UNIVERSITY OF ZIELONA GÓRA

FACULTY OF COMPUTER, ELECTRICAL AND CONTROL ENGINEERING
UNIVERSITY OF ZIELONA GÓRA

WIEA

GENERAL DESCRIPTION AND ECTS SCORING FOR FIELDS OF STUDY:

COMPUTER SCIENCE

POSTGRADUATE PROGRAMME

NUMERICAL METHODS

Course code: 11.9-WE-I-MN-PK1_S2S

Type of course: compulsory

Language of instruction: Polish

Director of studies: Prof. Krzysztof Gałkowski, Ph.D., D.Sc.

Name of lecturer: Prof. Krzysztof Gałkowski, Ph.D., D.Sc.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					7
Lecture	30	2	I	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	I	Grade	
Laboratory	18	2		Grade	

COURSE OBJECTIVE:

To gain an experience in computer solving of basic computational problems in Engineering with regard limitations of floating point arithmetic.

ENTRY REQUIREMENTS:

Mathematical analysis, linear algebra and analytic geometry, principles of programming.

COURSE CONTENTS:

Mathematics basics. Basic notions and theorems used in numerical analysis. Taylor series.

Numbers and Errors. Decimal, binary and hexadecimal numbers, floating point representations. Error definitions and most commonly seen error types. Ill-conditioning and numerical stability.

Rootfinding. Bisection, Newton and Secant methods. Error estimation. Ill-conditioning and numerical stability of solutions.

Interpolation. Aims and characterization, Lagrange metod. Newton metod. Errors. Spline. Hermite interpolation.

Approximation. Sum-of-squares error minimization. Orthogonal polynomials. Min-max error minimization. Chebyshev polynomials.

Numerical integration. Trapezoidal and Simpson method. Gauss metod. Error estimation. Richardson ekstrapolation.

Solving of the linear algebraic equations set. Gauss elimination method; LU factorization and Doolittle method. Error estimation and correction. Numerical stability of solutions and conditional number. Iterative methods: Jacobi and Gauss-Seidel method.

Solving of the nonlinear algebraic equations set. Newton method.
Basics of solving differential equations. Euler and Runge-Kutta methods.

TEACHING METHODS:

Lecture, laboratory exercises.

LEARNING OUTCOMES:

Code	Effects of the course
KU_07	Can use them in practical computer calculations using MATLAB environment
KK_03	Can work individually and in a team
KU_02, KU_03	Can prepare and present a short presentation on the results of an engineering task
KW_02	Can independently, using the literature, solve simple computational problem
KW_02	Can apply own general engineering and mathematical knowledge in carrying out calculations and their result appropriateness estimation
KW_02	Is aware of the fact that all computer calculations are accompanied by errors, understands their nature and knows methods for their avoidance
KW_02	Knows basic numerical methods applied in solving engineering computational problems

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture – the passing condition is to obtain a positive mark from the final test.

Laboratory – the passing condition is to obtain positive marks from all laboratory exercises to be planned during the semester.

Calculation of the final grade: lecture 50% + laboratory 50%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
60	Class participation	2,8
18	Reading of supplementary texts	0,84
18	Preparation for classes	0,84
18	Preparation of reports	0,84
18	Assignment completion	0,84
18	Personal and on-line consultations	0,84
150	**Total**	**7**
Part-time studies		
No. of hours	**Type of workload**	**ECTS**
36	Class participation	1,69
23	Reading of supplementary texts	1,07
23	Preparation of reports	1,07
23	Preparation for classes	1,07
23	Assignment completion	1,07
22	Personal and on-line consultations	1,03
150	**Total**	**7**

RECOMMENDED READING:

1. Lloyd N. Trefethen and David Bau, III: *Numerical Linear Algebra,* SIAM, 1997
2. H.M. Antia: *Numerical Methods for Scientists and Engineers*, Birkhauser, 2000
3. Richard L. Burden, J. Douglas Faires, *Numerical analysis*, Brooks /Cole Publishing Company, ITP An International Thomson Publishing Company, sixth edition, 1997
4. Kendall Atkinson, *Elementary numerical anlysis*, John Wiley & Sons, Inc., second edition, 1993

OPTIONAL READING: -

REMARKS: -

GRAPHS AND NETWORKS IN COMPUTER SCIENCE

Course code: 11.9-WE-I-GSI-PK2_S2S

Type of course: compulsory

Language of instruction: Polish

Director of studies: Assoc. Prof. Andrei Karatkevich, Ph.D., D.Sc.

