplikacji, Helion, 2016.
[4] Dokumentacja elektroniczna Open Handset Alliance: http://developer.android.com


**SECONDARY LITERATURE:**


[1] Murphy, M. L.: The Busy Coder's Guide to Android Development, CommonsWare, 2015.
[2] Płonkowski, M.: Android Studio : tworzenie aplikacji mobilnych, Helion, 2018.
[


**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**


Mariusz Fraś, mariusz.fras@pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish Aplikacje mobilne a platformę IOS**
**Name of subject in English Mobile Applications for IOS**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: academic**
**Level and form of studies: 1st/ ~~2nd level, uniform magister studies~~*, full-time / ~~part-time~~***
**Kind of subject: ~~obligatory /~~ optional / ~~university-wide~~***
**Subject code INZ002030Wl**
**Group of courses YES ~~/ NO~~***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 60 | | 60 | | |
| Form of crediting | Crediting with grade* | Examination / crediting with grade* | Crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark (X) final course | X | | | | |
| Number of ECTS points | 2 | | 2 | | |
| including number of ECTS points for practical classes (P) | | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,2 | | 1,2 | | |

*delete as not necessary

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge of basic programming techniques for Android.
2. Basic knowledge of design and programming of mobile applications.
3. Basic knowledge of graphical software.
4. Awareness of mobile and multimedia technologies for the society.

**SUBJECT OBJECTIVES**

C1. Transfer of knowledge about usage of Apple devices.
C2. Introduction to programming in Swift.
C3. Design and implementation of a mobile application in Swift.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEU_W01 Knows and understands the specificity of mobile applications.
PEU_W02 Knows how to design and implement mobile applications.
PEU_W02 Knows programming tools.

relating to skills:
PEU_U01 Defines a set of functional requirements of a mobile application, and – based on the definition – designs a mobile application.

PEU_U02 Implements a mobile application in accordance to the design.
PEU_U03 Publishes a mobile application.

relating to social competences:
PEU_K01 Cooperates with a potential user of a mobile application to define a set of functional requirements.
PEU_K02 Includes specific requirements in the user-interface design process.

**PROGRAMME CONTENT**

| | **Lecture** | **Number of hours** |
|---|---|---|
| Lec 1 | Introduction. Review of selected mobile applications. Introduction to Apple devices and Mac OS. | 2 |
| Lec 2-3 | UI and UX. Interactions. Touch screens. Material design. Human Interface guidelines. Voice communication. Siri. | 4 |
| Lec 4 | Tools for multimedia processing. Gathering multimedia data. Copyright. | **2** |
| Lec 5 | Implementation rules in Xcode. The structure of application written in Swift. | 2 |
| Lec 6-7 | Presentation of basic elements of Swift by examples. Core libraries. | 4 |
| Lec 8 | Apple Human Interface Guideline by examples. | 2 |
| Lec 9 | Libraries and frameworks supporting creation of multimedia applications. Short characteristics of Kotlin language. | **2** |
| Lec 10 | Applications of augmented reality. Code analysis of application with augmented reality mechanisms. | **2** |
| Lec 11 | Games review. Connections between games and the progress of algorithms and programming languages. | **2** |
| Lec 12 | Multimedia data compression. Compression formats. Video and audio streaming. | **2** |
| Lec 13 | Multimedia in mobile systems. Cameras. Recommended frameworks. | **2** |
| Lec 14 | Interaction mechanisms – review. New technologies and multimedia devices. | **2** |
| Lec 15 | Summary. Perspectives of multimedia techniqes. | **2** |
| | Total hours | **30** |

| | **Laboratory** | **Number of hours** |
|---|---|---|
| Lab 1-2 | Introduction. Introduction to Android Studio. Animate program. Implementation of a puzzle game. | 4 |
| Lab 3-4 | Implementation of photo gallery with animation and audio effects in AS 3.0. | 4 |
| Lab 5-6 | Implementation of photo gallery with animation and audio effects in Swift and Xcode. | 4 |
| Lab 7-8 | Implementation of an interactive game with animations and audio in Android Studio (Swift UI). | 4 |
| Lab 9-10 | Implementation of photo gallery with animation and audio effects in Swift and Xcode. | |
| Lab 11-14 | Design and implementation of a virtual museum. | 8 |
| Lab 15 | Demonstration of virtual museum implementation with the use of modern multimedia techniques. | 2 |
| | Total hours | 30 |

## TEACHING TOOLS USED

N1. Lectures in the form of multimedia presentations.
N2. Introduction to the laboratories in the form of multimedia presentation.
N3. Collections of additional materials (links, papers).
N4. Individual meetings.

## EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

| **Evaluation** (F – forming during semester), P – concluding (at semester end) | Learning outcomes code | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEU_W01<br>PEU_W02<br>PEU_W03<br>PEU_U01<br>PEU_U02<br>PEU_U03 | Students have to realize 9 laboratory tasks. For each they can get from 0-2 points. |
| F2 | PEU_W01<br>PEU_W02<br>PEU_W03<br>PEU_U01<br>PEU_U02<br>PEU_U03<br>PEU_K01<br>PEU_K02 | Design and implementation of a multimedia application for 0-4 points. |

P is calculated based on the formula given below. The highest grade requires the F2 is greater than zero.

| **Points** | 10-11 | 12-13 | 14-15 | 16-17 | 18-20 | 21-22 |
|---|---|---|---|---|---|---|
| **P** | 3,0 | 3,5 | 4,0 | 4,5 | 5,0 | 5,5 |

## PRIMARY AND SECONDARY LITERATURE

**PRIMARY LITERATURE:**


[1] Carmen Delessio, Lauren Darcey, Shane Conder, Android Studio w 24 godziny. Wygodne programowanie dla platformy Android, Helion 2017.
[2] Andrzej Stasiewicz, Android. Podstawy tworzenia aplikacji, Helion 2014.
[3] Kathy Sierra, Bert Bates, Rusz głową. JAVA, Wydanie 2, Helion 2011.
[4] Matthew Mathias, John Gallagher, Programowanie w języku Swift. BIG NERD RANCH GUIDE, Helion 2017.


**SECONDARY LITERATURE:**


[1] Randi L. Derakhshani, Dariusz Derakhshani, Autodesk 3ds Max 2014. Oficjalny podręcznik, Helion 2014.
[2] Dariusz Derakhshami, MAYA 2011. Wprowadzenie, Helion 2011.
[3] Cameron Chapman, Podręcznik genialnych pomysłów. Od inspiracji po realizację, Helion 2012.


## SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)


**Dr inż. profesor uczelni Krzysztof Waśko, krzysztof.wasko@pwr.edu.pl**

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish** Sieci Neuronowe
**Name of subject in English** Neural Networks
**Main field of study (if applicable):** Applied Computer Science
**Specialization (if applicable):**
**Profile: academic**
**Level and form of studies: 1st/ ~~2nd level, uniform magister studies*,~~ full-time / ~~part-time studies*~~**
**Kind of subject: ~~obligatory~~ / optional ~~/ university-wide*~~**
**Subject code INZ002041**
**Group of courses YES / ~~NO*~~**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 120 | | | | |
| Form of crediting | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 5 | | | | |
| including number of ECTS points for practical (P) classes | 3 | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 3 | | | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1.K1INF_U02 Good programming skills in a high level programming language
2.K1INF_W01 Basic knowledge in differential and matrix calculus

**SUBJECT OBJECTIVES**

C1. Knowledge in the neural network development
C2 Knowledge of various neural networks structures and the way of training.
C3 Skills in neural network development

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEU_W01 Knowledge in neural networks theory of architectures, training methods and the way of processing information
relating to skills:
PEU_U01 Is able to design and implement a neural network model
PEU_U02 Is able to conduct experiments and prepare reports

| PROGRAM CONTENT | | |
|---|---|---|
| **Lectures** | | **Number of hours** |
| Lec 1 | Introduction. Presentation of the course content, course organization and rules of assessment. Principles of neural network design. Simple neural networks – simple perceptron. | 3 |
| Lec 2 | Simple neural networks - Adaline. Backpropagation method – intuitions | 3 |
| Lec 3 | Backpropagation in matrix. Multilayered networks, choice of the neural networks architecture, hiperyparameters, the way of input output encoding | 3 |
| Lec 4 | Regularization, Autoencoder, Multilayerd networks – examples of applications | 3 |
| Lec 5 | Fundamentals of convolutional networks | 3 |
| Lec 6 | Unsupervised training CP – Counterpropagation network, SOM neural network, RBM network | 3 |
| Lec 7 | Associative memories – Hopfielda and BAM networks | 3 |
| Lec 8 | Boltzmann Machine. Test | 3 |
| Lec 9 | Survey of deep neural networks and their applications i ich zastosowań | 2 |
| Lec 10 | Survey of students. Test | 3 |
| | Total hours | |
| **Laboratory** | | **Number of hours** |
| Lab 1 | Introduction. Presentation of organization and assessment rules. OSH training. Short presentation of simple neuron. Implementation of the network and its training rule. | 3 |
| Lab 2 | Assessment of Task1 implementation. Conducting experiments and preparing a report. | 3 |
| Lab 3 | Project and implementation of MLP – Task 2 | 3 |
| Lab 4 | Conducting experiments for various number of neurons in the hidden layer, various learning coefficient and for sigmoid activation function. Report preparation. | 3 |
| Lab 5 | Changes in activation function, increasing the number of layers, various methods of learning coefficient optimization | 3 |
| Lab 6 | Implementation of simple convolutional network – Task 3 | 3 |
| Lab 7 | Continuing implementation of Task 3. Testing the network. | 3 |
| Lab 8 | Conducting experiments with convolutional network. Report preparation | 3 |
| Lab 9 | Discussions on obtained results | 3 |
| Lab 10 | Assessment of the results and survey of students | 3 |
| | Total hours | 30 |

| TEACHING TOOLS USED |
|---|
| N1. Lecture supported by multimedia presentations<br>N2. Specification of documents necessary to be assessed during the lab.<br>N3. Examples of documentations from lab. |

N4. e-learning platform used to collect didactic materials.

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEU_U01 | Punctuality, fulfilment of all orders in the task descriptions and the code quality are the criteria of assessment (0-10 points). |
| F2 | PEU_U02 | The quality of conducting experiments, the result analysis and the way of presentation are the main criteria of report evaluation. Scale: 1-10 points |
| | PEU_U01 | Punctuality, fulfilment of all orders in the task descriptions and the code quality are the criteria of assessment (0-20 points). |
| | PEU_U02 | The quality of conducting experiments, the result analysis and the way of presentation are the main criteria of report evaluation. Scale: 1-10 points. |
| | PEU_U01, | Punctuality, fulfilment of all orders in the task descriptions and the code quality are the criteria of assessment (0-20 points). |
| F3 | PEU_U02 | The quality of conducting experiments, the result analysis and the way of presentation are the main criteria of report evaluation. Scale: 1-10 points. |

C
The lecture is evaluated on the basis of test with open questions with a given points $F_w$.
The final note is calculated on the basis of the sum $(F_p+F_w)$ of points from lab $F_p$ and the test $F_w$ as follows:
(50%, 60%] → dst
(60%, 70%] → dst+
(70%, 80%] → db
(80%, 90%] → db+
(90%, → bdb
Remark: Each number of points ($F_p$,$F_w$ ) must be higher than 50% to pass the course.

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**


[1] S.Osowski: Sieci neuronowe w ujęciu algorytmicznym, WNT 1996
[2] I. Goodfellow, Y. Bengio, A. Courville: Deep learning, MIT 2016
[3] Sieci neuronowe w zastosowaniach, pod red. U. Markowskiej Kaczmar, H. Kwaśnickiej, Oficyna Wydawnicza PWr. 2005
[4] Michael Nielsen: Neural Network and Deep Learning,książka dostępna pod adresem http://neuralnetworksanddeeplearning.com/


**SECONDARY LITERATURE:**


[1] Biocybernetyka i inżynieria biomedyczna 2000 Tom 6 Sieci neuronowe (redaktorzy tomu (Włodzisław Duch, Józef Korbicz, Leszek Rutkowski, Ryszard Tadeusiewicz); Akademicka Oficyna Wydawnicza EXIT


**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**


**Urszula, Markowska-Kaczmar, urszula.markowska-kaczmar@pwr.edu.pl**

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish Systemy Operacyjne**
**Name of subject in English Operating Systems**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: academic / ~~practical~~***
**Level and form of studies: 1st/ ~~2nd level, uniform magister studies~~*, full-time / ~~part-time studies~~***
**Kind of subject: obligatory / ~~optional / university-wide~~***
**Subject code INZ004405**
**Group of courses ~~YES~~ / NO***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 60 | | 60 | | |
| Form of crediting | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | ~~Examination~~ / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | | | | | |
| Number of ECTS points | 2 | | 2 | | |
| including number of ECTS points for practical (P) classes | | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,2 | | 1,2 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Basic programming

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**SUBJECT OBJECTIVES**

C1 General knowledge about structure, mechanisms and applications of modern operating systems
C2 General knowledge about resource management in computer systems

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEU_W01 – Student knows operating systems' architectures
PEU_W02 – Student knows organizational principles of distributed operating systems
relating to skills:
PEU_U01 – Student is able to simulate standard resource allocation algorithms
PEU_U02 – Student is able to assess how resource allocation algorithms impact operating systems' effectiveness
relating to social competences:
PEU_K01 – Student understands the need to implement access control mechanisms in operating systems

PEU_K02 – Student understands contemporary research trends in operating systems, and how they influence organization of information systems

## PROGRAM CONTENT

| Lectures | | Number of hours |
|---|---|---|
| Lec 1 | Introduction. History of operating systems. Monitors, virtual machines, client-server architecture | 2 |
| Lec 2 | Process management. Resource allocation problems | 2 |
| Lec 3 | Process coordination, semaphores, critical sections, inter-process communication | 2 |
| Lec 4 | Synchronization. Deadlock avoidance and management | 2 |
| Lec 5 | Memory management. Memory allocation algorithms. Paging and segmentation | 2 |
| Lec 6 | Virtual memory | 2 |
| Lec7 | Disk space allocation. | 2 |
| Lec8 | File systems. Implementation and hardware requirements | 2 |
| Lec9 | Protection in operating systems. Access control mechanisms | 2 |
| Lec10 | Distributed systems. Hardware, software, communication | 2 |
| Lec11 | Clock synchronization in distributed systems. Election algorithms. Transactions | 2 |
| Lec12 | Process and processors management in distributed systems. Fault tolerance, resource allocation | 2 |
| Lec13 | Distributed file systems | 2 |
| Lec14 | Shared memory and distributed systems. Consistency models. Paging | 2 |
| Lec15 | Operating systems in GRID architectures. Perspectives of operating systems | 2 |
| | Total hours | 30 |

| Laboratory | | Number of hours |
|---|---|---|
| Lab 1 | UNIX shell, shell scripts | 6 |
| Lab 2 | Access control in Unix system | 4 |
| Lab 3 | CPU scheduling – methods and algorithms | 6 |
| Lab 4 | Memory management – methods and algorithms | 6 |
| Lab 5 | Resource management in distributed systems | 8 |
| | Total hours | 30 |

## TEACHING TOOLS USED

N1.Lecture
N2. Laboratory tasks
N3. Individual work

## EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

| **Evaluation** (F – forming (during semester), C – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEK_W01<br>PEK_W02<br>PEK_U01 | Evaluation of preparation for completing laboratory taks |

| | | |
|---|---|---|
| | PEK_U02<br>PEK_K01<br>PEK_K02 | |
| F2 | PEK_W01<br>PEK_W02<br>PEK_U01<br>PEK_U02<br>PEK_K01<br>PEK_K02 | Evaluation of laboratory tasks |
| C Final Test | | |

## PRIMARY AND SECONDARY LITERATURE

### PRIMARY LITERATURE:

A. Silbershatz, J.L. Peterson, P.B. Galvin, *Podstawy systemów operacyjnych*, WNT 1993.
A.S. Tannenbaum, *Rozproszone systemy operacyjne*, Wyd. Nauk. PWN, 1997.
A.M. Lister, R.D. Eager, *Wprowadzenie do systemów operacyjnych*, WNT, 1994.
M.J Bach, *Budowa systemu operacyjnego UNIX*, WNT, 1995

### SECONDARY LITERATURE:

W.R. Stevens, *Programowanie zastosowań sieciowych w systemie UNIX*, WNT, 1995.
Gabassi, *Przetwarzanie rozproszone w systemie UNIX*, Wyd. Lupus.

## SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Krzysztof Juszczyszyn, krzysztof.juszczyszyn@pwr.wroc.pl

**FACULTY** of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Techniki prezentacji**
**Name of subject in English: Presentation techniques**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable): not applicable**
**Profile: academic / ~~practical*~~**
**Level and form of studies: 1st/ ~~2nd level, uniform magister studies~~*, full-time / ~~part-time studies*~~**
**Kind of subject: obligatory / ~~optional / university-wide*~~**
**Subject code SCZ001115S**
**Group of courses ~~YES~~ / NO***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | | | | | 30 |
| Number of hours of total student workload (CNPS) | | | | | 60 |
| Form of crediting | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | E~~xamination~~ / crediting with grade* |
| For group of courses mark final course with (X) | | | | | |
| Number of ECTS points | | | | | 2 |
| including number of ECTS points for practical (P) classes | | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | | | | | 1,2 |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. None

**SUBJECT OBJECTIVES**

C1 Familiarizing students with the basic issues related to interpersonal communication and its applications in science and business.
C2 Improvement of students' competences in the field of creating and implementing various types of speeches and presentations in business practice.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEU_W01 Student knows the basic concepts and psychological mechanisms related to interpersonal communication and self-presentation.
PEU_W02 Student knows the techniques and tools used to present their own and team solutions and scientific, technical and business achievements.
relating to skills:
PEU_U01 Student is able to prepare various types of presentations and presentations of own solutions and achievements.

