

## FACULTY OF COMPUTER SCIENCE AND MANAGEMENT / DEPARTMENT...

**SUBJECT CARD****Name in Polish Zastosowania i wyzwania informatyki****Name in English Applications and Challenges of Computer Science****Main field of study (if applicable): Computer Science****Specialization (if applicable): Computer Engineering****Level and form of studies: 1st/ 2nd\* level, full-time / ~~part-time~~\*****Kind of subject: obligatory / ~~optional~~ / ~~university-wide~~\*****Subject code INZ0140Ws****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)	75				75
Form of crediting	<del>Examination</del> / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	Examination / crediting with grade*	<del>Examination</del> / 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	3				

\*delete as applicable

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

1. None

**SUBJECT OBJECTIVES**

C1 Educating the abilities of solving and understanding problems associated with the contemporary theories, solutions and technologies in computer engineering. Acquiring competence in the scope of the design of modern computers based on parallel, distributed, quantum and bio computations

C2 Acquiring competence in the scope of the assessment of the physical nature of information, quantum and bio computation. New kinds of computer architectures and software.

C3 Acquiring the knowledge of quantum computers and quantum computation. Acquiring the knowledge of bio computers and bio computation. Providing practical abilities in methods of the designing and implementation software with use quantum and bio solutions.

C4 Providing deepened knowledge of contemporary trends in the scope of new data security solutions, algebraic and quantum cryptography and security with use group, field and character theory.

C5 Providing the knowledge of trends essential to understand substantial problems of the safety and detection methods and to counteract problems of the safety in computer systems, web systems, mobile systems and built in systems.

C6 Acquiring the knowledge in processing and disclosing media data, of designing multimedia interfaces of computer applications and about developmental trends and the most significant new achievements in the area of contemporary multimedia technologies.

C7 Acquiring competence and shaping the attitude in the social scope including the ability of the harmonious group work and the reliable, honest and ethical practising a profession of the computer specialist and scientist with use contemporary theories and technologies.

#### **SUBJECT EDUCATIONAL EFFECTS**

relating to knowledge:

PEK\_W01 Student has a widened and deepened knowledge about of scope of the design of modern computers based on parallel, distributed, quantum and bio computations.

PEK\_W02 Student has a knowledge about modern intelligent methods based on biocomputing and cortex models, their applications and methods of their validation. He has a detailed knowledge in processing and disclosing media data, of designing multimedia interfaces of computer applications and about developmental trends and the most significant new achievements in the area of contemporary multimedia technologies.

PEK\_W03 Student knows contemporary trends in principles of essential methods, techniques, development tools applied at solving engineering complex tasks from the scope of designing and formulating mobile and hybrid systems.

PEK\_W04 Student has a widened and deepened knowledge of contemporary trends in the scope of new data security solutions, algebraic and quantum cryptography and security with use group, field and character theory.

PEK\_W05 Student has a knowledge trends essential to understand substantial problems of the safety and detection methods and to counteract problems of the safety in computer systems, web systems, mobile systems and built in systems.

relating to skills:

PEK\_U01 Student has an ability to understand contemporary solutions in computer science based on last research results and last technologies applications.

PEK\_U02 Student is able to understand and apply contemporary solutions and technologies in computer engineering. Especially he is able to understand technologies based on quantum and bio computing.

PEK\_U03 Student is able to identify and to describe requirements of the user of the multimedia, distributed, web and other modern systems with applying contemporary solutions and tools.

PEK\_U04 Student is able to understand human information processes, artificial intelligence and apply them in computer science profession.

PEK\_U05 Student has an ability of the selection of the proper architecture of the system parallel/distributed/bio/quantum/optical to the solved problem.

PEK\_U06 Student is able to select the appropriate method and the algorithm for solving a stated problem, as well as to effect the critical analysis and the evaluation of the suggested answer. He is using newest theoretical and technology solutions.

relating to social competences:

PEK\_K01 Student has competence for solving ethical and society problems related to contemporary theories and technologies in software engineering.

PEK\_K02 Student is able to cooperate in group, preparing presentation, discussion and argues ethical needs in modern computer science