Name of lecturer: Assoc. Prof. Andrei Karatkevich, Ph.D., D.Sc.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	III	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	III	Grade	
Laboratory	18	2		Grade	

COURSE OBJECTIVE:

Providing basic knowledge of the graph theory and Petri net theory; knowledge of the most important graph algorithms having applications on computer science.

Providing ability of describing of relations in a system or structure using a graph model; ability of reducing (when possible) the computer science and optimization problems to the graph problems and of applying the proper graph algorithms for their solving.

Providing ability of implementation of the main graph algorithms using one of the universal programming languages.

ENTRY REQUIREMENTS:

Basics of programming

COURSE CONTENTS:

Introduction to the graph theory. Main notions. Directed and undirected graphs, intuitive examples. Paths and cycles. Families of graphs: trees, complete graphs, bipartite graphs, planar graphs. Graph-theoretic data structures. Main properties of graphs.
Basic graph algorithms: BFS, DFS, spanning tree algorithms, algorithms computing shortest paths in weighted graphs, graph coloring algorithms, maximum flow in a flow network. Eulerian and Hamiltonian graphs. Computational complexity of the graph algorithms.
Application of the graph theory methods to the problems of discrete optimization.
Binary decision diagrams. Representation of Boolean functions by BDD, reduction and minimization, operations on BDDs. ROBDD as an efficient data structure. MTBDD.

Applying of the selected graph algorithms and graph models to computer engineering tasks. *Elements of the theory of Petri nets.* Main definitions, matrix representation, properties, classification. Behavioral properties of discrete event systems and corresponding features of Petri net models: deadlocks, liveness, safeness etc. Analysis of the reachability and coverability graphs of Petri nets.

TEACHING METHODS:

Lecture, laboratory exercises.

LEARNING OUTCOMES:

Code	Effects of the course
K2I_W01	Can work individually and in a team.
K2I_U08	Can, if necessary, reduce IT problems to graph problems and use graph algorithms to solve them
K2I_W04	Can implement graph algorithms using one of the universal programming languages
K2I_U08	Can describe internal system or structure relations with graph models, and dynamic concurrent process, of e.g., logic control with Petri nets
K2I_W04	Knows basic concepts of graphs theory and the most important graph algorithms

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture – the passing condition is to obtain a positive mark from the final test.

Laboratory – the passing condition is to obtain positive marks from all laboratory exercises to be planned during the semester.

Calculation of the final grade: lecture 60% + laboratory 40%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
60	Class participation	2
15	Reading of supplementary texts	0,5
30	Preparation for classes	1
15	Preparation of reports	0,5
30	Assignment completion	1
30	Personal and on-line consultations	1
180	**Total**	**6**
Part-time studies		
No. of hours	**Type of workload**	**ECTS**
36	Class participation	1,2
18	Reading of supplementary texts	0,6
18	Preparation of reports	0,6
36	Preparation for classes	1,2
36	Assignment completion	1,2
36	Personal and on-line consultations	1,2
180	**Total**	**6**

RECOMMENDED READING:

1. Narsingh Deo, *Graph Theory with Application to Engineering and Computer Science*, Prentice-Hall, Englewood Cliffs, N.J., 1974
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *Introduction to Algorithms* (3rd ed.). MIT Press and McGraw-Hill, 2009 (or the earliest editions)
3. Robin J Wilson, *Introduction to graph theory*, Longman, 1996 (or another edition)
4. James L. Peterson, *Petri Net Theory and the Modeling of Systems*. Prentice Hall,1981

OPTIONAL READING:

1. Tadao Murata, *Petri Nets: Properties, Analysis and Applications*, in: Proceedings of the IEEE, vol. 77, no. 4, April 1989
2. Reinhard Diestel, Graph theory. Electronic edition, Springer Verlag New York, 2000

REMARKS: -

OPERATIONAL RESEARCH

Course code: 11.9-WE-I-BO-PK4_S2S
Type of course: compulsory
Language of instruction: Polish
Director of studies: Assoc. Prof. Maciej Patan, Ph.D., D.Sc.
Name of lecturer: Assoc. Prof. Maciej Patan, Ph.D., D.Sc.
Assoc. Prof. Krzysztof Patan, Ph.D., D.Sc.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	I	Exam	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	I	Exam	
Laboratory	18	2		Grade	

COURSE OBJECTIVE:

To provide basic skills in formulation of optimization tasks.