PEU_U02 Student is able to critically analyze the speeches and presentations of other people, organizations and institutions.
relating to social competences:
PEU_K01 He can set priorities in his own work and in cooperation with others.
PEU_K02 It presents assertiveness and courage in passing on and defending one's own achievements and views.

| | **Seminar** | **Number of hours** |
|---|---|---|
| Sem 1 | Basics of interpersonal communication: basic concepts and models | 2 |
| Sem 2 | Basics of interpersonal communication: principles of creating an effective message, credibility of the sender | 2 |
| Sem 3 | The role of verbal communication (dictionary, grammar, functions of words, sentences and questions) | 2 |
| Sem4 | The role of non-verbal communication (voice and its characteristics, facial expressions and gestures, distance) | 2 |
| Sem5 | Types of messages and their functions in various areas of social communication | 2 |
| Sem6 | The specificity of communication in various areas of social communication - matching messages to the auditorium | 2 |
| Sem7 | Mechanisms of self-presentation in interpersonal communication | 2 |
| Sem8 | Rules for the development of effective multimedia presentations | 2 |
| Sem9 | Rules for the development of effective multimedia presentations – case studies | 2 |
| Sem10 | Principles of effective data presentation | 2 |
| Sem11 | Elevator pitch - development of a brief speech and presentation | 2 |
| Sem12 | Stress related to public speeches and methods of coping with it | 2 |
| Sem13 | Analysis of students' own speeches and presentations | 2 |
| Sem14 | Analysis of students' own speeches and presentations, cont. | 2 |
| Sem15 | Analysis of students' own speeches and presentations, cont. Summary of classes. Final test. | 2 |
| | Total hours | 30 |

**TEACHING TOOLS USED**

N1. Lecture
N2. Group exercises
N3. Case analysis
N4. Presentation prepared by students
N5. Discussion of problems and results of work

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 Activity during classes | PEU_W01 - 02<br>PEU_U01 - 02<br>PEU_K01- 02 | Oral feedback |

| | | |
|---|---|---|
| F2 Work prepared individually and in groups | PEU_W01 - 02<br>PEU_U01 - 02<br>PEU_K01- 02 | Work evaluation; oral feedback |
| C Own presentation of the student assessed by the teacher; final test | | |

## PRIMARY AND SECONDARY LITERATURE

**PRIMARY LITERATURE:**


[1] Jonathan Schwabish (2016) Better Presentations. A Guide for Scholars, Researchers, and Wonks.
[2] Maurizio La Cava (2015) Lean PresentationDesign. How to create presentations that everybody loves.
[3] Carmine Gallo (2014) Talk Like TED. The 9 Public-Speaking Secrets of the World's Top Minds


**SECONDARY LITERATURE**


[1] Keith Schreiter, Tom Schreiter (2017) The One-Minute Presentation: Explain Your Network Marketing Business Like A Pro. Fortune Network Publishing
[2] Stephen Haunts (2017) A Gentle Introductiont o Speaking in Public


**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**


Anna Borkowska, anna.borkowska@pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name in Polish: Paradygmaty programowania**
**Name in English: Programming Paradigms**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: ~~academic /~~ practical***
**Level and form of studies: 1st~~/ 2nd~~ level~~, uniform magister studies~~*, full-time ~~/ part-time~~ studies***
**Kind of subject: obligatory ~~/ optional / university-wide*~~**
**Subject code INZ004409L**
**Group of courses ~~YES /~~ NO***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | | | 30 | | |
| Number of hours of total student workload (CNPS) | | | 60 | | |
| Form of crediting | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | | | | | |
| Number of ECTS points | | | 2 | | |
| including number of ECTS points for practical (P) classes | | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | | | 1,2 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Basic knowledge of object-oriented programming and the ability to write simple programs.
2. Knowledge of basic algorithms and data structures.

**SUBJECT OBJECTIVES**

C1 Ability to use programming techniques typical of chosen programming paradigm.
C2 Ability to merge constructs from different paradigms in one program.

**SUBJECT EDUCATIONAL EFFECTS**

relating to skills:
PEK_U01 Implement programs in accordance with the given specification.
PEK_U02 Select the programming paradigm that best suits the problem in hand.
PEK_U03 Choose appropriate constructs available in programming language depending on the problem to be solved.
PEK_U04 Use the standard documentation of programming languages.
PEK_U05 Use a modern programming environment (e.g. IntelliJ) and programming tools.

**PROGRAM CONTENT**

| Laboratory | | Number of hours |
|---|---|---|
| Lec 1 | Grading policy. Safety rules. Introduction to the programming environment used. | 2 |
| Lec 2 | Functional programming in interactive environment. | 2 |
| Lec 3 | Simple functions with pattern matching. | 2 |
| Lec 4 | Higher-order functions. | 2 |
| Lec 5 | Functions with algebraic data types (e.g. trees). | 2 |
| Lec 6 | Functions on lazy lists and/or trees. | 2 |
| Lec 7 | Functions with computational effects. | 2 |
| Lec 8 | Using modules. | 2 |
| Lec 9 | Object-oriented program with class hierarchy. | 2 |
| Lec 10 | Object-oriented program with traits and mixins. | 2 |
| Lec 11 | Object-oriented program with generic classes. Variance properties. | 2 |
| Lec 12 | Concurrent programming with threads. | 2 |
| Lec 13 | Concurrent programming. Actors and message passing. | 2 |
| Lec 14 | Program with event handling or reactive programing | 2 |
| Lec 15 | Grading. | 2 |
| | Total hours | 30 |

| TEACHING TOOLS USED |
|---|
| N1. Modern programming environment and programming tools.<br>N2. E-learning system used to publish teaching materials and messages |

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEK_U01<br>PEK_U02<br>PEK_U03<br>PEK_U04<br>PEK_U05 | Grading programs written on-line during labs. |
| C The overall grade for labs according to the rules announced during the first lab. | | |

| PRIMARY AND SECONDARY LITERATURE |
|---|

## PRIMARY LITERATURE:

[1] Handouts provided by the teacher
[2] R. Martin, Clean Architecture, Pearson Education 2018
[3] M. Odersky, L.Spoon, B.Venners, Programming in Scala, Artima 2016
[4] J. Hickey, Introduction to Objective Caml, Internet

## SECONDARY LITERATURE:

[1] E. Chailloux, P.Manoury, B.Pagano, Developing Applications with Objective Caml, Internet
[2] K.D. Lee, Foundations of Programming Languages, Springer 2017
[3] A.Prokopec, Learning Concurrent Programming in Scala, Packt 2017
[4] R. W.Sebesta, Concepts of Programming Languages, Addison-Wesley 2012.
[5] P. Van Roy, S.Haridi, Concepts, Techniques, and Models of Computer Programming, MIT 2004

## SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Michał Szczepanik, michal.szczepanik@pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name in Polish: Paradygmaty programowania**
**Name in English: Programming Paradigms**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable): …**
**Profile: academic ~~/ practical*~~**
**Level and form of studies: 1st~~/ 2nd~~ level~~, uniform magister studies~~*, full-time ~~/ part-time~~ studies***
**Kind of subject: obligatory ~~/ optional / university-wide*~~**
**Subject code INZ004409Wc**
**Group of courses YES ~~/ NO~~***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | 15 | | | |
| Number of hours of total student workload (CNPS) | 80 | 60 | | | |
| Form of crediting | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 5 | | | | |
| including number of ECTS points for practical (P) classes | | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 3 | | | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Basic knowledge of object-oriented programming and the ability to write simple programs.
2. Knowledge of basic algorithms and data structures.

**SUBJECT OBJECTIVES**

C1 Basic understanding of fundamental programming paradigms and programming-language constructs.
C2 Ability to use programming techniques typical of chosen programming paradigm.
C3 Ability to merge constructs from different paradigms in one program.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEK_W01 Enumerate and characterize the basic programming paradigms.
PEK_W02 Know which programming languages support these paradigms.
PEK_W03 Know typical for basic paradigms programming mechanisms.
PEK_W04 Know common abstractions and mechanisms that support those abstractions in programming languages.

relating to skills:
PEK_U01 Implement programs in accordance with the given specification.
PEK_U02 Select the programming paradigm that best suits the problem in hand.
PEK_U03 Choose appropriate constructs available in programming language depending on the problem to be solved.
PEK_U04 Use the standard documentation of programming languages.

**PROGRAM CONTENT**

| | **Lectures** | **Number of hours** |
|---|---|---|
| Lec 1 | Introduction. Functional programming in interactive environment. | 2 |
| Lec 2 | Basics of functional programming: curried and uncurried form, tail recursion, pattern matching. | 2 |
| Lec 3 | Higher-order functions. Higher-order programming. | 2 |
| Lec 4 | Algebraic data types: definitions and usage. | 2 |
| Lec 5 | Eager and lazy evaluation. Streams. Parameter passing. | 2 |
| Lec 6 | Computational effects. Imperative programming. | 2 |
| Lec 7 | Abstract data types, monads, functional programming summary | 2 |
| Lec 8 | Object-oriented programming I. Reminder of known programming constructs. | 2 |
| Lec 9 | Object-oriented programming II. New programming constructs: traits, mixins, case classes and others. | 2 |
| Lec 10 | Variance properties and bounded polymorphism | 2 |
| Lec 11 | Concurrent programming. Threads and shared memory. | 2 |
| Lec 12 | Concurrent programming. Actors and message passing. | 2 |
| Lec 13 | Reactive Programming | 2 |
| Lec 14 | Handling events. GUI programming. | 2 |
| Lec 15 | Basics of logic programming. | 2 |
| | Total hours | 30 |

| | **Classes** | **Number of hours** |
|---|---|---|
| Cl 1 | Administrative class. Grading policy. | 1 |
| Cl 2 | Basics of functional programming. Pattern matching. | 2 |
| Cl 3 | Higher-order functions. Algebraic data types. | 2 |
| Cl 4 | Eager and lazy evaluation. Computational effects. | 2 |
| Cl 5 | Abstract data types. Basics of object-oriented programming. | 2 |
| Cl 6 | More advanced object-oriented mechanisms. Generic classes and variance properties. | 2 |
| Cl 7 | Concurrent programming with threads. | 2 |
| Cl 8 | Concurrent programming with actors and message passing. Handling events. Reactive programming | 2 |
| | Total hours | 15 |

**TEACHING TOOLS USED**

| |
|---|
| N1. Lecture supported by multimedia presentations.<br>N2. E-learning system used to publish teaching materials and messages. |

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEK_W01<br>PEK_W02<br>PEK_W03<br>PEK_W04<br>PEK_U01<br>PEK_U02<br>PEK_U03<br>PEK_U04 | Grading homework exercises solved at classes and declared as solved. |
| F2 | PEK_W01<br>PEK_W02<br>PEK_W03<br>PEK_W04 | Written examination. |
| C The overall grade of the course is the grade for written exam, possibly modified by 0,5 up or down depending on the activity during classes. | | |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

[1] Handouts provided by the teacher
[2] R. Martin, Clean Architecture, Pearson Education 2018
[3] M. Odersky, L.Spoon, B.Venners, Programming in Scala, Artima 2016
[4] J. Hickey, Introduction to Objective Caml, Internet

**SECONDARY LITERATURE:**

[1] E. Chailloux, P.Manoury, B.Pagano, Developing Applications with Objective Caml, Internet
[2] K.D. Lee, Foundations of Programming Languages, Springer 2017
[3] A.Prokopec, Learning Concurrent Programming in Scala, Packt 2017
[4] R. W.Sebesta, Concepts of Programming Languages, Addison-Wesley 2012.
[5] P. Van Roy, S.Haridi, Concepts, Techniques, and Models of Computer Programming, MIT 2004

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

Michał Szczepanik, michal.szczepanik@pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish Programowanie aplikacji multimedialnych**
**Name of subject in English Programming multimedia aplications**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: academic**
**Level and form of studies: 1st/ ~~2nd level, uniform magister studies~~*, full-time / ~~part-time~~***
**Kind of subject: ~~obligatory /~~ optional / ~~university-wide~~***
**Subject code INZ004438Wl**
**Group of courses YES ~~/ NO~~***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 60 | | 60 | | |
| Form of crediting | Crediting with grade* | Examination / crediting with grade* | Crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark (X) final course | X | | | | |
| Number of ECTS points | 2 | | 2 | | |
| including number of ECTS points for practical classes (P) | | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,2 | | 1,2 | | |

*delete as not necessary

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge of basic programming techniques for Android or iOS platform
2. Basic knowledge of design and programming of user interface
3. Basic knowledge of graphical software
4. Awareness of mobile and multimedia technologies for the society

**SUBJECT OBJECTIVES**

C1. Transfer of knowledge about the application areas of modern multimedia techniqes
C2. Presentation of programming tools for multimedia processing.
C3. Design and implementation of a mobile application.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEU_W01 Knows and understands the specificity of multimedia applications.
PEU_W02 Knows how to design and implement multimedia applications.
PEU_W02 Knows programming tools for multimedia processing.

relating to skills:
PEU_U01 Defines a set of functional requirements of a multimedia application, and – based on the definition – designs a multimedia application.

PEU_U02 Implements a multimedia application in accordance to the design.
PEU_U03 Creates and processes multimedia.

relating to social competences:
PEU_K01 Cooperates with a potential user of a multimedia application to define a set of functional requirements.
PEU_K02 Includes specific requirements in the user-interface design process.

**PROGRAMME CONTENT**

| | **Lecture** | **Number of hours** |
|---|---|---|
| Lec 1 | Introduction. Review of selected multimedia applications. | 2 |
| Lec 2-3 | UI and UX. Interactions. Touch screens. Material design. Human Interface guidelines. Voice communication. | 4 |
| Lec 4 | Tools for multimedia processing. Gathering multimedia data. Copyright. | **2** |
| Lec 5 | Implementation rules in Android Studio. The structure of android application. Implementation of user-interfce. | 2 |
| Lec 6 | Apple XCode environment. The structure of application written in Swift. Introduction to Swift language. | 2 |
| Lec 7 | 2D and 3D animations. Introduction to the 3ds Max and Maya programs. Implementation of animations in ActionScript 3.0 and Lingo. | 2 |
| Lec 8 | Scene planning. Non-linear assembly of video – Adobe Premiere, After Effects. | **2** |
| Lec 9 | Libraries and frameworks supporting creation of multimedia applications. Short characteristics of Kotlin language. | **2** |
| Lec 10 | Applications of augmented reality. Code analysis of application with augmented reality mechanisms. | **2** |
| Lec 11 | Games review. Connections between games and the progress of algorithms and programming languages. | **2** |
| Lec 12 | Multimedia data compression. Compression formats. Video and audio streaming. | **2** |
| Lec 13 | Multimedia in mobile systems. Cameras. Recommended frameworks. | **2** |
| Lec 14 | Interaction mechanisms – review. New technologies and multimedia devices. | **2** |
| Lec 15 | Summary. Perspectives of multimedia techniqes. | **2** |
| | Total hours | **30** |

| | **Laboratory** | **Number of hours** |
|---|---|---|
| Lab 1-2 | Introduction. Introduction to Android Studio. Animate program. Implementation of a puzzle game. | 4 |
| Lab 3-4 | Implementation of photo gallery with animation and audio effects in AS 3.0. | 4 |
| Lab 5-6 | Implementation of photo gallery with animation and audio effects in Swift and Xcode. | 4 |
| Lab 7-8 | Implementation of an interactive game with animations and audio in Android Studio (Swift UI). | 4 |
| Lab 9-10 | Implementation of photo gallery with animation and audio effects in Swift and Xcode. | |
| Lab 11-14 | Design and implementation of a virtual museum. | 8 |

| | | |
|---|---|---|
| Lab 15 | Demonstration of virtual museum implementation with the use of modern multimedia techniqes. | 2 |
| | Total hours | 20 |

**TEACHING TOOLS USED**

N1. Lectures in the form of multimedia presentations.
N2. Introduction to the laboratories in the form of multimedia presentation.
N3. Collections of additional materials (links, papers).
N4. Individual meetings.

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming during semester), P – concluding (at semester end) | Learning outcomes code | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEU_W01<br>PEU_W02<br>PEU_W03<br>PEU_U01<br>PEU_U02<br>PEU_U03 | Students have to realize 9 laboratory tasks. For each they can get from 0-2 points. |
| F2 | PEU_W01<br>PEU_W02<br>PEU_W03<br>PEU_U01<br>PEU_U02<br>PEU_U03<br>PEU_K01<br>PEU_K02 | Design and implementation of a multimedia application for 0-4 points. |

P is calculated based on the formula given below. The highest grade requires the F2 is greater than zero.

| **Points** | 10-11 | 12-13 | 14-15 | 16-17 | 18-20 | 21-22 |
|---|---|---|---|---|---|---|
| **P** | 3,0 | 3,5 | 4,0 | 4,5 | 5,0 | 5,5 |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

[1] Carmen Delessio, Lauren Darcey, Shane Conder, Android Studio w 24 godziny. Wygodne programowanie dla platformy Android, Helion 2017.
[2] Andrzej Stasiewicz, Android. Podstawy tworzenia aplikacji, Helion 2014.
[3] Kathy Sierra, Bert Bates, Rusz głową. JAVA, Wydanie 2, Helion 2011.
[4] Matthew Mathias, John Gallagher, Programowanie w języku Swift. BIG NERD RANCH GUIDE, Helion 2017.