#### **PROGRAMME CONTENT**

**Form of classes - lecture**

**Number  
of hours**

Lec 1	Physical nature of information and computation. Discrete and continuous information. Information density and entropy, the indeterminacy information rule. Old and new ideas of computers and computations. Macro, micro and nano scale of information flow. Basic description of mechanical-, electromagnetic-, optical-, bio- and quantum- information forms and transformations. Parallel and distributed computing. The future - galactic computer or one particle computer?	6
Lec 2	Quantum computers and quantum algorithms. Qubit as an quantum information unit. Quantum processes: teleportation, tunnelling and computation. Quantum gates. Toffoli gate and reverse computation. Quantum computers with use NMR, Mah-Zhender interferometer, quantum dot, heavy ion in semiconductor lattice. QC-algorithms and its complexity.	6
Lec 3	Human information processes. Artificial neural networks versus human brain. Limitations of artificial intelligence. What is a biocomputer? Biological cells, albumens as processor and memory. Modern computer vision and multimedia.	4
Lec 4	Computer crime. The nature of the new computer based crimes. Computer crime scene examination. Computer forensic.	6
Lec 5	New data security solutions. Algebraic and quantum cryptography. Security with use group, field and character theory. Continuous cryptography. Statistical databases. Zero knowledge proof in practice.	4
Lec 6	New types of algorithms. Object identification in Hilbert and Banach space. Prediction with use GRNN and wavelet.	2
Lec 7	Final test	2
	Total hours	30
<b>Form of classes - class</b>		<b>Number of hours</b>
Cl 1		
Cl 2		
Cl 3		
Cl 4		
..		
	Total hours	
<b>Form of classes - laboratory</b>		<b>Number of hours</b>
Lab 1		
Lab 2		
Lab 3		
Lab 4		
Lab 5		
...		
	Total hours	
<b>Form of classes - project</b>		<b>Number of hours</b>
Proj 1		
Proj 2		
Proj 3		

Proj 4		
...		
	Total hours	
<b>Form of classes - seminar</b>		<b>Number of hours</b>
Sem 1	Old and new ideas of hardware and software theories in computer science. Important role of physical nature of information.	4
Sem 2	Applications of quantum computers and quantum algorithms. Designing of quantum software.	4
Sem 3	Applications of artificial intelligence. New theories and new applications of cortex memory.	4
Sem 4	Applications of biocomputing. Challenges of computer science solutions based on biological cells and albumens as processor and memory.	4
Sem 5	Crimes and computer forensics. Applications and challenges of computer engineering in crime scene investigations, trace identification and free of law risk computing.	4
Sem 6	Applications of modern algebra, group theory, cohomology, spectral theory and other current achievements of mathematics in computer engineering.	4
Sem 7	Applications and challenges of object identification and object processing. Applications and challenges of mobile solutions. Theories and applications of designing and implementation mobile applications.	6
	Total hours	30
<b>TEACHING TOOLS USED</b>		
N1. Multimedia presentations N2. The course Web page N3. Electronics and paper books and library references		

#### **EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT**

<b>Evaluation</b> (F – forming (during semester), P – concluding (at semester end))	<b>Educational effect number</b>	<b>Way of evaluating educational effect achievement</b>
F1	PEK_W01-PEK_W05 PEK_U01-PEK_U06	Short tests
F2	PEK_U01-PEK_K02	Evaluation of presentation, discussion and activity
F3	PEK_W01- PEK_K02	Final test
C=F1+F2+F3		
<b>PRIMARY AND SECONDARY LITERATURE</b>		

**PRIMARY LITERATURE:**

- [1] Stakhov A.: Mathematics of Harmony: From Euclid to Contemporary Mathematics and Computer Science. World Scientific Publishing 2009.
- [2] Aaronson S.: Quantum computing since Democritus. Cambridge University Press 2013.
- [3] Yanofsky N.S.: Quantum Computing for Computer Scientists. Cambridge University Press 2008.
- [4] Pardalos P.M., Principe J.C.: Biocomputing. Springer 2002.
- [5] Rohrkemper R.: Effective Topologies for Computation in Cortex-like Networks: Tools for evaluating computational richness and robustness/ LAP LAMBERT Academic Publishing 2012.
- [6] Ali M., Bosse T., Hindriks K., Hoogendorn M., Jonker C., Treur J.: Contemporary Challenges and Solutions in Applied Artificial Intelligence. Springer 2013.
- [7] Sein M.K., Munkvold BE., Orvik T., Wojtkowski W., Wojtkowski W.G., Zupannic Joze., Wrycza S.: Contemporary Trends in Systems Development. Springer 2013.

**SECONDARY LITERATURE:**

- [1] Carvalho V.H.: Image processing. Methods, Applications and Challenges. Gazelle 2012
- [2] Selected science paper.

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

**Arkadiusz Liber, PhD**

**Arkadiusz . Liber / at / pwr . wroc . pl**

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR  
SUBJECT

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

AND SPECIALIZATION .....

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***
<b>PEK_W01</b>	K2INF_W06	C1-C7	Lec1-Lec6	N1, N2, N3
<b>PEK_W02</b>	K2INF_W06	C1-C7	Lec1-Lec6	N1, N2, N3
<b>PEK_W03</b>	K2INF_W06	C1-C7	Lec1-Lec6	N1, N2, N3
<b>PEK_W04</b>	K2INF_W06	C1-C7	Lec1-Lec6	N1, N2, N3
<b>PEK_W05</b>	K2INF_W06	C1-C7	Lec1-Lec6	N1, N2, N3
<b>PEK_W06</b>	K2INF_W06	C1-C7	Lec1-Lec6	N1, N2, N3
<b>PEK_U01 - PEK_U06</b>	K2INF_U08	C1-C7	Sem1-Sem6	N1, N2, N3
<b>PEK_K01-PEK_K02</b>	K2INF_W06, K2INF_U08	C1-C7	Lec1-Lec6 Sem1-Sem6	N1, N2, N3

\*\* - enter symbols for main-field-of-study/specialization educational effects

\*\*\* - from table above