To provide knowledge in elementary procedures of quantitative optimization.

To give critical insight in the subject of reliability and efficiency of numerical process related to determination of the best solution.

To derive essential skills of using optimization techniques in engineering applications.

ENTRY REQUIREMENTS:

Mathematical analysis, Linear algebra and analytic geometry

COURSE CONTENTS:

Linear programming tasks (LPT). Standard formulation of LPT. Method of elementary solutions and simplex algorithm. Optimal choice for production assortment. Mixture problem. Technological process choice. Rational programming. Transportation and assignment problems. Two-person zero sum games and games with nature.
Network programming. Network models with determined logical structure. CPM and PERT methods. Time-cost analysis. CPM_COST and PERT-COST methods.
Non-linear programming tasks (NPT) – optimality conditions. Convex sets and functions. Necessary and sufficient conditions for the solution existence in the case without constraints. Lagrange multiplayers method. Extrema of the function with equality and inequality constraints. Kuhn-Tucker conditions. Constraints regularity. Conditions of an equilibrium point existence. Least squares method. Quadratic programming.

Computational methods for solving NPT. Directional search methods: Fibonacci, golden search, Kiefer, Powell and Davidon. Method of basic search: Hooke-Jeeves and Nelder-Mead. Continuous and discrete gradient algorithm. Newton method. Gauss-Newton and Levenberg-Marquardt algorithms. Elementary methods of feasible direction: Gauss-Seidel, steepest decent, conjugate gradient of Fletcher-Reeves, variable metric of Davidon-Fletcher-Powell. Searching for minimum in the case of constraints: internal, external and mixed penalty functions, projected gradient, sequential quadratic programming and admissible directions method. Elements of dynamic programming.
Practical issues. Simplification and elimination of constraints. Discontinuity elimination. Scaling. Numerical approximation of gradient. Usage of numerical packages. Presentation of methods implemented in popular environments for symbolic and numerical processing.

TEACHING METHODS:

Lecture, laboratory exercises.

LEARNING OUTCOMES:

Code	Effects of the course
K2I_W01 K2I_K01	Is aware of the importance of optimization in engineering practice
K2I_W06 K2I_U10	Can define mathematical and simulation models of opitimization tasks
K2I_U11 K2I_K05	Is able to make a time-cost analysis of logistics enterprises
K2I_K05	Can creatively use dedicated software and accessible numerical libraries in implementing optimization tasks
K2I_W06 K2I_K05	Understands the concept of an optimization task and its theoretical and practical aspects
K2I_W01 K2I_W06	Knows basic linear programming tasks and algorithms finding their solutions
K2I_W01 K2I_W06	Knows optimization conditions for non-linear programming tasks and numerical fundamentals for their solving

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture – the passing condition is to obtain positive mark from the exam;
Laboratory – the passing condition is to obtain positive marks from all laboratory exercises to be planned within the laboratory schedule.

Calculation of the final grade: lecture 50% + laboratory 50%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
60	Class participation	2,00
20	Preparation for classes	0,67
20	Reading of supplementary texts	0,67
30	Preparation of reports	1,00
30	Assignment completion	1,00
20	Preparation to exam	0,67
180	**Total**	**6**
Part-time studies		
No. of hours	**Type of workload**	**ECTS**
36	Class participation	1,20
24	Preparation for classes	0,8
24	Reading of supplementary texts	0,8
36	Preparation of reports	1,20

36	Assignment completion	1,20
24	Preparation to exam	0,8
180	**Total**	**6**

RECOMMENDED READING:

1. Ferris M., Mangasarian O., Wright S.: *Linear programming in MATLAB*, Cambridge University Press, 2008.
2. Ravindran A., Philips D., Solberg J.: *Operational research: Principles and Practice*, Wiley, 1987.
3. Winston W.: *Operations Research Applications and Algorithms*, Wadsworth Publishing Company, 1997.
4. Hillier F., Lieberman G.: *Introduction to operations research,* McGraw-Hill College, 1995.
5. Bertsekas D.: *Nonlinear programming*, 2nd edition, Athena Scientific, 2004
6. Boyd S., Vandenberghe L.: *Convex optimization*, Cambridge University Press, 2004.