**SECONDARY LITERATURE:**

[1] Randi L. Derakhshani, Dariusz Derakhshani, Autodesk 3ds Max 2014. Oficjalny podręcznik, Helion 2014.
[2] Dariusz Derakhshami, MAYA 2011. Wprowadzenie, Helion 2011.

| |
|---|
| [3] Cameron Chapman, Podręcznik genialnych pomysłów. Od inspiracji po realizację, Helion 2012. |
| **SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)** |
| **Dr inż. profesor uczelni Krzysztof Waśko, krzysztof.wasko@pwr.edu.pl** |

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Routing i przełączanie w sieciach**
**Name of subject in English: Routing and Switching**
**Main field of study (if applicable): Applied of Computer Science**
**Specialization (if applicable): ……..**
**Profile: academic / practical***
**Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister studies~~*, full-time / ~~part-time~~ studies***
**Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~***
**Subject code INZ002026**
**Group of courses YES / ~~NO~~***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 60 | | 60 | | |
| Form of crediting | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 2 | | 2 | | |
| including number of ECTS points for practical (P) classes | 0 | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,2 | | 1,2 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. K1INF_W01 - Has basic knowledge in the field of linear algebra, analytical geometry and mathematical analysis, necessary to solve computational problems of engineering character from technical and non-technical disciplines
2. K1INF_W02 - Has basic knowledge in the field of discrete mathematics, mathematical logic, probability theory and mathematical statistics, necessary to solve IT engineering problems.
3. K1INF_W07 - Has basic knowledge in the field of computer structure, organization and architecture.
4. K1INF_W10 - Has basic knowledge in the field of computer networks and their architectures.
5. 5. K1INF_U08 - Is able to configure basic devices and network software in computer networks.

**SUBJECT OBJECTIVES**

C1 Acquiring knowledge in the field of functionality and application of protocols operating in switched Ethernet networks.

C2. Acquiring knowledge in the field of functionality and the use of routing protocols intended for work inside and between autonomous areas of computer networks (IGP - Interior Gateway Routing Protocol, EGP - Exterior Gateway Routing Protocol).
C3. Acquiring knowledge in the field of functionality and application of protocols and services supporting the computer networks.
C4. Acquiring knowledge in the field of operation, management and configuration of network operating systems.
C5. Acquiring the ability to configure network devices (network operating systems) and protocols in the level of 2 and 3 layer od ISO-OSI model as well as the skills of monitoring , management and diagnostic of computer networks.

**SUBJECT EDUCATIONAL EFFECTS**

Relating to knowledge:

PEK_W01 - Has basic and structured knowledge about the functionality and operation of protocols and services supporting computer networks.

PEK_W02 - Has basic and structured knowledge in the field of configuration and operation of network operating systems.

Relating to skills:

PEK_U01 - Has skills related to basic configuration of various types of network protocols, network services, network operating systems, as well as analysis of their operation and detection of basic errors in computer networks.

**PROGRAM CONTENT**

| | **Lectures** | **Number of hours** |
|---|---|---|
| Lec1 | Plan of the lecture.<br>Explanation of the assessment method.<br>Introduction to computer networks. The benefits and threats of global digitization and unlimited communication.<br>Protocols and services supporting switched networks.<br>Explanation of operation and application of VTP (VLAN Trunking Protocol) and DTP (Dynamic Trunking Protocol) protocols. | 2 |
| Lec2 | Protocols and services supporting switched networks.<br>Explanation of the operation and application of the Spanning Tree Protocol (STP). | 2 |
| Lec3 | Protocols and services supporting switched networks.<br>Explanation of operation and application of the EtherChannel protocol.<br>Explanation of the operation and application of the switch port monitoring protocol (port mirroring). SPAN (Switched Port Analyzer) service. | 2 |
| Lec4 | Protocols that provide redundancy of the default gateway (FHRP - First Hop Redundancy Protocols).<br>Description of the operation of HSRP (Hot Standby Router Protocol) and GLBP (Gateway Load Balancing Protocol) protocols. | 2 |
| Lec5 | Vector routing protocols on the example of EIGRP in IPv4 and IPv6 networks. | 2 |
| Lec6 | Parameterization of the EIGRP protocol in the IPv4 and IPv6 networks. | 2 |

| | | |
|---|---|---|
| Lec7 | Link-state routing protocols on the example of OSPF protocol in the IPv4 and IPv6 networks. | 2 |
| Lec8 | Parameterization of the OSPF protocol in the IPv4 and IPv6 networks. | 2 |
| Lec9 | Multi-area routing. Routing in a multi-access network. Information exchange between different routing protocols. | 2 |
| Lec10 | PPP (Point To Point) protocol and its variations (PPPoE). | 2 |
| Lec11 | Virtual networks and VPN tunnels. | 2 |
| Lec12 | EGP routing protocols on the example of BGP protocol. | 2 |
| Lec13 | Access control in computer networks. Extended access control lists. | 2 |
| Lec14 | Securing, monitoring and diagnostics of computer networks. Protocols and services (SNMP, syslog, netflow, others). | 2 |
| Lec15 | Directions of computer network development. New generations of networks and ways to configure them. Software defined network SDN (Software Defined Network). | 2 |
| | Total hours | 30 |

| **Laboratory** | | **Number of hours** |
|---|---|---|
| Lab1 | Organizational cLabsses.<br>ExpLabnation of the assessment method.<br>Principles of health and safety.<br>Presentation of the network topology in the Labboratory and the deployment of network devices.<br>Construction of active devices, description of interfaces. | 2 |
| Lab2 | Configuring and testing VTP (VLABN Trunking Protocol) and DTP (Dynamic Trunking Protocol) protocol operations. | 2 |
| Lab3 | Configuring and testing the Spanning Tree Protocol (STP). | 2 |
| Lab4 | Configuring and testing the various EtherChannel variants.<br>Configuration and testing port mirroring protocol operation. | 2 |
| Lab5 | Configuring and testing a group of protocols that create a redundant default gateways - FHRP (First Hop Redundancy Protocols). | 2 |
| Lab6 | Basic configuration and testing of the EIGRP protocol in the IPv4 and IPv6 environment. | 2 |
| Lab7 | Advanced configuration and testing of EIGRP in an IPv4 and IPv6 environment. | 2 |
| Lab8 | Basic configuration and testing of the OSPF protocol in the IPv4 and IPv6 environment. | 2 |
| Lab9 | Advanced configuration and testing of OSPF in an IPv4 and IPv6 environment. Parameterization of the protocol. | 2 |
| Lab10 | Configuration and testing of OSPF protocol in an Ethernet multi-access network environment.<br>Configuration and testing of OSPF in an environment that combines multiple areas managed by the OSPF protocol and other routing protocols. | 2 |
| Lab11 | Configuration and testing of PPP protocol (EncapsuLabtion, PAP and CHAP authentication).<br>Configuring and testing the PPPoE protocol. | 2 |

| | | |
|---|---|---|
| Lab12 | Configuration and testing virtual network connections - VPN tunnels (Virtual Private Network). Creation of GRE (Generic Routing EncapsuLabtion) tunnels.<br>Configuration and application the BGP (Border Gateway Protocol) routing protocol. | 2 |
| Lab13 | Configuration and use of extended access control lists (Extended ACLs) | 2 |
| Lab14 | Network monitoring and diagnostics.<br>Configuration and operation of the SNMP protocol.<br>Configuration and application of IP SLAB service (Service Level Agreements).<br>Configuration and application of the Syslog service. | 2 |
| Lab15 | Additional cLabsses devoted to the implementation of selected issues not done or finished during the semester. | 2 |
| | Total hours | 30 |

**TEACHING TOOLS USED**

N1. Lecture supported by multimedia presentations and network simulator.
N2. Various types of network software.
N3. Simulator enabling creation, configuration and testing of various topologies of computer networks.
N4. Quizzes and knowledge tests.
N5. A real environment for creating, configuring and testing various topologies of computer networks

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1-F14 - partial grades obtained at La2-15 laboratories | PEK_U01 | Student's presence.<br>Theoretical preparation for the lab (quiz, test, other) on a point, percentage or traditional scale.<br>Evaluation of the lab tasks on a point or traditional scale. |
| P1 – concluding lab grade | PEK_U01 | An average of the F1-14 forming grades. |
| F15 - forming lecture grade | PEK_W01, PEK_W02 | Observation of student activity. Solving sample problems and tasks. |
| P2 – concluding lecture grade | PEK_W01, PEK_W02 | A computer test, containing questions of various types (multiple and single choice, computational, open, other) checking knowledge in the field of lecture. The test is given a positive evaluation, if the student scores at least 51% of the maximum number of points. Later, the rating is increased by 0.5 every 10%. A positive P2 rating can be adjusted by rating F15. |
| P3 – grade concluding the group of courses | PEK_W01, PEK_W02, PEK_U01 | Score summarizing the group of courses. Rating calculated as an average of P1 and P2 grade. The condition for passing the subject is positive evaluation of P1 and P2. |

## PRIMARY AND SECONDARY LITERATURE

**PRIMARY LITERATURE:**


[1] Andrew S. Tanenbaum, David J. Wetherall, “Computer Networks, 5th Edition”, Published by Pearson, Sep 27, 2010

[2] J. Woźniak, K. Nowicki, „Sieci LAN, MAN i WAN - protokoły komunikacyjne”, Wydawnictwo - FPT, Kraków 2000

[3] Training materials of the Cisco Network Academy

[4] Wendell Odom, “CCENT/CCNA ICND1 100-105 Official Cert Guide:, Cisco Systems; Auflage: Har/Dvdr (17. Mai 2016)

[5] Wendell Odom, “CCNA Routing and Switching ICND2 200-105 Official Cert Guide: Official Cert Guid / Learn, prepare, and practice for exam success”, Cisco Systems; Auflage: Har/Cdr (4. Juli 2016)


**SECONDARY LITERATURE:**


[1] http://www.freebookcentre.net/Networking/Free-Computer-Networking-Books-Download.html

[2] CCNA Exploration Companion Guide books


**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**


Kamil Nowak, kamil.nowak@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY of Computer Science and Management

**SUBJECT CARD**

| | |
|---|---|
| **Name of subject in Polish** | **Języki skryptowe** |
| **Name of subject in English** | **Script Languages** |
| **Main field of study:** | **Applied Computer Science** |
| **Specialization:** | |
| **Profile:** | **academic** |
| **Level and form of studies:** | **1st level, full-time** |
| **Kind of subject:** | **obligatory** |
| **Subject code** | **INZ002025** |
| **Group of courses** | **NO** |

| | Lecture | Classes | Lab | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | 30 | | |
| Number of hours of total student workload (CNPS) | 85 | | 90 | | |
| Form of crediting | Examination | | Crediting with grade | | |
| For group of courses mark (X) final course | | | | | |
| Number of ECTS points | 3 | | 3 | | |
| including number of ECTS points for practical classes (P) | | | 3 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1.8 | | 1.8 | | |

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge on structural and object oriented programming
2. Knowledge on data structures and algorithms

**SUBJECT OBJECTIVES**

C1 Understands the application area of script languages
C2 Understand and exploit the particularities of OOP in Script Languages.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEU_W01 Student knows idiosyncrasy of scripting language development process
PEU_W02 Student know how scripted code can collaborate with IT environment

relating to skills:
PEU_U01 Student can develop an application that cooperate with the rest of operating system
PEU_U02 Student can create GUI application

relating to social competences:
PEU_K01 Student realizes need for self-directed learning

**PROGRAMME CONTENT**

| Lecture | Number of hours |
|---|---|

| | | |
|---|---|---|
| Lec 1 | Introduction. Tools for developing an application. | **2** |
| Lec 2 | Debugging application. Using input and output streams. Strings. | **2** |
| Lec 3 | Lists and tuples. Using correct coding style. | **2** |
| Lec 4 | Sets and dictionaries. Text files. | **2** |
| Lec 5 | Binary and structured text files. Using exceptions. | **2** |
| Lec 6 | Text processing. Regular expressions. | **2** |
| Lec 7 | Using object oriented approach. Classes and objects. | **2** |
| Lec 8 | Lambda expressions. Reading and writing CSV and XLS files. | **2** |
| Lec 9 | Internet access. Using HTTP and SMTP protocols. | **2** |
| Lec 10 | Testing code. | **2** |
| Lec 11 | Reading and writing DOC files. Graphics processing. | **2** |
| Lec 12 | Database access. | **2** |
| Lec 13 | Building GUI applications. | **2** |
| Lec 14 | Using threads and processes. | **2** |
| Lec 15 | Elements of functional programming. | **2** |
| | **Total hours** | **30** |

| **Laboratory** | | **Number of hours** |
|---|---|---|
| Lab 1 | Introduction. Safety guidelines. Development environments and tools setup. | **2** |
| Lab 2 | Standard input and output. | **2** |
| Lab 3 | Basic data structures: lists, tuples. | **2** |
| Lab 4 | File access. Dictionaries. | **2** |
| Lab 5 | Error handling: exceptions, asserts. | **2** |
| Lab 6 | Text processing. Regular expressions. | **2** |
| Lab 7 | Object oriented programming: classes and objects. | **2** |
| Lab 8 | Collaboration with OS environment. Using DOC, CSV and XLS files | **2** |
| Lab 9 | Accessing web resources: e-mail, WWW, web API. | **2** |
| Lab 10 | Code testing. | **2** |
| Lab11-12 | Mini-project 1 – console application using database, web resources | **4** |
| Lab13-14 | Mini project 2 – GUI application using database and web resources | **4** |
| Lab 15 | Course review and summary | **2** |
| | **Total hours** | **30** |

| TEACHING TOOLS USED |
|---|
| N1. Lectures. Lecture notes in PDF format available on-line.<br>N2. LMS systems with additional tools for online and collaborative work.<br>N3. Laboratory equipped with necessary software and hardware |

| EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT | | |
|---|---|---|
| **Evaluation** (F – forming during semester), P – concluding (at semester end) | **Learning outcomes code** | **Way of evaluating learning outcomes achievement** |
| F1 | PEU_U01<br>PEU_U02 | 10 weekly assignments, graded on quality of the code and the punctuality of delivery |
| F2 | PEU_U01<br>PEU_U02 | 2 mini projects, graded on creativity, originality, quality of the code and the punctuality of delivery |
| F3 | PEU_W01 | Exam 100% grade |
| P (Lab) = F1+F2<br>P (Lecture) = F3 | | |

| PRIMARY AND SECONDARY LITERATURE |
|---|
| **PRIMARY LITERATURE:** |
| [1] M Lutz, Learning Python, 5th ed, O'Reilly Media, 2013.<br>[2] E. Matthes , Python Crash Course, 2nd ed, No Starch Press, 2019.<br>[3] A. Sweigart, Automate the Boring Stuff with Python, 2nd ed, No Starch Press, 2019. |
| **SECONDARY LITERATURE:** |
| [1] J. Danjou, Serious Python, No Starch Press, 2018.<br>[2] L. Vaughan, Impractical Python Projects, No Starch Press, 2018. |

| SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS) |
|---|
| Wojciech Thomas, wojciech.thomas/at/pwr.edu.pl, |

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish:** Projektowanie oprogramowania
**Name of subject in English** Software Engineering
**Main field of study (if applicable):** Applied Computer Science
**Specialization (if applicable):**
**Profile: academic / ~~practical~~***
**Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister studies~~*, full-time / ~~part-time~~ studies***
**Kind of subject: obligatory / ~~optional~~ / ~~university-wide~~***
**Subject code INZ004419**
**Group of courses ~~YES~~ / NO***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | | | 30 | |
| Number of hours of total student workload (CNPS) | 90 | | | 90 | |
| Form of crediting | Examination | | | crediting with grade | |
| For group of courses mark final course with (X) | | | | | |
| Number of ECTS points | 3 | | | 3 | |
| including number of ECTS points for practical (P) classes | | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 1,8 | | | 1,8 | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Basics of Software Engineering
2. Familiarity with object-oriented programming principles

**SUBJECT OBJECTIVES**

C1 Familiarity with basic concepts of software engineering
C2 Familiarity with requirements engineering priciples and techiques
C3 Familiarity with main aspects of modelling, design and testing of information systems

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
K1INF_W14

relating to skills:
K1INF_U03
K1INF_U04

K1INF_U21

## PROGRAM CONTENT

| Lectures | | Number of hours |
|---|---|---|
| Lec 1 | Introduction, Basic Terms and Definitions | 2 |
| Lec 2 | Requirements Engineering (Stakeholder Requirements Definition Process, Techniques of Requirements Elicitation, Semantics of Business Vocabulary and Business Rules, System Requirements Analysis Process, Requirements Classification, Requirements Diagrams, Use Case Diagram) | 10 |
| Lec 3 | Modelling and Design (Software Architecture, Behavioural Modelling, Structural Modelling, Database Design) | 16 |
| Lec 4 | Testing | 2 |
| | Total hours | 30 |

| Project | | Number of hours |
|---|---|---|
| Proj 1 | Elaboration of application concept (Aim of the Project, General Assumptions, Stakeholders Description, Gantt Chart, Use Case Diagram) | 4 |
| Proj 2 | Requirements specification (Functional Requirements Specification, Non-Functional Requirements, Requirement Matrix, Requirements Diagram, Dictionary and Business Rules) | 6 |
| Proj 3 | Design (Structural Model, Behavioral Model, Database Model, Software Architecture, User Interface Design) | 12 |
| Proj 4 | Construction and tests (Implementation, Tests) | 8 |
| | Total hours | 30 |

## TEACHING TOOLS USED

N1. Informative lecture supported by multimedia presentations
N2. Software modelling and design tools
N3. IDE used for programming and testing

## EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 – elaboration of application concept | | Checking of completeness, intra and inter consistency. Up to 15% of maximal number of points for the whole project |
| F2 – requirements specification | | Checking of intra-consistency, completeness, correctness, GUI guidelines. Up to 25% of the maximal number of points for the whole project |
| F3 - design | | Checking for inter-consistency (with preceding phases, and between different diagrams), completeness. Up to 40% of the maximal number of points for the whole project |

| | | |
|---|---|---|
| F4 – construction and tests | | As above. Up to 20% of the maximal number of points. |
| P1 – final grade from project | | The grade calculated basing on the formula:<br><0%, 50%) → 2.0<br><50%, 60%) → 3.0<br><60%, 70%) → 3.5<br><70%, 80%) → 4.0<br><80%, 90%) → 4.5<br><90%, 95%) → 5.0<br><95%, 100%) → 5.5 |
| P2 – final grade from lecture | | Exam – test.<br>The grade calculated basing on the formula:<br><0%, 50%) → 2.0<br><50%, 60%) → 3.0<br><60%, 70%) → 3.5<br><70%, 80%) → 4.0<br><80%, 90%) → 4.5<br><90%, 95%) → 5.0<br><95%, 100%) → 5.5 |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

[1] Bruegge Bernd. Object-oriented software engineering: using UML, Patterns, and Java. Pearson/Prentice Hall, cop. 2004.
[2] Pfleeger Shari Lawrence. Software engineering: theory and practice. Pearson/Prentice Hall, 2006.

**SECONDARY LITERATURE:**

[1] Sommerville Ian, Software engineering, Addison-Wesley, 2007.
[2] Materials prepared by the lecturer

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

Marek Krótkiewicz, marek.krotkiewicz@pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish …Programowanie strukturalne i obiektowe…….**
**Name of subject in English … Structural and Object oriented Programming…**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable): ……..**
**Profile: academic**
**Level and form of studies: 1st , full-time**
**Kind of subject: obligatory**
**Subject code INZ004399**
**Group of courses YES**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | 30 | 30 | | |
| Number of hours of total student workload (CNPS) | 120 | | 60 | | |
| Form of crediting | crediting with grade | crediting with grade* | crediting with grade* | | |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 4 | | 2 | | |
| including number of ECTS points for practical (P) classes | | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 2,4 | | 1,2 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. None

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**SUBJECT OBJECTIVES**

C1 Knows the basics of Structured and Object Oriented Programming
C2 Knows the methodology of problem solving and decomposition

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEU_W01 Knows the basics of structured and Object Oriented Programming
PEU_W02 Knows the methodology of problem solving and decomposition

relating to skills:
PEU_U01 Is able to implement algorithms in JAVA
PEU_U02 Masters the tools and methods needed for program testing and debugging
…
relating to social competences:
…

**PROGRAM CONTENT**

| | Lectures | Number of hours |
|---|---|---|
| Lec 1 | Introduction to computers, the concept of an algorithm, instruction, variables, heap, stack, one dimension arrays, compiler, simple program | 2 |

| | | |
|---|---|---|
| Lec 2 | Principles of structured programming, basic data types, operators, rules for coding and naming | 2 |
| Lec 3 | Problem decomposition, functions, iteration, recursion and their comparison. | 2 |
| Lec 4 | OOP paradigm, types of methods, scope of visibility, functions and parameter passing | 2 |
| Lec 5 | Inheritance and aggregation | 2 |
| Lec 6 | Exceptions, assertions, program testing with JUnit | 2 |
| Lec 7 | Useful classes, stream processing, object serialization, properties, advanced enumerations | 2 |
| Lec 8 | Interfaces, Abstract classes | 2 |
| Lec 9 | Principles of GUI, event driven programming, layout managers, basic GUI components | 2 |
| Lec 10 | More on GUI components, implementation of MVG pattern | 2 |
| Lec 11 | Basic collections | 2 |
| Lec 12 | More on collection, pro and cons of generic collections | 2 |
| Lec 13 | Threads, sockets simple client-server application | 2 |
| Lec 14 | Good programming practices, Clear Code methodology | 2 |
| Lec 15 | Final test | 2 |
| | Total hours | 30 |

| **Classes** | | **Number of hours** |
|---|---|---|
| Cl 1 | Ways of conduct, first algorithms | 2 |
| Cl 2 | One dimension arrays, simple numeric argorithms | 2 |
| Cl 3 | Problem decomposition | 2 |
| Cl 4 | Recursive data structures: list and queues | 2 |
| Cl 5 | Recursive data structures: trees and sets | 2 |
| Cl 6 | Test1: Algorithms | 2 |
| Cl 7 | OOP paradigm | 2 |
| Cl 8 | Defining Hierarchy of classes | 2 |
| Cl 9 | Polymorphism | 2 |
| Cl 10 | GUI components, layout managers | 2 |
| Cl 11 | MVC programming pattern | 2 |
| Cl 12 | Basic Collections | 2 |
| Cl 13 | Advanced Collections | 2 |
| Cl 14 | Test #2 | 2 |
| Cl 15 | Case study | 2 |
| | Total hours | |

| **Laboratory** | | **Number of hours** |
|---|---|---|
| Lab 1 | Ways of conduct, first algorithms, the Eclipse IDE | 2 |
| Lab 2 | Modifications of a simple program, debugging | 2 |
| Lab 3 | Standard input/output, simple numeric algorithms | 2 |
| Lab 4 | Dynamic data stuctures implementation | 2 |

| | | |
|---|---|---|
| Lab 5 | Simple classes | 2 |
| Lab 6 | Inheritance and aggragation | 2 |
| Lab 7 | Program testing with JUnit | 2 |
| Lab 8 | File and folders processing | 2 |
| Lab 9 | Interfaces, Abstract Classes | 2 |
| Lab 10 | Basic GUI | 2 |
| Lab 11 | Advanced GUI | 2 |
| Lab 12 | Collections | 2 |
| Lab 13 | GUI for the implemented database | 2 |
| Lab 14 | Practical Test 1 | 2 |
| Lab 15 | Practical Test 2 | 2 |
| | Total hours | 30 |

**TEACHING TOOLS USED**

N1. Lecture notes in PDF format available on-line
N2. Source files for case study programs available on - line
N3. Laboratory equipped with necessary software and hardware

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes numer | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEU_W01<br>PEU_W02<br>PEU_U01 | During Classes, the students have to present solutions to tasks given to them on a weekly basis. Activity measured on a weekly base makes 30% of the final grade. 70% comes from two tests. |
| F2 | PEU_W01<br>PEU_W02<br>PEU_U01<br>PEU_U02 | During laboratories, the students have to present solutions to tasks given to them on a weekly basis. An overdue for solution delivery of one week is allowed but affects the grade. In order to pass, they have to pass the practical test at the end of the semester. During the test, they are given modified versions of tasks solved during the semester. 40% of the grade comes from work during the semester and 60% from the final test. |
| P1 | PEU_W01<br>PEU_W02<br>PEU_U01 | The final test during the lecture is required for all students that have not gathered at least over 75% of all points from the classes. To pass the final test at least 50% of points are obligatory. |

**PRIMARY AND SECONDARY LITERATURE**

## PRIMARY LITERATURE:

[1] Eckel B.: Thinking in Java, available at www.bruceeckel.com (http://mindviewllc.com/quicklinks/)
[2] Burd B.: Java For Dummies, Wiley Publishing Inc.
[3] Cadenhead R.:Sams Teach Yourself Java in 21 Days (Covering Java 7 and Android) Prentice Hall Publishing

## SECONDARY LITERATURE:

[1] Schildt H.: Java The Complete Reference, The McGraw Inc.
[2] Flanagan D.: Java Examples in a Nutshell, O'Reilly
[3] Darwin I.F.:Java Cookbook, O'Reilly

## On-Line Documantation

[1] https://docs.oracle.com/javase/8/docs/api/
[2] http://www.java2s.com/Tutorial/Java/

## SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

Andrzej Siemiński, Andrzej.Sieminski@pwr.edu.pl

FACULTY Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish Wspomaganie zarządzania projektami informatycznymi**
**Name of subject in English Support for IT Project Management**
**Main field of study (if applicable): Computer Science**
**Specialization (if applicable): ……..**
**Profile: academic**
**Level and form of studies: 1st level, full-time**
**Kind of subject: optional**
**Subject code INZ002033Wls**
**Group of courses NO**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 15 | | 30 | | 15 |
| Number of hours of total student workload (CNPS) | 30 | | 60 | | 30 |
| Form of crediting | crediting with grade | | crediting with grade | | crediting with grade |
| For group of courses mark (X) final course | X | | | | |
| Number of ECTS points | 1 | | 2 | | 1 |
| including number of ECTS points for practical classes (P) | | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 0,8 | | 1,6 | | 0,8 |

*delete as not necessary

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge of the basics of programming
2. Basic knowledge of database technology

**SUBJECT OBJECTIVES**

C1 Familiarize students with basic methods for IT project management.
C2 Familiarize students with categories of software tools aiding IT project management.
C3 Gaining skills in work breakdown, planning, scheduling, cost estimation, and monitoring in IT projects.
C4 Gaining skills in utilizing software tools aiding IT project management.
C5 Gaining skills in working and cooperating with a team utilizing software tools aiding IT project management.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEK_W01 student has a basic knowledge of methods for IT project management.
PEK_W02 student knows categories of software tools aiding IT project management.

relating to skills:
PEK_U01 student can select and utilize aiding software tools appropriate for different phases of IT project management.
PEK_U02 student is able to carry out work breakdown, allocate resources, schedule and monitor accomplishment of a small IT project.

relating to social competences:

PEK_K01 student can retrieve and utilize information from recommended sources and acquire knowledge on his own.
PEK_K02 student understands the necessity of working systematically and creatively to accomplish the course.
PEK_K03 student is capable of cooperating in a team utilizing software tools aiding IT project management.

## PROGRAMME CONTENT

| Lecture | | Number of hours |
|---|---|---|
| Lec 1 | Introduction. Basic concepts. Life cycle of an IT project. | 1 |
| Lec 2 | Total cost of acquiring and maintaining an IT system. | 2 |
| Lec 3 | Systematics of supporting software. | 2 |
| Lec 4 | Software size measurements - review of supporting tools | 2 |
| Lec 5 | Support for planning and scheduling an IT project. | 2 |
| Lec 6 | Supporting the management of project teams | 2 |
| Lec 7 | Supporting communication in an IT project | 2 |
| Lec 8 | Final test | 2 |
| | Total hours | **15** |

| Laboratory | | Number of hours |
|---|---|---|
| Lab 1 | Introduction to the class. Division into teams. Task allocation. | 2 |
| Lab 2 | Utilizing software for business process modeling. | 2 |
| Lab 3 | Utilizing software for requirements management. | 2 |
| Lab 4 | Utilizing software for system modeling. | 2 |
| Lab 5 | Utilizing software for interface modeling. | 2 |
| Lab 6 | Utilizing software to create and maintain a RACI matrix. | 2 |
| Lab 7 | Utilizing software to schedule an IT project. | 2 |
| Lab 8 | Utilizing software to assign and account for tasks. | 2 |
| Lab 9 | Utilizing software to monitor project performance. | 2 |
| Lab 10 | Utilizing software to communicate within a group. | 2 |
| Lab 11 | Utilizing software to estimate the total cost of software acquisition and maintenance. | 2 |
| Lab 12 | Utilizing software for risk management. | 2 |
| Lab 13 | Utilizing software for configuration management. | 2 |
| Lab 14 | Utilizing software integrated in cloud computing. | 2 |
| Lab 15 | Final report presentation | 2 |
| | Total hours | 30 |

| Seminar | | Number of hours |
|---|---|---|
| Semin 1 | Introduction. Allocation of seminar topics. | 1 |
| Semin 2 | Comparative analysis of business process modeling software. | 1 |
| Semin 3 | Comparative analysis of requirements management software. | 1 |
| Semin 4 | Comparative analysis of system modeling software. | 1 |
| Semin 5 | Comparative analysis of interface modeling software. | 1 |
| Semin 6 | Comparative analysis of software for scheduling an IT project. | 1 |

| | | |
|---|---|---|
| Semin 7 | Comparative analysis of task allocation and accounting software. | 1 |
| Semin 8 | Comparative analysis of project implementation monitoring software. | 1 |
| Semin 9 | Comparative analysis of group communication software. | 1 |
| Semin 10 | Comparative analysis of risk management software. | 1 |
| Semin 11 | Comparative analysis of data archiving software. | 1 |
| Semin 12 | Comparative analysis of software integrated in a computing cloud. | 1 |
| Semin 13 | Meyers-Briggs Personality Tests. | 1 |
| Semin 14 | The Big Five Personality Tests. | 1 |
| Semin 15 | DISC Personality Tests. | 1 |
| | Total hours | 15 |

## TEACHING TOOLS USED

N1. Lecture (delivered with slides)
N2. Laboratory (utilizing supporting software tools)
N3. Seminar (comparative analysis of various supporting software tools)
N4. Consultations
N5. Student's own work

## EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

| **Evaluation** (F – forming during semester), P – concluding (at semester end) | Learning outcomes code | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEK_U01 ÷ PEK_U02 | Assessment for reports on exercises performed on particular topics during the laboratories |
| F2 | PEK_U01 ÷ PEK_U02, PEK_K03 | Grade for preparing and conducting classes on the leading topic in a given laboratory. |
| F3 | PEK_K01 ÷ PEK_K02 | Assessment of the presentation of the assigned topic delivered during the seminar |
| F4 | PEK_K01 ÷ PEK_K02 | Assessment of activity in discussing the topics presented during the seminar |
| F5 | PEK_W01 ÷ PEK_W02 | Final test |
| P (lect) = F5 | | |
| P (lab) = W1 × F1 + W2 × F2, weights W1, W2 will be given at the beginning of the semester | | |
| P (sem) = W3 × F3 + W4 × F4, weights W3, W4 will be given at the beginning of the semester | | |

## PRIMARY AND SECONDARY LITERATURE

**PRIMARY LITERATURE:**


[1] Project Management Institute. A Guide to the Project Management Body of Knowledge (PMBOK Guide) – 6th Edition 2017
[2] SWEBOK - Guide to the Software Engineering Body of Knowledge v.3.0 IEEE 2014.
[3] Kathy Schwalbe: Information Technology Project Management, 9th Edition. Cengage Learning 2018


**SECONDARY LITERATURE:**


[1] Capterra: https://www.capterra.com/
[2] Software Advice: https://www.softwareadvice.com/
[3] GetApp: https://www.getapp.com/
[4] G2: https://www.g2.com/

| SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS) |
| --- |
| Dr hab. inż. Bogdan Trawiński, prof. ucz., bogdan.trawinski@pwr.edu.pl |

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish Metody systemowe i decyzyjne**
**Name of subject in English Systems analysis and decision support methods.**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: academic / ~~practical*~~**
**Level and form of studies: 1st/ ~~2nd level, uniform magister studies~~*, full-time / ~~part-time studies*~~**
**Kind of subject: obligatory / ~~optional / university-wide*~~**
**Subject code INZ002024**
**Group of courses YES / ~~NO~~***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | 15 | 15 | | |
| Number of hours of total student workload (CNPS) | 140 | | 50 | | |
| Form of crediting | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark (X) final course | X | | | | |
| Number of ECTS points | 5 | | 2 | | |
| including number of ECTS points for practical (P) classes | 2 | | 2 | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 3 | | 1,2 | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knows basics of mathematical analysis and linear algebra.
2. Basic programming skills (variables, functions, loops, conditional statements).

**SUBJECT OBJECTIVES**

C1 Knowledge about methods of modelling static and dynamic systems.
C2 Acquisition of skills necessary to develop computer models of technical and non-technical processes.
C3 Learning how to formulate typical decision making problems and how to solve them.
C4 Learning how to use computer engineering software to develop decision making support systems and solve optimization tasks.

**SUBJECT EDUCATIONAL EFFECTS**

related to knowledge:
PEK_W01 Knows basic ideas, problems and methods of systems modelling and identification.
PEK_W02 Knows typical decision making tasks and knows methods of solving optimization problems.

related to skills:

PEK_U01 Knows how to formulate decision making problems.
PEK_U02 Knows how to use MATLAB and SIMULINK for engineering computations, in particular for systems modelling and identification.
PEK_U03 Knows how to use computer engineering software to solve optimization tasks and to develop decision making support systems.

related to social competences:
PEK_K01 Knows how to make documentation of their own work, that is readable for other people.