OPTIONAL READING: -

REMARKS: -

SOFTWARE MODELING TECHNIQUES

Course code: 11.9-WE-I-TMP-PK5_S2S
Type of course: compulsory
Language of instruction: Polish
Director of studies: Ass. Prof. Tomasz Gratkowski, Ph.D.
Name of lecturer: Ass. Prof. Tomasz Gratkowski, Ph.D.
Ass. Michał Doligalski, Ph.D.
WIEA employers

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	I	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	I	Grade	
Laboratory	18	2		Grade	

COURSE OBJECTIVE:

To introduce students with the basics of software engineering and software modeling methods.

Formation of the students understanding of the principles of object-oriented programming.

To familiarize students with the principles of compiler design.

ENTRY REQUIREMENTS:

Principles of programming.

COURSE CONTENTS:

Elements of software engineering. Software development. Software crisis and ways to tackle them. Conceptual modeling. The role of modeling in software development. Historical background of modern modeling techniques. Object-oriented design methods and UML notation. Structured and object-oriented methodology. Business process modeling in BPMN. Create a software model based on BPMN model. Analysis and requirements modeling. Domain analysis and modeling. Architecture design. Software life cycle. System Design and System Analysis. The basic object-oriented concepts and relationships between objects. Modeling links between objects. Messages and procedure calls. Classes, inheritance, generalization / specialization, polymorphism, interfaces. Unified Modelling Language UML.

The genesis of the uprising. Definition and objectives of the creation of UML. The scope of UML. UML diagrams. Characteristic diagrams. UML Extensions: Stereotypes, labels, OCL. Transformation models (QVT, XSLT). Reminder basic features of object-oriented programming languages (C + +, Java, C #).

TEACHING METHODS:

Lecture, laboratory exercises.

LEARNING OUTCOMES:

Code	Effects of the course
K2I_W07	Knows fundamentals of UML language, most important UML diagrams, their applications, objects linking methods
K2I_U12 K2I_K01 K2I_K04	Understands the need for software modeling aiming at the ease of its design and increasing its reliability
K2I_W07 K2I_U12	Knows software and business processes modeling languages and techniques
K2I_U12 K2I_U14 K2I_K03 K2I_K04	Can model software using appropriate modelling languages
K2I_W07 K2I_U12	Knows fundamentals of object programming and can design software, with the application of object paradigms

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture – the passing condition is to obtain a positive mark from the final test.

Laboratory – the passing condition is to obtain positive marks from all laboratory exercises to be planned during the semester.

Calculation of the final grade: lecture 55% + laboratory 45%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
60	Class participation	2.00
15	Reading of supplementary texts	0.50
45	Preparation for classes	1.50
30	Preparation of reports	1.00
30	Tasks execution	1.00
180	**Total**	**6**
Part-time studies		
No. of hours	**Type of workload**	**ECTS**
36	Class participation	1.20
18	Reading of supplementary texts	0.60
36	Preparation of reports	1.20
54	Preparation for classes	1.80
36	Tasks execution	1.20
180	**Total**	**6.00**

RECOMMENDED READING:

1. Stanisław Wrycza: Język UML 2.0 w modelowaniu systemów informatycznych, Helion 2006
2. Brookes F. P.,: Mityczny osobomiesiąc. Eseje o inżynierii oprogramowania WNT, Warszawa, 2000.
3. Grady B., Rumbaugh J., Jacobson I.: UML przewodnik użytkownika, Wydawnictwa Naukowo – Techniczne, Warszawa, 2002.
4. Graessle P., Baumann H., Baumann P.:, UML 2.0 w akcji. Przewodnik oparty na projektach, Helion 2006 (e-book 2011).
5. Marek Piotrowski , Notacja modelowania procesów biznesowych – podstawy, BTC, Legionowo 2007
6. Szymon Drejewicz, Zrozumieć BPMN. Modelowanie procesów biznesowych, Helion2012