**PROGRAM CONTENT**

| | **Lectures** | **Number of hours** |
|---|---|---|
| Lec 1 | Model in systems research. Introduction – basic concept. | 1 |
| Lec 2 | Typical plant models – relations between descriptions. | 1 |
| Lec 3 | Elementary linear elements. | 1 |
| Lec 4 | Model building task based on experiment – identification problem. | 1 |
| Lec 5 | Identification of static plant. Deterministic problem – determination of the plant parameters. | 2 |
| Lec 6 | Noised measurements of the physical variables. | 1 |
| Lec 7 | Estimation of plant parameters with noisy measurements. | 1 |
| Lec 8 | Choice of the best model – probabilistic case. Regression functions. | 1 |
| Lec 9 | Determination of the regression functions based on the experimental data. | 1 |
| Lec 10 | Machine learning algorithm in decision support. | 2 |
| Lec 11 | Model based decision making (acceptable, satisfactory and optimal decisions). | 1 |
| Lec 12 | Analytical methods of unconstrained optimization for multivariable functions. | 1 |
| Lec 13 | Analytical methods of constrained optimization for multivariable functions. | 2 |
| Lec 14 | Numerical optimization methods – basic concepts. Numerical optimization methods for single variable function. | 1 |
| Lec 15 | Non gradient optimization methods for multivariable function wit out constraints. | 2 |
| Lec 16 | Gradient based optimization methods for multivariable function wit out constraints. | 1 |
| Lec 17 | Numerical optimization method for multivariable function with constraints. Random search. | 2 |
| Lec 18 | Linear programming. | 2 |
| Lec 19 | Discrete optimization – the branch and bound algorithm. | 1 |
| Lec 20 | Decision making in uncertain conditions. | 1 |
| Lec 21 | Game theory in decision making. | 2 |
| Lec 22 | Multi-criteria optimization. | 1 |
| Lec 23 | Multi-stage decision making, dynamical programming. | 1 |
| | Total hours | **30** |

| Classes | | Number of hours |
|---|---|---|
| Cl 1 | Examples of dynamical processes and their models. | 1 |
| Cl 2 | Discrete processes examples and their models. | 1 |
| Cl 3 | Identification algorithm for static plant – deterministic case. | 1 |
| Cl 4 | Identification algorithm for static plant – probabilistic case. | 1 |
| Cl 5 | Machine learning algorithms | 2 |
| Cl 6 | Optimization problems formulations. Decision variables, performance index, constraints. | 2 |
| Cl 7 | Foundations of optimization. Convex sets and functions, quadratic form, gradient, the Hess matrix. | 1 |
| Cl 8 | Analytical methods for unconstrained and constrained optimization. Equality constraints and the Lagrange function. | 2 |
| Cl 9 | Analytical methods for unconstrained and constrained optimization. Inequality constraints and Kuhn-Tucker conditions. | 2 |
| Cl 10 | Linear programming. | 1 |
| Cl 11 | Integer programming. | 1 |
| | Total hours | 15 |
| **Laboratory** | | **Number of hours** |
| Lab 1 | Instructions for OSH. Introduction for MATLAB. Basic commands, working with command window. | 1 |
| Lab 2 | Advanced functions in MATLAB for data processing. | 1 |
| Lab 3 | Dynamical processes modeling in Simulink. Simulation studies. | 2 |
| Lab 4 | Identification algorithm for selected plant. Test. | 2 |
| Lab 5 | Optimization method for one variable function. Implementation and graphical presentation of selected methods. | 2 |
| Lab 6 | Optimization method for multi variable function. Implementation and graphical presentation of selected methods. Report. | 3 |
| Lab 7 | Application of Matlab's toolbox for advanced problems of modeling and optimization. | 2 |
| Lab 8 | Elaboration of student's own project in Matlab environment. Report. | 2 |
| | Total hours | 15 |

**TEACHING TOOLS USED**

N1. Traditional lecture. Multimedia presentations.
N2. Student's own works – solving calculation tasks.
N3. Collective works – consultations with teacher.
N4. Student's own works – literature studies.
N5. Student's own works – computer programming.
N5. Student's own works – simulation studies.
N7. Student's own works – results presentation.

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), C – | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|

| | | |
|---|---|---|
| concluding (at semester end) | | |
| F1 | PEK_U02 | Observation of student's activity. Conversation with student about current laboratory exercises. Programming test. |
| F2 | PEKU03<br>PEK_K01 | Observation of student's activity. Conversation with student about current laboratory exercises. Report evaluation. |
| F3 | PEK_W01<br>PEK_W02<br>PEK_U01 | Observation of student's activity. Solving exercises. Test. |
| C1 (Lec) | PEK_W01<br>PEK_W02<br>PEK_U01 | On the basis of F3 and exam. |
| C2 (La) | PEK_U02<br>PEK_U03 | On the basis of F1, F2. |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

[1] Bubnicki Z., *Identification of control plants*, PWN, Warszawa, 1980.
[2] Bubnicki Z. *Modern Control Theory*, Springer, Berlin-Heidelberg-New York, 2005
[3] Ikonen E., Najim K*., Advanced identification and control*, CRC Press LLC, 2002

**SECONDARY LITERATURE:**

[1] Bazaraa M. S., Sherali H.D., Shett C. M., *Nonlinear Programming Theory and Algorithms*, John Wiley and Sons, Inc., 2006
[2] Bishop C.M., *Pattern Recognition and Machine Learning*, Springer Science +Business Media, LLC
[3] Duda R.O., Hart P.E., Storok D.G., Pattern Classification, John Wiley and Sons, Inc., 2006.
[4] Chong E.K.P., Żak S.H., *An Introduction to Optimization*, Wiley-Interscience, 2008.
[5] Ogata K., *Modern Control Engineering*, Prentice Hall, 2009.

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

prof. dr hab. inż. Jerzy Świątek, jerzy.swiatek@pwr.edu.pl

Zał. nr 5 do ZW 16/2020

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish** Zespołowe Przedsięwzięcie Inżynierskie
**Name of subject in English** Team Project
**Main field of study (if applicable):** Applied Computer Science
**Specialization (if applicable): ……..**
**Profile: academic***
**Level and form of studies: 1st level, full-time**
**Kind of subject: obligatory**
**Subject code INZ002017**
**Group of courses YES***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | | | | 120 | 15 |
| Number of hours of total student workload (CNPS) | | | | | |
| Form of crediting | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* | Examination / crediting with grade* |
| For group of courses mark final course with (X) | | | | X | |
| Number of ECTS points | | | | 20 | |
| including number of ECTS points for practical (P) classes | | | | 19 | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | | | | 12 | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge of the basic stages of implementation of an IT project, techniques used to prioritize and task assessment.
2. Ability to program, test, create technical documentation.

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**SUBJECT OBJECTIVES**

C1 To enable students to gain professional experience in "near-natural" conditions.
C2. Implementation of a small or medium scale engineering project in a team, using modern approaches, practices and tools.

**SUBJECT EDUCATIONAL EFFECTS**

relating to skills:
PEU_U01 Student plans iteration tasks, estimates their execution time, presents the way they are implemented.
PEU_U02 Student works individually and in a team; communicates with team members using modern means and tools.
PEU_U03 Student solves the encountered (complex) engineering problems using various sources of information.

PEU_U04 Student presents a solution from various perspectives (business, technical). He takes part in the discussion.

relating to social competences:
PEU_K01 Student improves technical skills and shares his knowledge with colleagues.
PEU_K02 Student cooperates in the group taking on different roles.

| | **Project** | **Number of hours** |
|---|---|---|
| Proj 1 | Vision. Definition of requirements. Task planning as part of the first iteration. | 8 |
| Proj 2 | Implementation of tasks according to the plan. Preparation of technical documentation. Summary of iteration and planning of the next one.[1] | 112 |
| | Total hours | 120 |

| | **Seminar** | **Number of hours** |
|---|---|---|
| Sem 1 | Organizational classes. Preparation of speeches schedule. | 1 |
| Sem 2 | Presentation of the product vision, expected business benefits, addressed problems, competitive products - according to the schedule. | 7 |
| Sem 3 | Presentation of the program product (in its current form), its basic functionalities, used technologies and approaches to solve problems - according to the schedule. | 7 |
| | Total hours | **15** |

**TEACHING TOOLS USED**

N1. Software for modeling, implementation, software testing, code sharing (possibly others), preparation of multimedia presentations.
N2. A system supporting team, work among others in the area of planning tasks and reporting work progress.

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| $F_i$ – phase grade (option) | PEK_U01, …, PEK_U03 PEK_K01,PEK_K02 | The lecturer may decide on the phase evaluation after each (selected) phases of the project implementation. The grade should reflect the scope of implementation, its quality, and being in time. |
| FP - final evaluation of the project | PEK_U01, … PEK_U03 PEK_K01, PEK_K02 | The grade is determined on the basis of the scope, completeness (relative to plans) of implementation, quality of the solution and documentation (at least user / |

[1] The number of iterations depends on the type of project and is determined by the course provider. Activities: summary of iterations and subsequent planning take place at the end and the beginning of each iteration. Some iterations may end with the release of the product. The number of releases and their scope is determined by the teacher together with the team.

| | | |
|---|---|---|
| | | administrator documentation required), timeliness of tasks implementation, if phase evaluations were not used or based on phase estimates (average of phase ratings) |
| FS - final grade from the seminar | PEK_U04, PEK_K01 | The grade is based on:<br>a) Preparations of the presentation: preservation of time limits, readability, substantive value of the presentation, purity of the language used, attempt to involve the participants<br>b) Participation in the discussion of the presented solutions |
| P – final grade | PEK_U01… PEK_U04, PEK_K01, PEK_K02 | Grade calculated on the formula:<br>P = 0.8 * FP + 0.2 * FS |

| **PRIMARY AND SECONDARY LITERATURE** |
|---|
| **PRIMARY LITERATURE:**<br>[1] K. Schwaber, Agile Project Management with Scrum, Microsoft Press, 2004<br>[2] A. Cocburn, Agile Software Development: The Cooperative Game, Addison Wesley, 2006<br><br>**SECONDARY LITERATURE:**<br>[1] Literature about the technology used by a team. |
| **SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)** |
| **Dr inż. Bogumiła Hnatkowska,** Bogumila.Hnatkowska@pwr.wroc.pl |

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name of subject in Polish: Rachunek prawdopodobieństwa i statystyka**
**Name of subject in English: Theory of probabilistic and statistics**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable): ……..**
**Profile: academic / practical***
**Level and form of studies: 1st/ ~~2nd~~ level, ~~uniform magister studies~~*, full-time / ~~part-time~~ studies***
**Kind of subject: obligatory / ~~optional~~ / ~~university-wide~~***
**Subject code: INZ004410**
**Group of courses YES / ~~NO~~***

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | 30 | | | |
| Number of hours of total student workload (CNPS) | 200 | | | | |
| Form of crediting | Examination / ~~crediting with grade~~* | ~~Examination~~ / crediting with grade* | | | |
| For group of courses mark final course with (X) | X | | | | |
| Number of ECTS points | 7 | | | | |
| including number of ECTS points for practical (P) classes | | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 4,2 | | | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Passed the subject: Algebra and Analytic Geometry. Knowledge of the subject.
2. Passed the subject: Mathematical analysis. Knowledge of the subject.
3. Passed the subject: Discrete Mathematics. Knowledge of the subject.

**SUBJECT OBJECTIVES**

C1 Acquisition of basic knowledge of probability and increased knowledge of selected aspects of the theory of probability.
C2 Acquisition of basic knowledge of the reliability of systems.
C3 Acquisition of basic knowledge of mathematical statistics.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEU_W01 - has knowledge of the nature and properties of probability and probability space, and has knowledge of calculating probability and conditional probability events.
PEU_W02 - know the total probability theorem events and Bayesian model and also has knowledge of the reliability of circuits.

PEU_W03 - has knowledge of random variables, the distribution of the probability distribution function of a random variable, has a knowledge of the basic parameters of random variable and their interpretations.
PEU_W04 - knows limit theorems and their interpretation, and knows the probability inequalities, and knows how to pre-analyze the data for the analysis of probabilistic.

PEU_W05 - knows the point estimate and the maximum likelihood estimators.
PEU_W06 - has knowledge of confidence intervals for the mean and variance of the normal distribution and the ratio, it also has the knowledge of statistical hypothesis testing, tests for the mean and variance for a normal distribution and proportion.
PEU_W07 - known compatibility tests and independence tests, chi-square test, gained knowledgeof analysis of variance and one-dimensional linear regression.

relating to skills:
PEU_U01 - can calculate the overlap of events, conditional probability and the probability of overlap completely overlapping events.
PEU_U02 - can calculate the reliability of connections.
PEU_U03 - is able to calculate the distribution and the cumulative distribution of a random variable, and the basic parameters of random variables.
PEU_U04 - can use estimation and processes greatest reliability estimates, test hypotheses about the mean and variance of the normal distribution, as well as be a one-dimensional linear regression.

relating to social competences:
PEU_K01 - understands the importance of the theory of probability and statistics in the processes of social and economics.
PEU_K02 - understands the importance of the theory of probability and statistics in the technology.

**PROGRAMME CONTENT**

| | **Lectures** | **Number of hours** |
|---|---|---|
| Lec 1 | The essence of a random experience. The definition and the properties of probability. Calculation of the probability of the event. The definition of the probability space. | 2 |
| Lec 2 | Conditional probability. Definition and examples. | 2 |
| Lec 3 | Bayesian formula. Total probability theorem events. | 2 |
| Lec 4 | Independence of events. Reliability of connections. | 2 |
| Lec 5 | Random variable. Probability distribution. The distribution of the random variable. Formal definitions and examples. | 2 |
| Lec 6 | Basic parameters of random variable. Interpretation of parameters. | 2 |
| Lec 7 | Limit theorems and their interpretation. Important inequalities of probability. | 2 |
| Lec 8 | Preliminary analysis of the data. | 2 |
| Lec 9 | The point estimate. | 2 |
| Lec 10 | Maximum likelihood estimators. | 2 |

| | | |
|---|---|---|
| Lec 11 | Confidence intervals for the mean and variance of the normal distribution and the aspect ratio. | 2 |
| Lec 12 | Testing statistical hypotheses. Tests for the mean and variance for a normal distribution and proportion. | 2 |
| Lec 13 | Compliance tests and independence tests. Chi-square test. | 2 |
| Lec 14 | Analysis of variance. Simple linear regression. | 2 |
| Lec 15 | Repertory. | 2 |
| | Total hours | **30** |

| **Classes** | | **Number of hours** |
|---|---|---|
| Cl 1 | Determination and calculation of the probability of events - accounting exercises. | 2 |
| Cl 2 | Conditional probability - examples and tutorials. | 2 |
| Cl 3 | Independence of events - examples, tutorials. Reliability of connections - accounting exercises. | 2 |
| Cl 4 | Random variable. Probability distribution. The distribution of the random variable. Analysis of the properties of the distributions of random variables. Examples of phenomena of the distribution. | 2 |
| Cl 5 | Basic parameters of the random variable and their interpretation - tutorials. | 2 |
| Cl 6 | Important inequalities in probability theory, limit theorems and their interpretation - tutorials. | 2 |
| Cl 7 | Preliminary analysis of the data. Examples of data analysis problems. Types of analytical variables. Examples and tutorials. | 2 |
| Cl 8 | Point estimation - tutorials. | 2 |
| Cl 9 | Maximum likelihood estimators - tutorials. | 2 |
| Cl 10 | Confidence intervals for the mean and variance of the normal distribution and the aspect ratio. Classes. | 2 |
| Cl 11 | Statistical hypothesis testing - examples. Tests for the mean and variance of the normal distribution and the ratio - examples and tutorials. | 2 |
| Cl 12 | Compliance tests and chi-square independence - tutorials. | 2 |
| Cl 13 | Analysis of variance. Simple linear regression. Examples and tutorials. | 2 |
| Cl 14 | Simple linear regression. | 2 |
| Cl 15 | Final test. | 2 |
| | Total hours | **30** |

**TEACHING TOOLS USED**

N1. Traditional lecture. Slideshows.
N2. Tutorials and discussion of solutions of the foundations of probability theory and the reliability of systems. Discussing and presenting solutions lists. Final test of the exercise.
N3. Counseling for students.
N4. Self-study students - solving task lists.
N5. Own work - self-study problems of lecture and exam preparation.

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 | PEU_U01-PEU_U04 | Examples and tutorials. Solving lists. Analysis of system reliability problems. |
| F2 | | |
| F3 | | |
| C | PEU_W01-PEU_W_07, PEU_K01-PEU_K02 | Examination. |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**


[1] J. Bartos, W. Dyczka, W. Krysicki, *Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach*, PWN, Warszawa 2008.
[2] J. Jakubowski, R. Sztencel, *Rachunek prawdopodobieństwa dla prawie każdego,* Script, Warszawa, 2009.
[3] A. Plucińska, E. Pluciński, *Rachunek prawdopodobieństwa*, WNT, Warszawa 1999.
[4] R. Zieliński, *Tablice statystyczne*, WNT, Warszawa 2006.
[5] J. Koronacki, J. Mielniczuk, *Statystyka dla studentów kierunków technicznych i przyrodniczych*, WNT, Warszawa 2001.
[6] L. Gajek, M. Kaluszka, *Wnioskowanie statystyczne. Modele i metody*, Wydawnictwa Naukowo-Techniczne, Warszawa 1984.
[7] D. Bobrowski, *Probabilistyka w zastosowaniach technicznych*, WNT, Warszawa 1986.
[8] D. Bobrowski, *Modele i metody matematyczne teorii niezawodności w przykładach i zadaniach*, WNT, Warszawa 1985.
[9] M. Fisz, *Probability theory and mathematical statistics, 3 edition*, Krieger Pub Co, June 1980.
[10] A. Stanisz, *Przystępny kurs satystyki z zastosowaniem STATISTICA PL na przykładach z medycyny*. Tom 1, 2, 3. Wydawnictwo StatSoft Polska, Kraków 2007.
[11] A. Luszkiewicz, T. Słaby, *Statystyka z pakietem komputerowym STATISTICA PL. Teoria i zastosowania.* Wydawnictwo C.H. Beck, Warszawa 2001.
[12] H. Kobayashi, B.L. Mark, W. Turin, *Probability, Random Processes and Statistical Analysis.* Cambridge University Press, Cambridge (UK) 2012.


**SECONDARY LITERATURE:**


[1] W. Feller, *Wstęp do rachunku prawdopodobieństwa*, tom I.II, PWN, Warszawa 2009.
[2] G. Grimmet, D. Stirzaker, *One thousand exercises In probability*, Oxford University Press, 2004.
[3] H. Jasiulewicz, W. Kordecki, *Rachunek prawdopodobieństwa i statystyka matematyczna. Definicje, twierdzenia, wzory*, GiS, Wrocław 2001.
[4] H. Jasiulewicz, W. Kordecki, *Rachunek prawdopodobieństwa i statystyka matematyczna. Przykłady i zadania*, GiS, Wrocław 2001.
[5] M. Maliński, *Weryfikacja hipotez statystycznych wspomagana komputerowo*, Wyd. Politechniki Śląskiej, Gliwice 2004.

[6] O. Hryniewicz, *Wykłady ze statystyki.* Skrypt Wyższej Szk. Informatyki Stosow. i Zarz. Warszawa 2001.
[7] A. Zelaś, B. Pawełek, S. Wanat, *Metody statystyczne. Zadania i sprawdziany.* PWE Warszawa 2002.
[8] J. Jakubowski, R. Sztencel, *Wstęp do teorii prawdopodobieństwa.* Wydawnictwo SCRIPT, Warszawa 2010.

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

Prof. PWr. dr hab. inż Ireneusz Jóźwiak, ireneusz.jozwiak@pwr.edu.pl

FACULTY of Computer Science and Management

**SUBJECT CARD**

**Name in Polish:** **Programowanie systemów webowych**
**Name in English:** **Web Systems Programming**
**Main field of study (if applicable): Applied Computer Science**
**Specialization (if applicable):**
**Profile: practical**
**Level and form of studies:** **1st, full-time**
**Kind of subject:** **optional**
**Subject code** **INZ004420**
**Group of courses:** **YES**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 15 | | 30 | | |
| Number of hours of total student workload (CNPS) | 120 | | | | |
| Form of crediting | Crediting with grade | | Crediting with points | | |
| For group of courses mark (X) final course | X | | | | |
| Number of ECTS points | 4 | | | | |
| including number of ECTS points for practical (P) classes | 2 | | | | |
| including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU) | 2,4 | | | | |

*delete as applicable

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Basic knowledge of structured and object-oriented programming
2. Basic database skills

**SUBJECT OBJECTIVES**

C1 Acquisition of knowledge and skills in developing systems that are based on client-server communication and use of HTTP.

**SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:
PEU_W01 Understands HTTP communication
PEU_W02 Selects the appropriate technology for programming Web-based systems' components

relating to skills:
PEU_U01 Adapts, arranges and rearranges working systems or their components in accordance with the submitted requirements
PEU_U02 Constructs simple web-based systems in accordance with the submitted requirements

relating to social competences:
PEU_K01 Presents the results of his or her work

**PROGRAMME CONTENT**

| Form of classes – lecture | | Number of hours |
|---|---|---|
| Lec1 | Internet and Web - Introduction | 2 |
| Lec2 | Introduction to HTML5 | 2 |
| Lec3 | Introduction to CSS3 | 2 |
| Lec4 | Selected elements of JavaScript, Document Object Model and event handling | 2 |
| Lec5 | Working with WWW and database server | 2 |
| Lec6 | Overview of backend programming languages, frontend frameworks and usage of AJAX | 2 |
| Lec7 | Session mechanisms, usage of database | 2 |
| Lec8 | Final test | 1 |
| | Total hours | **15** |
| **Form of classes - laboratory** | | **Number of hours** |
| Lab 1 | Introductory classes: presentation of health and safety regulations, fire protection rules as well as grading and class policies. | 2 |
| Lab 2 | HTML5 programming basics - part 1 | 2 |
| Lab 3 | HTML5 programming basics - part 2 | 2 |
| Lab 4 | CSS3 programming basics - part 1 | 2 |
| Lab 5 | CSS3 programming basics - part 2 | 2 |
| Lab 6 | JavaScript programming | 2 |
| Lab 7 | DOM and event handling | 2 |
| Lab 8 | Web Server and SQL | 2 |
| Lab 9 | Basics of backend programming | 2 |
| Lab 10 | Usage of javascript libraries | 2 |
| Lab 11 | Usage of session mechanisms | 2 |
| Lab 12 | Usage of database | 2 |
| Lab 13 | Programming service with login ability | 2 |
| Lab 14 | Usage of AJAX | 2 |

| | | |
|---|---|---|
| Lab 15 | Credit | 2 |
| | Total number of hours | **30** |

**TEACHING TOOLS USED**

N1. Lectures illustrated with the multimedia boards
N2. Laboratory exercises with use of appropriate programming environments
N3. The e-learning system for publishing course materials and receiving students' work
N4. **Student's i**ndividual work based on the lists of tasks
N5. **Student's** individual work – final test preparation
N6. **Final test conducted by the e-learning system**

**EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Educational effect number | Way of evaluating educational effect achievement |
|---|---|---|
| F1 – F8 | PEU_W02<br>PEU_U01<br>PEU_K01 | Scoring on a scale (0-10). |
| F9 – F14 | PEU_W01<br>PEU_W02<br>PEU_U01<br>PEU_U02<br>PEU_K01 | Scoring on a scale (0-10). |
| P Lec | PEU_W01<br>PEU_W02 | Crediting: over 50% points for correct answers in the final test.<br>Points from the laboratory and points from the lecture are weighed so that their impact on the final grade is equal and then they are added together.<br>Positive grade determined by proportional ranges from 50% to 100% of total points. |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

[1] Paul Deitel, Harvey Deitel, Abbey Deitel: Internet & World Wide Web: How to Program, Fifth Edition, Prentice Hall, 2011

**SECONDARY LITERATURE:**

[1] HTML & CSS Design and Build Websites by Jon Duckett, Wiley 2011
[2] David Flanagan, JavaScript: The Definitive Guide. Activate Your Web Pages. 6th Edition, 1996
[3] Introduction to Client/Server Systems: A Practical Guide for Systems Professionals, Paul E. Renaud, 1993

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

**Aleksander Mariański, aleksander.marianski@pwr.edu.pl**

FACULTY OF COMPUTER SCIENCE AND MANAGEMENT

SUBJECT CARD

| | |
|---|---|
| Name in English | **ALGEBRA AND ANALYTIC GEOMETRY** |
| Name in Polish | **ALGEBRA Z GEOMETRIĄ ANALITYCZNĄ** |
| Main field of study (if applicable) | ***Computer Science*** |
| Level and form of studies | **I level, full time** |
| Kind of subject | **obligatory** |
| Subject code | **MAT001688** |
| Group of courses | **YES** |

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | 30 | | | |
| Number of hours of total student workload (CNPS) | | | | | |
| Form of crediting | exam | crediting with grade | | | |
| For group of courses mark (X) final course | X | | | | |
| Number of ECTS points | | | | | |
| including number of ECTS points for practical (P) classes | | | | | |
| including number of ECTS points for direct teacher-student contact (BK) classes | | | | | |

## PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

It is recommended that the knowledge of mathematics is equivalent to high school certificate at the basic level.

## SUBJECT OBJECTIVES

C1 Presentation of basic theorems and algorithms concerning the theory of linear equations.
C2 Presentation of basic notions concerning matrix calculus, eigenvalues and eigenvectors of matrices.
C3 Exposition of rudiments of the theory of complex numbers, polynomial and rational functions.
C4 Exposition of rudiments of analytic geometry in $R^3$.
C5 Expalining the basic notions of theory of vector spaces.

## SUBJECT EDUCATIONAL EFFECTS

**Relating to knowledge a student**

PEK_W1 knows basic methods of solving systems of linear equations,
PEK_W2 knows basic properties of complex numbers,
PEK_W3 knows basic algebraic properties of polynomials,
PEK_W4 knows characterizations of lines and planes in $R^3$.
PEK_W5 knows basic notions of theory of vector spaces.

| **Relating to skills a student:** |
|---|
| PEK_U1 can add and multiply matrices and calculate determinants, |
| PEK_U2 can solve systems of linear equations, |
| PEK_U3 can find eigenvalues and eigenvectors of a matrix, |
| PEK_U4 can carry out calculations with use of complex numbers, |
| PEK_U5 can find line and plane equations in the space $R^3$. |

| **PROGRAM CONTENT** | | |
|---|---|---|
| | **Form of classes - lectures** | **Hours** |
| Lec1 | Mathematical induction. Newton's binomial formula. | 1 |
| Lec2 | The notion of a matrix. Operations on matrices. Transposition. Examples of matrices (triangular, symmetric, diagonal etc.). | 2 |
| Lec3 | The determinant of a matrix. The Laplace expansion. Cofactor of an element of a matrix. Minors. Properties of determinants. Calculation of determinants by elementary row and column operations. Cauchy's theorem. Nonsingular matrix. | 3 |
| Lec4 | Inverse matrix. Computation of inverse matrix by cofactors or by elementary row operations. Properties of inverse matrices. Matrix equations. Rank of a matrix. Applications of determinants, their connections with rank and invertibility. | 2 |
| Lec5 | Systems of linear equations. Rouché–Capelli theorem. Cramer's formulas. Gaussian elimination. Solving arbitrary systems of linear equations. | 3 |
| Lec6 | Complex numbers. Operations on complex numbers in algebraic form. Complex conjugate. Modulus. Argument. | 2 |
| Lec7 | Geometric interpretation of a complex number. Polar form of a complex number. De Moivre's formula. Roots of complex numbers. | 2 |
| Lec8 | Polynomials. Polynomial remainder theorem. Fundamental theorem of algebra. Roots of polynomials with real coefficients. | 2 |
| Lec9 | Linear and quadratic factors of a real polynomial. Decomposition of a polynomial into factors. Rational functions. Real partial fractions with irreducible denominators. Partial fraction decomposition of a real rational function. | 2 |
| Lec10 | Eigenvalues and eigenvectors of a matrix. | 2 |
| Lec11 | Analytic geometry in the space $R^3$. Operations on vectors. Length of a vector. Scalar product, cross product and triple product of vectors - computing area and volume. | 2 |
| Lec12 | Planes. Normal to a plane. Equations of a plane. Relative location of planes. | 1 |
| Lec13 | Line in the space. Equations of a line (parametric, directional). Line as an intersection of planes. Relative location of two lines. Relative location of a line and a plane. Orthogonal projection of a point onto a line or a plane. | 3 |
| Lec14 | Vector spaces (finite dimensional). Linear combination of vectors. Linear independence. Basis and dimension of a vector space. | 3 |
| | **Total hours** | **30** |

| **Form of classes – classes** | | **Hours** |
|---|---|---|
| Cl1 | Transformation of algebraic expressions. Newton's binomial formula. | 1 |
| Cl2 | Operations on matrices. | 1 |
| Cl3 | Calculation of matrix determinants with use of their properties. Laplace expansion. Computation of an inverse matrix. Solving matrix equations. Evaluation of the rank of a matrix. | 4 |

| | | |
|---|---|---|
| Cl4 | Kronecker-Capelli theorem. Cramer's formulas. Gaussian elimination. Solving of arbitrary systems of linear equations. | 4 |
| Cl5 | Operations on complex numbers in algebraic form. Polar form. Geometric interpretation. Powers and roots of complex numbers. Solving simple equations and inequalities. | 6 |
| Cl6 | Finding roots of polynomials. Decomposition of a polynomial into irreducible components. Partial fraction decomposition of a real rational function. | 4 |
| Cl7 | Eigenvalues and eigenvectors of a matrix. | 2 |
| Cl8 | Vector operations. Scalar, cross or triple product of vectors and their applications to calculating area and volume. | 2 |
| Cl9 | Solving problems in analytic geometry in $R^3$ – finding equations of lines and planes, finding projections of vectors etc. | 4 |
| Cl10 | Test. | 2 |
| | **Total hours** | **30** |

| **TEACHING TOOLS USED** |
|---|
| N1 Lectures – traditional or using multimedia tools. |
| N2 Classes – traditional method (problems sessions and discussion). |
| N3 Student's self-study with the assistance of mathematical packages. |
| N4 Tutorial. |

**EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT**

| Evaluation (F-forming; P - concluding) | Educational effect number | Way of evaluating educational effect achievement |
|---|---|---|
| F – Cl | PEK_U1 - PEK_U5 | oral presentations, quizzes, tests |
| F – Lec | PEK_W1 - PEK_W5 | exam |
| P - rules set by the lecturer | | |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE**


[1] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2015.

[2] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2014.

[3] P. Kajetanowicz, J. Wierzejewski, Algebra z geometrią analityczną, PWN 2008.

[4] M. Zakrzewski, Markowe wykłady z matematyki, Algebra z geometrią, Oficyna Wyd. GiS, Wrocław 2015.


**SECONDARY LITERATURE**


[1] B. Gleichgewicht, Algebra, Oficyna Wydawnicza GiS, Wrocław 2004.

[2] A. Mostowski, M. Stark, Elementy algebry wyższej, PWN, Warszawa 1963.

[3] W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, Cz. A, PWN, Warszawa 2003.

[4] F. Leja, Geometria analityczna, PWN, Warszawa 1972.

[5] E. Kącki, D. Sadowska, L. Siewierski, Geometria analityczna w zadaniach, PWN, Warszawa 1993.

| **SUBJECT SUPERVISORS** |
| --- |
| Wydziałowa Komisja Programowa ds. kursów ogólnouczelnianych<br>dr Karina Olszak (Karina.Olszak@pwr.edu.pl) |

CORRELATION MATRIX BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

## ALGEBRA AND ANALYTIC GEOMETRY MAT001688

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY ***Computer science***

| Subject educational effect | Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable) | Subject objectives | Programme content | Teaching tool number |
| --- | --- | --- | --- | --- |
| PEK_W1 | K1INF_W01 | C1, C2 | Lec5, Cl4 | N1-N4 |
| PEK_W2 | K1INF_W01 | C3 | Lec6-Lec9, Cl5, Cl6 | N1-N4 |
| PEK_W3 | K1INF_W01 | C3 | Lec8, Lec9, Cl6 | N1-N4 |
| PEK_W4 | K1INF_W01 | C4 | Lec11-Lec13, Cl8, Cl9 | N1-N4 |
| PEK_W5 | K1INF_W01 | C5 | Lec14 | N1, N3, N4 |
| PEK_U1 | K1INF_W01 | C2 | Lec2-Lec4, Lec10, Cl2, Cl3 | N1-N4 |
| PEK_U2 | K1INF_W01 | C1, C2 | Lec5, Cl4 | N1-N4 |
| PEK_U3 | K1INF_W01 | C2 | Lec10, Cl7 | N1-N4 |
| PEK_U4 | K1INF_W01 | C3 | Lec6-Lec9, Cl5, Cl6 | N1-N4 |
| PEK_U5 | K1INF_W01 | C4 | Lec11-Lec13, Cl8, Cl9 | N1-N4 |

| | |
|---|---|
| FACULTY OF COMPUTER SCIENCE AND MANAGEMENT | |
| SUBJECT CARD | |
| Name in English | **MATHEMATICAL ANALYSIS I** |
| Name in Polish | **ANALIZA MATEMATYCZNA I** |
| Main field of study (if applicable) | ***Computer Science*** |
| Specialization (if applicable) | |
| Level and form of studies | **I level, full time** |
| Kind of subject | **obligatory** |
| Subject code | **MAT001689** |
| Group of courses | **YES** |

| | Lecture | Exercise class | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized University classes (ZZU) | 30 | 30 | | | |
| Number of hours of total student workload (CNPS) | | | | | |
| Form of crediting | exam | crediting with grade | | | |
| For a group of courses mark the final course (X) | X | | | | |
| Number of ECTS points | 6 | | | | |
| including number of ECTS points for practical (P) classes | | | | | |
| including number of ECTS points for direct teacher-student contact (BK) classes | | | | | |

| **PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES** |
|---|
| Knowledge of mathematics equivalent to high school certificate at the advanced level is recommended. |

| **SUBJECT OBJECTIVES** |
|---|
| C1 Provide training in basic elementary functions and their properties.<br>C2 Provide training in basic differential calculus of one-variable functions.<br>C3 Introduction to the concept of definite integral, its basic properties and methods of calculation.<br>C4 Presentation of practical applications of differential and integral calculus of one-variable functions. |

| **SUBJECT EDUCATIONAL EFFECTS** |
|---|
| **Relating to knowledge a student:**<br>PEK_W1 knows graphs and properties of basic elementary functions,<br>PEK_W2 knows basic notions and theorems of differential calculus for one-variable functions,<br>PEK_W3 knows the concept of definite integral, its properties and basic applications.<br><br>**Relating to skills a student:**<br>PEK_U1 can solve typical equations and inequalities with elementary functions, |

| |
|---|
| PEK_U2 can examine a function and draw its graph,<br>PEK_U3 can evaluate typical indefinite integrals and calculate definite integrals,<br>PEK_U4 can apply differential and integral calculus to solve practical problems. |

| PROGRAMME CONTENT | | |
|---|---|---|
| **Form of classes - lecture** | | **Hours** |
| Lec1 | Definition of a function. Basic examples: linear, quadratic and polynomial functions. Rational functions. Composition of functions. Transformations of graphs of functions. | 3 |
| Lec2 | Injective functions. The inverse function and its graph. Power and exponential functions and their inverses. Properties of logarithms. | 2 |
| Lec3 | Trigonometric functions. Unit (trigonometric) circle. Inverse trigonometric functions. | 2 |
| Lec4 | Sequences of real numbers. Finite and infinite limit of a sequence. Basic theorems on limits of sequences. Indeterminate expressions. The number *e*. | 3 |
| Lec5 | The limit of a function at a point and the limit at infinity. Examples of the limits of certain indeterminate expressions. Asymptotes. | 2 |
| Lec6 | Continuity of a function at a point and on an interval. Basic properties of continuous functions. Approximate solutions of equations. | 2 |
| Lec7 | The derivative of a function. Geometrical and physical interpretations of the derivative. Tangent line. Differential of a function. Derivatives of basic elementary functions. Differentiation rules. | 2 |
| Lec8 | Lagrange's theorem. Intervals of monotonicity of a function. De l'Hospital's rule. | 2 |
| Lec9 | Local and global extrema. Examples of optimization problems. | 2 |
| Lec10 | Definition and basic properties of indefinite integral. Basic rules. The substitution rule and integration by parts. | 2 |
| Lec11 | Definition and basic properties of definite integral. Fundamental theorem of calculus (Newton-Leibniz theorem). | 2 |
| Lec12 | Applications of integral calculus (average value of a function, area of a flat region, volumes of solids of revolution, arc length etc.) | 2 |
| Lec13 | Integration of rational and trigonometric functions. | 2 |
| Lec14 | Examples of applications of mathematical analysis methods for one-variable functions (e.g. Taylor's theorem, convexity and inflection points of a function, or other applications typical for the field of study). | 2 |
| | **Total hours** | **30** |
| **Form of classes – classes** | | **Hours** |
| Cl1 | Elements of mathematical logic (logical connectives, quantifiers). Determination of the function domain. Even and odd functions. | 2 |
| Cl2 | Composition of functions. Transformations of graphs of functions. Polynomial and rational equations and inequalities. | 2 |
| Cl3 | The inverse function. Typical equations and inequalities with exponential and logarithmic functions. | 2 |
| Cl4 | Trigonometric and inverse trigonometric functions. Unit (trigonometric) circle. Typical trigonometric equations and inequalities. | 2 |
| Cl5 | Monotonicity and boundedness of sequences. Computing proper and improper limits of sequences. | 2 |
| Cl6 | Limits of functions. Asymptotes. | 2 |
| Cl7 | Continuity of a function. Approximate solutions of equations. | 2 |
| Cl8 | Derivative of a function. Rules of differentiation. Tangent line. Differentials and their applications. | 2 |
| Cl9 | De l'Hospital's rule. Intervals of monotonicity of a function. | 2 |

| | | |
|---|---|---|
| Cl10 | Determining local and global extrema of a function. | 2 |
| Cl11 | Evaluation of indefinite integrals of elementary functions. Integration by parts and by substitution. | 2 |
| Cl12 | Calculating definite integrals. Area of a flat region as an application of definite integral. | 2 |
| Cl13 | Applications of definite integral. | 2 |
| Cl14 | Integration of rational and trigonometric functions. | 2 |
| Cl15 | Test. | 2 |
| | **Total hours** | **30** |

| **TEACHING TOOLS USED** |
|---|
| N1 Lectures – traditional or using multimedia tools.<br>N2 Classes – traditional method (problems sessions and discussion).<br>N3 Student's self-study with the assistance of mathematical packages.<br>N4 Tutorial. |

**EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT**

| Evaluation (F - forming; P - concluding) | Educational effect number | Way of evaluating educational effect achievement |
|---|---|---|
| F-Cl | PEK_U1-PEK_U4, PEK_K1 | tests, oral presentations, quizzes |
| F-Lec | PEK_W1-PEK_W3 | exam |
| P - rules set by the lecturer | | |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**


[1] G. Decewicz, W. Żakowski, Matematyka, Cz.1, WNT, Warszawa 2007.
[2] M. Gewert, Z. Skoczylas, Analiza matematyczna 1. Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław, 2015.
[3] M. Gewert, Z. Skoczylas, Analiza matematyczna 1. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław, 2015.
[4] W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach, Cz. I, PWN, Warszawa, 2006.