OPTIONAL READING: -

REMARKS: UML, BPML, Software, model

NETWORK PROGRAMMING

Course code: 11.3-WE-I-PS-PSW_D9_IK2I_S2S

Type of course: compulsory

Language of instruction: Polish

Director of studies: Ass. Prof. Tomasz Gratkowski, Ph.D.

Name of lecturer: Ass. Prof. Tomasz Gratkowski, Ph.D.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	15	1	II	Grade	
Laboratory	30	2		Grade	
Project	15	1		Grade	
Part-time studies					
Lecture	9	1	II	Grade	
Laboratory	18	2		Grade	
Project	9	1		Grade	

COURSE OBJECTIVE:

Abilities and competence in design and implementation network applications in Java language.

ENTRY REQUIREMENTS:

Principles of programming, Java programming

COURSE CONTENTS:

High level mechanism of access to the global network – Internet. Working with Uniform Resource Locator (URL). Network protocols. Creating Content and Protocol Handlers in Java.

Model client-server. Stream Sockets - TCP and Datagram Socket (connectionless sockets) - UDP. IP multicast addressing. Programming services for Internet. Network Time Protocol. Interactive using remote machines.

Java Mail API. Web applications. Interactive Java Applets. Java Web Start.

Using of Java DataBase Connectivity (JDBC) to connect to the network database resources. Processing of data stored in XML documents.

Building of web application in Web Service technologies.

TEACHING METHODS:

Lecture, laboratory exercises, project.

LEARNING OUTCOMES:

Code	Effects of the course
K2I_W11, K2I_U14	Can choose an appropriate network protocol to optimize the performance of created application network.
K2I_W11, K2I_U14	Can use standard network protocols.
K2I_W11, K2I_U14	Can develop their own network protocol
K2I_W11, K2I_U14	Can design and create a network application in object-based Java
K2I_K01	Can explain global Internet network resources accessing methods with the application of Java language
K2I_W11	Can explain network sockets operation mechanism

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture – the passing condition is to obtain a positive mark from the final test.

Laboratory – the passing condition is to obtain positive marks from all laboratory exercises to be planned during the semester.

Project – positive marks for main project.

Calculation of the final grade: lecture 40% + laboratory 30% + project 30%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
60	Class participation	2
24	Reading of supplementary texts	0.8
24	Preparation for classes	0.8
24	Preparation of reports	0.8
24	Assignment completion	0.8
24	Personal and on-line consultations	0.8
180	**Total**	**6**
Part-time studies		
No. of hours	**Type of workload**	**ECTS**
36	Class participation	1.2
29	Reading of supplementary texts	0.97
29	Preparation of reports	0.97
29	Preparation for classes	0.97
29	Assignment completion	0.97
28	Personal and on-line consultations	0.93
180	**Total**	**6**

RECOMMENDED READING:

1. Stevens W.R.: *UNIX Network Programming, Volume 1, Second Edition: Networking APIs: Sockets and XTI*, Prentice Hall, 1998.
2. Horstmann C. S., Cornell G.: *Core Java 2, Volume 1: Fundamentals (8th Edition)*, Prentice Hall PTR, 2007.
3. Horstmann C. S., Cornell G.: *Core Java, Vol. 2: Advanced Features, (8th Edition)*, Prentice Hall PTR, 2008.
4. Harold E. R.: *Java Network Programming, Third Edition*, Oreilly & Associates Inc 2004.

OPTIONAL READING:

1. Jendrock E., Haase K., Gollapudi D., Srivathsa C.: The Java EE 6 Tutorial; 2012; [http://download.oracle.com/javaee/6/tutorial/doc/javaeetutorial6.pdf]
2. Graham S., Simeonov S., Boubez T., Daniels G., Davis D., Nakamura Y., Neyama R.: *Building Web Services with Java: Making Sense of XML, SOAP*, Pearson Education; 1st edition, 2001.
3. Monnox A.: Rapid J2EE Development: An Adaptive Foundation for Enterprise Applications; Prentice Hall, 2005.