**SECONDARY LITERATURE:**


[1] F. Leja, Rachunek różniczkowy i całkowy, PWN, 2012.
[2] R. Leitner, Zarys matematyki wyższej dla studiów technicznych, cz.1-2, WNT, Warszawa, 2006.
[3] M. Zakrzewski, Markowe wykłady z matematyki. Analiza, Oficyna Wydawnicza GiS, Wrocław, 2013.


| **SUBJECT SUPERVISORS** |
|---|
| Wydziałowa Komisja Programowa ds. kursów ogólnouczelnianych<br>dr Jolanta Sulkowska (Jolanta.Sulkowska@pwr.edu.pl) |

CORRELATION MATRIX BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

**MATHEMATICAL ANALYSIS I MAT1689**

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY ***Computer Science***

| Subject educational effect | Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable) | Subject objectives | Programme content | Teaching tool number |
|---|---|---|---|---|
| PEK_W1 | K1INF_W01 | C1 | Lec1-Lec6 | N1-N4 |
| PEK_W2 | K1INF_W01 | C2 | Lec7-Lec9, Lec14 | N1-N4 |
| PEK_W3 | K1INF_W01 | C3 | Lec10-Lec13 | N1-N4 |
| PEK_U1 | K1INF_W01 | C1 | Lec1-Lec3, Cl1-Cl4 | N1-N4 |
| PEK_U2 | K1INF_W01 | C1 | Lec5-Lec9, Cl5-Cl10 | N1-N4 |
| PEK_U3 | K1INF_W01 | C3 | Lec10, Lec11, Lec13, Cl11, Cl12, Cl14 | N1-N4 |
| PEK_U4 | K1INF_W01 | C2, C4 | Lec7, Lec12, Lec14, Cl8-Cl10, Cl12, Cl13 | N1-N4 |

| FACULTY OF COMPUTER SCIENCE AND MANAGEMENT<br>SUBJECT CARD | |
|---|---|
| Name in English | **MATHEMATICAL ANALYSIS II** |
| Name in Polish | **ANALIZA MATEMATYCZNA II** |
| Main field of study (if applicable) | ***Computer Science*** |
| Specialization (if applicable): | |
| Level and form of studies: | **I level, full time** |
| Kind of subject: | **obligatory** |
| Subject code: | **MAT001690** |
| Group of courses: | **YES** |

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | 15 | | | |
| Number of hours of total student workload (CNPS) | | | | | |
| Form of crediting | exam | crediting with grade | | | |
| For group of courses mark (X) final course | X | | | | |
| Number of ECTS points | 5 | | | | |
| including number of ECTS points for practical (P) classes | | | | | |
| including number of ECTS points for direct teacher-student contact (BK) classes | | | | | |

| **PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES** |
|---|
| Student must have basic knowledge in one-variable differential and integral calculus, confirmed by completing the *Mathematical Analysis I* course with a positive grade. |

| **SUBJECT OBJECTIVES** |
|---|
| C1 Provide training in basics of infinite series and power series theories.<br>C2 Presentation of rudiments of multivariable differential calculus.<br>C3 Exposition of basics of multiple integrals.<br>C4 Introduction to the idea of the Laplace and Fourier transformations. |

| **PRZEDMIOTOWE EFEKTY KSZTAŁCENIA** |
|---|
| **Relating to knowledge a student**<br>PEK_W1 knows basic convergence tests for infinite series,<br>PEK_W2 knows rudiments of multivariable differential and integral calculus,<br>PEK_W3 knows the notions of the Laplace and Fourier transformations.<br>**Relating to skills a student**<br>PEK_U1 is able to find power series representation of a function and knows how to use it for |

| |
|---|
| approximations,<br>PEK_U2 can calculate and interpret partial derivatives, directional derivatives and gradients of multivariable functions, is able to find local and global extrema of two-variable functions,<br>PEK_U3 can calculate double integrals and apply double-integral calculus to solve engineering problems,<br>PEK_U4 can find the Laplace transforms of basic functions. |

| PROGRAM CONTENT | | |
|---|---|---|
| **Form of classes - lectures** | | **Hours** |
| Lec1 | Improper integrals. Absolute and conditional convergence. Cauchy principal value. | 2 |
| Lec2 | Infinite series. The basic tests for convergence and divergence. Absolute and conditional convergence. The alternating series test (Leibniz's theorem). | 2 |
| Lec3 | Power series. The radius and interval of convergence. Cauchy-Hadamard theorem. Taylor series. | 2 |
| Lec4 | Sets in the plane and in space. Functions of several variables. Graphs of typical two-variable functions. Surfaces of revolution and cylindrical surfaces. | 2 |
| Lec5 | The partial derivative. Definition. Geometric interpretation. Higher order partial derivatives. Schwarz's Theorem. | 2 |
| Lec6 | The tangent plane to the graph of two-variable function. Directional derivatives. Gradient of a function | 2 |
| Lec7 | Local and global extrema of two-variable function. Necessary and sufficient conditions for the existence of minimum /maximum. Examples of extremal problems in geometry and engineering. | 2 |
| Lec8 | Conditional extrema. Applications. Examples of optimization problems. | 2 |
| Lec9 | Double integral, its definition and interpretation. Methods of calculation of double integrals over normal and regular regions. | 2 |
| Lec10 | Properties of double integrals. Jacobian determinant. Change of variables in double integrals. Double integrals in polar coordinates. | 2 |
| Lec11 | Applications of double integrals in geometry, physics and engineering. | 2 |
| Lec12 | Introduction to theory of ordinary differential equations. Laplace transformation. | 2 |
| Lec13 | Laplace inverse transformation and its applications in ordinary differential equations. | 2 |
| Lec14 | Fourier transformation and its applications. | 4 |
| | **Total hours** | **30** |
| **Form of classes - classes** | | **Hours** |
| Cl1 | Improper integrals. | 1 |
| Cl2 | Infinite series. | 1 |
| Cl3 | Power series. | 1 |
| Cl4 | Functions of two variables. | 1 |
| Cl5 | Partial derivatives. | 1 |
| Cl6 | Gradient of a function. Tangent planes. | 1 |
| Cl7 | Local and global minima and maxima. | 1 |
| Cl8 | Conditional extrema. | 1 |
| Cl9 | Double integrals. | 1 |
| Cl10 | Double integrals in polar coordinates. | 1 |
| Cl11 | Applications of double integrals. | 1 |
| Cl12 | Integral transforms. | 2 |
| Cl13 | Test. | 2 |
| | **Total hours** | **15** |

| TEACHING TOOLS USED |
|---|
| N1 Lectures – traditional or using multimedia tools.<br>N2 Classes - traditional method (problems sessions and discussion).<br>N3 Student's self-study with the assistance of mathematical packages. |

**EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT**

| Evaluation (F-forming; P - concluding) | Educational effect number | Way of evaluating educational effect achievement |
|---|---|---|
| F1 | PEK_U1- PEK_U4 | tests, oral presentations, quizzes |
| F2 | PEK_W1-PEK_W3 | exam |
| P – rules set by the lecturer | | |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE**


[1] F. Leja, Rachunek Różniczkowy i Całkowy, Wydawnictwo Naukowe PWN, 2012

[2] R. Leitner, Zarys Matematyki Wyższej dla Studiów Technicznych, Cz. 1-2, WNT, Warszawa, 2006.

[3] M. Gewert, Z. Skoczylas, Analiza Matematyczna 2. Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław, 2016


**SECONDARY LITERATURE**


[1] W. Krysicki, L. Włodarski, Analiza Matematyczna w Zadaniach, Cz. II, PWN, Warszawa, 2006

[2] G. M. Fichtenholz, Rachunek Różniczkowy i Całkowy, T. I - II, PWN, Warszawa, 2007

[3] M. Gewert, Z. Skoczylas, Analiza Matematyczna 2. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław, 2016


| SUBJECT SUPERVISORS |
|---|
| Wydziałowa Komisja Programowa ds. Kursów Ogólnouczelnianych<br>doc. dr Zbigniew Skoczylas (Zbigniew.Skoczylas@pwr.edu.pl) |

CORRELATION MATRIX BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

**MATHEMATICAL ANALYSIS 2.4 A MAT001690**

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY ***Computer Science***

| Subject educational effect | Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable) | Subject objectives | Programme content | Teaching tool number |
|---|---|---|---|---|
| PEK_W1 | K1INF_W01 | C1 | Lec2, Lec3, Cl2, Cl3 | N1- N3 |
| PEK_W2 | K1INF_W01 | C2, C3 | Lec4-Lec12, Cl4-Cl11 | N1- N3 |
| PEK_W3 | K1INF_W01 | C4 | Lec13, Lec14, Cl12 | N1- N3 |
| PEK_U1 | K1INF_W01 | C1 | Lec3, Cl3 | N1- N3 |
| PEK_U2 | K1INF_W01 | C2 | Lec5-Lec8, Cl5-Cl8 | N1- N3 |
| PEK_U3 | K1INF_W01 | C3 | Lec9-Lec11, Cl9-Cl11 | N1- N3 |
| PEK_U4 | K1INF_W01 | C4 | Lec12, Lec13, Cl12 | N1- N3 |

FACULTY OF COMPUTER SCIENCE AND MANAGEMENT

SUBJECT CARD

| | |
|---|---|
| Name in English | **ALGEBRA AND ANALYTIC GEOMETRY** |
| Name in Polish | **ALGEBRA Z GEOMETRIĄ ANALITYCZNĄ** |
| Main field of study (if applicable) | ***Computer Science*** |
| Level and form of studies | **I level, full time** |
| Kind of subject | **obligatory** |
| Subject code | **MAT001688** |
| Group of courses | **YES** |

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | 30 | | | |
| Number of hours of total student workload (CNPS) | | | | | |
| Form of crediting | exam | crediting with grade | | | |
| For group of courses mark (X) final course | X | | | | |
| Number of ECTS points | | | | | |
| including number of ECTS points for practical (P) classes | | | | | |
| including number of ECTS points for direct teacher-student contact (BK) classes | | | | | |

## PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

It is recommended that the knowledge of mathematics is equivalent to high school certificate at the basic level.

## SUBJECT OBJECTIVES

C1 Presentation of basic theorems and algorithms concerning the theory of linear equations.
C2 Presentation of basic notions concerning matrix calculus, eigenvalues and eigenvectors of matrices.
C3 Exposition of rudiments of the theory of complex numbers, polynomial and rational functions.
C4 Exposition of rudiments of analytic geometry in $R^3$.
C5 Expalining the basic notions of theory of vector spaces.

## SUBJECT EDUCATIONAL EFFECTS

**Relating to knowledge a student**

PEK_W1 knows basic methods of solving systems of linear equations,
PEK_W2 knows basic properties of complex numbers,
PEK_W3 knows basic algebraic properties of polynomials,
PEK_W4 knows characterizations of lines and planes in $R^3$.
PEK_W5 knows basic notions of theory of vector spaces.

| **Relating to skills a student:** |
|---|
| PEK_U1 can add and multiply matrices and calculate determinants, |
| PEK_U2 can solve systems of linear equations, |
| PEK_U3 can find eigenvalues and eigenvectors of a matrix, |
| PEK_U4 can carry out calculations with use of complex numbers, |
| PEK_U5 can find line and plane equations in the space $R^3$. |

| **PROGRAM CONTENT** | | |
|---|---|---|
| **Form of classes - lectures** | | **Hours** |
| Lec1 | Mathematical induction. Newton's binomial formula. | 1 |
| Lec2 | The notion of a matrix. Operations on matrices. Transposition. Examples of matrices (triangular, symmetric, diagonal etc.). | 2 |
| Lec3 | The determinant of a matrix. The Laplace expansion. Cofactor of an element of a matrix. Minors. Properties of determinants. Calculation of determinants by elementary row and column operations. Cauchy's theorem. Nonsingular matrix. | 3 |
| Lec4 | Inverse matrix. Computation of inverse matrix by cofactors or by elementary row operations. Properties of inverse matrices. Matrix equations. Rank of a matrix. Applications of determinants, their connections with rank and invertibility. | 2 |
| Lec5 | Systems of linear equations. Rouché–Capelli theorem. Cramer's formulas. Gaussian elimination. Solving arbitrary systems of linear equations. | 3 |
| Lec6 | Complex numbers. Operations on complex numbers in algebraic form. Complex conjugate. Modulus. Argument. | 2 |
| Lec7 | Geometric interpretation of a complex number. Polar form of a complex number. De Moivre's formula. Roots of complex numbers. | 2 |
| Lec8 | Polynomials. Polynomial remainder theorem. Fundamental theorem of algebra. Roots of polynomials with real coefficients. | 2 |
| Lec9 | Linear and quadratic factors of a real polynomial. Decomposition of a polynomial into factors. Rational functions. Real partial fractions with irreducible denominators. Partial fraction decomposition of a real rational function. | 2 |
| Lec10 | Eigenvalues and eigenvectors of a matrix. | 2 |
| Lec11 | Analytic geometry in the space $R^3$. Operations on vectors. Length of a vector. Scalar product, cross product and triple product of vectors - computing area and volume. | 2 |
| Lec12 | Planes. Normal to a plane. Equations of a plane. Relative location of planes. | 1 |
| Lec13 | Line in the space. Equations of a line (parametric, directional). Line as an intersection of planes. Relative location of two lines. Relative location of a line and a plane. Orthogonal projection of a point onto a line or a plane. | 3 |
| Lec14 | Vector spaces (finite dimensional). Linear combination of vectors. Linear independence. Basis and dimension of a vector space. | 3 |
| | **Total hours** | **30** |

| **Form of classes – classes** | | **Hours** |
|---|---|---|
| Cl1 | Transformation of algebraic expressions. Newton's binomial formula. | 1 |
| Cl2 | Operations on matrices. | 1 |
| Cl3 | Calculation of matrix determinants with use of their properties. Laplace expansion. Computation of an inverse matrix. Solving matrix equations. Evaluation of the rank of a matrix. | 4 |

| | | |
|---|---|---|
| Cl4 | Kronecker-Capelli theorem. Cramer's formulas. Gaussian elimination. Solving of arbitrary systems of linear equations. | 4 |
| Cl5 | Operations on complex numbers in algebraic form. Polar form. Geometric interpretation. Powers and roots of complex numbers. Solving simple equations and inequalities. | 6 |
| Cl6 | Finding roots of polynomials. Decomposition of a polynomial into irreducible components. Partial fraction decomposition of a real rational function. | 4 |
| Cl7 | Eigenvalues and eigenvectors of a matrix. | 2 |
| Cl8 | Vector operations. Scalar, cross or triple product of vectors and their applications to calculating area and volume. | 2 |
| Cl9 | Solving problems in analytic geometry in $R^3$ – finding equations of lines and planes, finding projections of vectors etc. | 4 |
| Cl10 | Test. | 2 |
| | **Total hours** | **30** |

| **TEACHING TOOLS USED** |
|---|
| N1 Lectures – traditional or using multimedia tools.<br>N2 Classes – traditional method (problems sessions and discussion).<br>N3 Student's self-study with the assistance of mathematical packages.<br>N4 Tutorial. |

**EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT**

| Evaluation (F-forming; P - concluding) | Educational effect number | Way of evaluating educational effect achievement |
|---|---|---|
| F – Cl | PEK_U1 - PEK_U5 | oral presentations, quizzes, tests |
| F – Lec | PEK_W1 - PEK_W5 | exam |
| P - rules set by the lecturer | | |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE**


[1] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2015.

[2] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2014.

[3] P. Kajetanowicz, J. Wierzejewski, Algebra z geometrią analityczną, PWN 2008.

[4] M. Zakrzewski, Markowe wykłady z matematyki, Algebra z geometrią, Oficyna Wyd. GiS, Wrocław 2015.