REMARKS:

Java language, model client-server, URL, TCP, UDP, mail, network protocols, NTP, applets, Java Web Start, JDBC, XML, WebService

SOCIAL NETWORKS AND MULTI-AGENT SYSTEMS

Course code: 11.3-WE-I-SSiSW-PSW_A4_ISI_S2S
Type of course: compulsory
Language of instruction: Polish
Director of studies: Ass. Prof. Mariusz Jacyno, Ph.D.
Name of lecturer: Ass. Prof. Mariusz Jacyno, Ph.D.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					7
Lecture	30	2	II	Grade	
Laboratory	15	1		Grade	
Project	15	1		Grade	

COURSE OBJECTIVE:

To introduce students to modern software engineering approaches that utilise agent-based technology. To outline new Internet technologies, including social media and to explain how social networks can be employed for Big Data analytics. To characterise modern techniques and solutions for performing analytics on large subsets of data.

ENTRY REQUIREMENTS:

Java programming.

COURSE CONTENTS:

Intelligent agents and multi-agent systems. Architecture and design of intelligent agents. Coordination mechanisms for multi-agent systems. Engineering of autonomic and complex software systems using agent-based technology.
Social networks. Properties of social networks. The role and application of social networking in e-business. Mechanisms for managing and monitoring social systems.
Big Data and social media analysis. Phenomenon of Big Data. Application of Big Data within the context of e-business. Tools and technologies for performing analytics on large scale. Hadoop ecosystem and its application for Big Data analytics. SAS tools and technologies for real-time analytics.

TEACHING METHODS:

Lecture, laboratory exercises, project.

LEARNING OUTCOMES:

Code	Effects of the course
K1I_K01	Student is aware of three main agent-based coordination techniques.
K1I_W10	Student is capable to implement a simple trading agent and participate in TAC competition.

K1I_U23	Student can outline the distinguishing properties of social media and social networks in particular.
K1I_U23	Student can outline main technologies used during big data analytics and can assess their applicability based on the discussed context.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture – the passing condition is to obtain positive mark from the exam.
Laboratory – the passing condition is to obtain positive marks from all laboratory exercises to be planned within the laboratory schedule.

Project – the passing condition is to obtain positive mark from the project.

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
60	Class participation	2
30	Reading of supplementary texts	1
30	Preparation for classes	1
30	Preparation of reports	1
30	Assignment completion	2
210	**Total**	**7**

RECOMMENDED READING:

1. Wooldridge M.: *Multi-agent systems (second edition)*, MIT Press, 2013
2. Watts J. D.: *Six degress: the science of a connected age*, W.W. Norton & Company, 2003
3. White T.: *Hadoop: The Definite Guide (third edition)*, O'Reilly Media, 2012
4. Owen S., Anil R., Dunning T., Fridman E.: *Mahout in action*, Manning Publications, 2011

REMARKS: -

PARALLEL AND FUNCTIONAL PROGRAMMING TECHNIQUES

Course code: 11.3-WE-I-RiFTP-PSW_A5_ISI_S2S
Type of course: optional
Language of instruction: Polish
Director of studies: Ass. Prof. Marek Sawerwain, Ph.D.
Name of lecturer: Ass. Prof. Marek Sawerwain, Ph.D.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	15	1	III	Grade	
Laboratory	15	1		Grade	
Project	15	1		Grade	
Part-time studies					
Lecture	9	1	III	Grade	
Laboratory	9	1		Grade	
Project	9	1		Grade	

COURSE OBJECTIVE:

To provide basic information about parallel and functional programming techniques.

To shape understanding and awareness of the role of parallel programming techniques as well as highlight the increasing role of functional programming.

To give basic skills in creating parallel programs for multicore systems based on traditional processors (CPU) as well as graphics multicore processors of general use.

To shape of the basic skills in the functional programming paradigm, and in particular: the role of functions and recursion, programming without side effect and the acquisition of skill to use the method of the lazy computations.