**SECONDARY LITERATURE**


[1] B. Gleichgewicht, Algebra, Oficyna Wydawnicza GiS, Wrocław 2004.

[2] A. Mostowski, M. Stark, Elementy algebry wyższej, PWN, Warszawa 1963.

[3] W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, Cz. A, PWN, Warszawa 2003.

[4] F. Leja, Geometria analityczna, PWN, Warszawa 1972.

[5] E. Kącki, D. Sadowska, L. Siewierski, Geometria analityczna w zadaniach, PWN, Warszawa 1993.

| **SUBJECT SUPERVISORS** |
| --- |
| Wydziałowa Komisja Programowa ds. kursów ogólnouczelnianych<br>dr Karina Olszak (Karina.Olszak@pwr.edu.pl) |

CORRELATION MATRIX BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

## ALGEBRA AND ANALYTIC GEOMETRY MAT001688

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY ***Computer science***

| Subject educational effect | Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable) | Subject objectives | Programme content | Teaching tool number |
| --- | --- | --- | --- | --- |
| PEK_W1 | K1INF_W01 | C1, C2 | Lec5, Cl4 | N1-N4 |
| PEK_W2 | K1INF_W01 | C3 | Lec6-Lec9, Cl5, Cl6 | N1-N4 |
| PEK_W3 | K1INF_W01 | C3 | Lec8, Lec9, Cl6 | N1-N4 |
| PEK_W4 | K1INF_W01 | C4 | Lec11-Lec13, Cl8, Cl9 | N1-N4 |
| PEK_W5 | K1INF_W01 | C5 | Lec14 | N1, N3, N4 |
| PEK_U1 | K1INF_W01 | C2 | Lec2-Lec4, Lec10, Cl2, Cl3 | N1-N4 |
| PEK_U2 | K1INF_W01 | C1, C2 | Lec5, Cl4 | N1-N4 |
| PEK_U3 | K1INF_W01 | C2 | Lec10, Cl7 | N1-N4 |
| PEK_U4 | K1INF_W01 | C3 | Lec6-Lec9, Cl5, Cl6 | N1-N4 |
| PEK_U5 | K1INF_W01 | C4 | Lec11-Lec13, Cl8, Cl9 | N1-N4 |

FACULTY OF COMPUTER SCIENCE AND MANAGEMENT

SUBJECT CARD

| | |
|---|---|
| Name in English | **MATHEMATICAL ANALYSIS I** |
| Name in Polish | **ANALIZA MATEMATYCZNA I** |
| Main field of study (if applicable) | ***Computer Science*** |
| Specialization (if applicable) | |
| Level and form of studies | **I level, full time** |
| Kind of subject | **obligatory** |
| Subject code | **MAT001689** |
| Group of courses | **YES** |

| | Lecture | Exercise class | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized University classes (ZZU) | 30 | 30 | | | |
| Number of hours of total student workload (CNPS) | | | | | |
| Form of crediting | exam | crediting with grade | | | |
| For a group of courses mark the final course (X) | X | | | | |
| Number of ECTS points | 6 | | | | |
| including number of ECTS points for practical (P) classes | | | | | |
| including number of ECTS points for direct teacher-student contact (BK) classes | | | | | |

| **PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES** |
|---|
| Knowledge of mathematics equivalent to high school certificate at the advanced level is recommended. |

| **SUBJECT OBJECTIVES** |
|---|
| C1 Provide training in basic elementary functions and their properties. |
| C2 Provide training in basic differential calculus of one-variable functions. |
| C3 Introduction to the concept of definite integral, its basic properties and methods of calculation. |
| C4 Presentation of practical applications of differential and integral calculus of one-variable functions. |

| **SUBJECT EDUCATIONAL EFFECTS** |
|---|
| **Relating to knowledge a student:** |
| PEK_W1 knows graphs and properties of basic elementary functions, |
| PEK_W2 knows basic notions and theorems of differential calculus for one-variable functions, |
| PEK_W3 knows the concept of definite integral, its properties and basic applications. |
| |
| **Relating to skills a student:** |
| PEK_U1 can solve typical equations and inequalities with elementary functions, |

| |
|---|
| PEK_U2 can examine a function and draw its graph,<br>PEK_U3 can evaluate typical indefinite integrals and calculate definite integrals,<br>PEK_U4 can apply differential and integral calculus to solve practical problems. |

| **PROGRAMME CONTENT** | | |
|---|---|---|
| **Form of classes - lecture** | | **Hours** |
| Lec1 | Definition of a function. Basic examples: linear, quadratic and polynomial functions. Rational functions. Composition of functions. Transformations of graphs of functions. | 3 |
| Lec2 | Injective functions. The inverse function and its graph. Power and exponential functions and their inverses. Properties of logarithms. | 2 |
| Lec3 | Trigonometric functions. Unit (trigonometric) circle. Inverse trigonometric functions. | 2 |
| Lec4 | Sequences of real numbers. Finite and infinite limit of a sequence. Basic theorems on limits of sequences. Indeterminate expressions. The number *e*. | 3 |
| Lec5 | The limit of a function at a point and the limit at infinity. Examples of the limits of certain indeterminate expressions. Asymptotes. | 2 |
| Lec6 | Continuity of a function at a point and on an interval. Basic properties of continuous functions. Approximate solutions of equations. | 2 |
| Lec7 | The derivative of a function. Geometrical and physical interpretations of the derivative. Tangent line. Differential of a function. Derivatives of basic elementary functions. Differentiation rules. | 2 |
| Lec8 | Lagrange's theorem. Intervals of monotonicity of a function. De l'Hospital's rule. | 2 |
| Lec9 | Local and global extrema. Examples of optimization problems. | 2 |
| Lec10 | Definition and basic properties of indefinite integral. Basic rules. The substitution rule and integration by parts. | 2 |
| Lec11 | Definition and basic properties of definite integral. Fundamental theorem of calculus (Newton-Leibniz theorem). | 2 |
| Lec12 | Applications of integral calculus (average value of a function, area of a flat region, volumes of solids of revolution, arc length etc.) | 2 |
| Lec13 | Integration of rational and trigonometric functions. | 2 |
| Lec14 | Examples of applications of mathematical analysis methods for one-variable functions (e.g. Taylor's theorem, convexity and inflection points of a function, or other applications typical for the field of study). | 2 |
| | **Total hours** | **30** |
| **Form of classes – classes** | | **Hours** |
| Cl1 | Elements of mathematical logic (logical connectives, quantifiers). Determination of the function domain. Even and odd functions. | 2 |
| Cl2 | Composition of functions. Transformations of graphs of functions. Polynomial and rational equations and inequalities. | 2 |
| Cl3 | The inverse function. Typical equations and inequalities with exponential and logarithmic functions. | 2 |
| Cl4 | Trigonometric and inverse trigonometric functions. Unit (trigonometric) circle. Typical trigonometric equations and inequalities. | 2 |
| Cl5 | Monotonicity and boundedness of sequences. Computing proper and improper limits of sequences. | 2 |
| Cl6 | Limits of functions. Asymptotes. | 2 |
| Cl7 | Continuity of a function. Approximate solutions of equations. | 2 |
| Cl8 | Derivative of a function. Rules of differentiation. Tangent line. Differentials and their applications. | 2 |
| Cl9 | De l'Hospital's rule. Intervals of monotonicity of a function. | 2 |

| | | |
|---|---|---|
| Cl10 | Determining local and global extrema of a function. | 2 |
| Cl11 | Evaluation of indefinite integrals of elementary functions. Integration by parts and by substitution. | 2 |
| Cl12 | Calculating definite integrals. Area of a flat region as an application of definite integral. | 2 |
| Cl13 | Applications of definite integral. | 2 |
| Cl14 | Integration of rational and trigonometric functions. | 2 |
| Cl15 | Test. | 2 |
| | **Total hours** | **30** |

| **TEACHING TOOLS USED** |
|---|
| N1 Lectures – traditional or using multimedia tools.<br>N2 Classes – traditional method (problems sessions and discussion).<br>N3 Student's self-study with the assistance of mathematical packages.<br>N4 Tutorial. |

## EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

| Evaluation (F - forming; P - concluding) | Educational effect number | Way of evaluating educational effect achievement |
|---|---|---|
| F-Cl | PEK_U1-PEK_U4, PEK_K1 | tests, oral presentations, quizzes |
| F-Lec | PEK_W1-PEK_W3 | exam |
| P - rules set by the lecturer | | |

## PRIMARY AND SECONDARY LITERATURE

**PRIMARY LITERATURE:**


[1] G. Decewicz, W. Żakowski, Matematyka, Cz.1, WNT, Warszawa 2007.
[2] M. Gewert, Z. Skoczylas, Analiza matematyczna 1. Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław, 2015.
[3] M. Gewert, Z. Skoczylas, Analiza matematyczna 1. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław, 2015.
[4] W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach, Cz. I, PWN, Warszawa, 2006.


**SECONDARY LITERATURE:**


[1] F. Leja, Rachunek różniczkowy i całkowy, PWN, 2012.
[2] R. Leitner, Zarys matematyki wyższej dla studiów technicznych, cz.1-2, WNT, Warszawa, 2006.
[3] M. Zakrzewski, Markowe wykłady z matematyki. Analiza, Oficyna Wydawnicza GiS, Wrocław, 2013.


## SUBJECT SUPERVISORS


Wydziałowa Komisja Programowa ds. kursów ogólnouczelnianych
dr Jolanta Sulkowska (Jolanta.Sulkowska@pwr.edu.pl)

CORRELATION MATRIX BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

**MATHEMATICAL ANALYSIS I MAT1689**

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY ***Computer Science***

| Subject educational effect | Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable) | Subject objectives | Programme content | Teaching tool number |
|---|---|---|---|---|
| PEK_W1 | K1INF_W01 | C1 | Lec1-Lec6 | N1-N4 |
| PEK_W2 | K1INF_W01 | C2 | Lec7-Lec9, Lec14 | N1-N4 |
| PEK_W3 | K1INF_W01 | C3 | Lec10-Lec13 | N1-N4 |
| PEK_U1 | K1INF_W01 | C1 | Lec1-Lec3, Cl1-Cl4 | N1-N4 |
| PEK_U2 | K1INF_W01 | C1 | Lec5-Lec9, Cl5-Cl10 | N1-N4 |
| PEK_U3 | K1INF_W01 | C3 | Lec10, Lec11, Lec13, Cl11, Cl12, Cl14 | N1-N4 |
| PEK_U4 | K1INF_W01 | C2, C4 | Lec7, Lec12, Lec14, Cl8-Cl10, Cl12, Cl13 | N1-N4 |

FACULTY OF COMPUTER SCIENCE AND MANAGEMENT

SUBJECT CARD

| | |
|---|---|
| Name in English | **MATHEMATICAL ANALYSIS II** |
| Name in Polish | **ANALIZA MATEMATYCZNA II** |
| Main field of study (if applicable) | ***Computer Science*** |
| Specialization (if applicable): | |
| Level and form of studies: | **I level, full time** |
| Kind of subject: | **obligatory** |
| Subject code: | **MAT001690** |
| Group of courses: | **YES** |

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | 15 | | | |
| Number of hours of total student workload (CNPS) | | | | | |
| Form of crediting | exam | crediting with grade | | | |
| For group of courses mark (X) final course | X | | | | |
| Number of ECTS points | 5 | | | | |
| including number of ECTS points for practical (P) classes | | | | | |
| including number of ECTS points for direct teacher-student contact (BK) classes | | | | | |

| **PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES** |
|---|
| Student must have basic knowledge in one-variable differential and integral calculus, confirmed by completing the *Mathematical Analysis I* course with a positive grade. |

| **SUBJECT OBJECTIVES** |
|---|
| C1 Provide training in basics of infinite series and power series theories.<br>C2 Presentation of rudiments of multivariable differential calculus.<br>C3 Exposition of basics of multiple integrals.<br>C4 Introduction to the idea of the Laplace and Fourier transformations. |

| **PRZEDMIOTOWE EFEKTY KSZTAŁCENIA** |
|---|
| **Relating to knowledge a student**<br>PEK_W1 knows basic convergence tests for infinite series,<br>PEK_W2 knows rudiments of multivariable differential and integral calculus,<br>PEK_W3 knows the notions of the Laplace and Fourier transformations.<br>**Relating to skills a student**<br>PEK_U1 is able to find power series representation of a function and knows how to use it for |

approximations,
PEK_U2 can calculate and interpret partial derivatives, directional derivatives and gradients of multivariable functions, is able to find local and global extrema of two-variable functions,
PEK_U3 can calculate double integrals and apply double-integral calculus to solve engineering problems,
PEK_U4 can find the Laplace transforms of basic functions.

| PROGRAM CONTENT | | |
|---|---|---|
| **Form of classes - lectures** | | **Hours** |
| Lec1 | Improper integrals. Absolute and conditional convergence. Cauchy principal value. | 2 |
| Lec2 | Infinite series. The basic tests for convergence and divergence. Absolute and conditional convergence. The alternating series test (Leibniz's theorem). | 2 |
| Lec3 | Power series. The radius and interval of convergence. Cauchy-Hadamard theorem. Taylor series. | 2 |
| Lec4 | Sets in the plane and in space. Functions of several variables. Graphs of typical two-variable functions. Surfaces of revolution and cylindrical surfaces. | 2 |
| Lec5 | The partial derivative. Definition. Geometric interpretation. Higher order partial derivatives. Schwarz's Theorem. | 2 |
| Lec6 | The tangent plane to the graph of two-variable function. Directional derivatives. Gradient of a function | 2 |
| Lec7 | Local and global extrema of two-variable function. Necessary and sufficient conditions for the existence of minimum /maximum. Examples of extremal problems in geometry and engineering. | 2 |
| Lec8 | Conditional extrema. Applications. Examples of optimization problems. | 2 |
| Lec9 | Double integral, its definition and interpretation. Methods of calculation of double integrals over normal and regular regions. | 2 |
| Lec10 | Properties of double integrals. Jacobian determinant. Change of variables in double integrals. Double integrals in polar coordinates. | 2 |
| Lec11 | Applications of double integrals in geometry, physics and engineering. | 2 |
| Lec12 | Introduction to theory of ordinary differential equations. Laplace transformation. | 2 |
| Lec13 | Laplace inverse transformation and its applications in ordinary differential equations. | 2 |
| Lec14 | Fourier transformation and its applications. | 4 |
| | **Total hours** | **30** |
| **Form of classes - classes** | | **Hours** |
| Cl1 | Improper integrals. | 1 |
| Cl2 | Infinite series. | 1 |
| Cl3 | Power series. | 1 |
| Cl4 | Functions of two variables. | 1 |
| Cl5 | Partial derivatives. | 1 |
| Cl6 | Gradient of a function. Tangent planes. | 1 |
| Cl7 | Local and global minima and maxima. | 1 |
| Cl8 | Conditional extrema. | 1 |
| Cl9 | Double integrals. | 1 |
| Cl10 | Double integrals in polar coordinates. | 1 |
| Cl11 | Applications of double integrals. | 1 |
| Cl12 | Integral transforms. | 2 |
| Cl13 | Test. | 2 |
| | **Total hours** | **15** |

| TEACHING TOOLS USED |
|---|
| N1 Lectures – traditional or using multimedia tools.<br>N2 Classes - traditional method (problems sessions and discussion).<br>N3 Student's self-study with the assistance of mathematical packages. |

**EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT**

| Evaluation (F-forming; P - concluding) | Educational effect number | Way of evaluating educational effect achievement |
|---|---|---|
| F1 | PEK_U1- PEK_U4 | tests, oral presentations, quizzes |
| F2 | PEK_W1-PEK_W3 | exam |
| P – rules set by the lecturer | | |

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE**


[1] F. Leja, Rachunek Różniczkowy i Całkowy, Wydawnictwo Naukowe PWN, 2012

[2] R. Leitner, Zarys Matematyki Wyższej dla Studiów Technicznych, Cz. 1-2, WNT, Warszawa, 2006.

[3] M. Gewert, Z. Skoczylas, Analiza Matematyczna 2. Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław, 2016


**SECONDARY LITERATURE**


[1] W. Krysicki, L. Włodarski, Analiza Matematyczna w Zadaniach, Cz. II, PWN, Warszawa, 2006

[2] G. M. Fichtenholz, Rachunek Różniczkowy i Całkowy, T. I - II, PWN, Warszawa, 2007

[3] M. Gewert, Z. Skoczylas, Analiza Matematyczna 2. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław, 2016


**SUBJECT SUPERVISORS**


Wydziałowa Komisja Programowa ds. Kursów Ogólnouczelnianych
doc. dr Zbigniew Skoczylas (Zbigniew.Skoczylas@pwr.edu.pl)


CORRELATION MATRIX BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

**MATHEMATICAL ANALYSIS 2.4 A MAT001690**

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY ***Computer Science***

| Subject educational effect | Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable) | Subject objectives | Programme content | Teaching tool number |
|---|---|---|---|---|
| PEK_W1 | K1INF_W01 | C1 | Lec2, Lec3, Cl2, Cl3 | N1- N3 |
| PEK_W2 | K1INF_W01 | C2, C3 | Lec4-Lec12, Cl4-Cl11 | N1- N3 |
| PEK_W3 | K1INF_W01 | C4 | Lec13, Lec14, Cl12 | N1- N3 |
| PEK_U1 | K1INF_W01 | C1 | Lec3, Cl3 | N1- N3 |
| PEK_U2 | K1INF_W01 | C2 | Lec5-Lec8, Cl5-Cl8 | N1- N3 |
| PEK_U3 | K1INF_W01 | C3 | Lec9-Lec11, Cl9-Cl11 | N1- N3 |
| PEK_U4 | K1INF_W01 | C4 | Lec12, Lec13, Cl12 | N1- N3 |