ENTRY REQUIREMENTS:

Methods of Programming, Algorithms and Data Structures, Theoretical Foundations of Computer Science, Logic for Computer Scientists

COURSE CONTENTS:

Theory of computation models: models of parallel computations and complexity classes.

Programmer tools: available tools for parallel programming for CUDA and OpenCL technologies.

Basic operations: Parallel primitive operations.

Data Dependency: dependency and division of data, models of execution of parallels environments for CPU and GPU.

Programming paradigm: Functional paradigm and basic constructions in selected functional languages OCaml, F#, Scala.

Basic data types: Data types in functional programming, exceptions and objects.

High-class function: first-class and higher-order functions, functional model of computations (in a form of simplified operational description).

Type system and imperative control flow instructions: type systems, and lazy-computations, imperative features in functional programming languages.

TEACHING METHODS:

Lecture, laboratory exercises, project.

LEARNING OUTCOMES:

Code	Effects of the course
K2I_W13	Knows model of parallel programming used in modern hardware-software computation systems.
K2I_W11	Knows and understands the basics of functional paradigm and the role of imperative constructions in functional languages.
K2I_W09	Knows the role of primitive parallel operations and knows of complexity class of parallel algorithms. Also knows the notion of first-order function and type notion and understands type system in functional language.
K2I_U07	Knows how to make implementation of simple algorithms with lazy-computations technique. Can also implement programs solving problem with techniques of parallel programming or functional programming.
K2I_U16	Can use existing libraries which supports parallel programming techniques for CPU and GPU.
K2I_K01	Is aware of dynamic development of parallel programming techniques and rising role of functional programming.
K2I_K03	Can work individually and in a team.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture – the passing condition is to obtain a positive mark from the final test.

Laboratory - the passing condition is to obtain positive grades obtained during the laboratory exercises.

Project - the passing condition is to obtain positive mark from written (the electronic form is also acceptable) report about the realized project.

Calculation of the final grade: lecture: 40% + laboratory: 30% + project: 30%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
45	Class participation	1,5
20	Reading of supplementary texts	0,65
20	Preparation for classes	0,65
20	Preparation of reports	0,65
20	Assignment completion	0,65
25	Personal and on-line consultations	0,9
150	**Total**	**5**

Part-time studies		
No. of hours	**Type of workload**	**ECTS**
27	Class participation	1,1
24	Reading of supplementary texts	0,75
24	Preparation of reports	0,75
24	Preparation for classes	0,75
24	Assignment completion	0,75
27	Personal and on-line consultations	0,90
150	**Total**	**5**

RECOMMENDED READING:

1. R. Pickering, Foundations of F#, Apress, USA, 2007.
2. C. Smith, Programming F#, O'Reilly Media, Inc., Sebastopol, USA, 2010.
3. J. Sanders, E. Kandrot, CUDA by Example: An Introduction to General-Purpose GPU Programming, Addison-Wesley Professional, 2010,
4. B. Gaster, L. Howes, D. R. Kaeli, P. Mistry, D. Schaa, Heterogeneous Computing with OpenCL, Morgan Kaufmann, 2011.
5. P. Pacheco, An Introduction to Parallel Programming, Morgan Kaufmann, 2011.
6. M. Herlihy, N. Shavit, The Art of Multiprocessor Programming, Morgan Kaufmann, 2012.

OPTIONAL READING:

1. S. Thomspon, Haskell - The Craft of Functional Programming, Addison-Wesley Longman Publishing Co., Inc. Boston, MA, USA, 1999.
2. J. Harrop, F# for Scientists, John Wiley & Sons, Inc., Hoboken, New Jerseym USA, 2008.
3. D. Syme, A. Granicz, A. Cisternino, Expert F# 2.0, Apress, USA, 2010.
4. R. Farber, CUDA Application Design and Development, Morgan Kaufmann, 2011.
5. Wen-mei W. Hwu, eds, GPU Computing Gems, Emerald Edition and Jade Edition, Morgan Kaufmann, 2011.

REMARKS: -

APPLICATION DEVELOPMENT FOR ANDROID PLATFORM

Course code: 11.3-WE-I-PAnPA-PSW_A5_ISI_S2S
Type of course: optional
Entry requirements: Java and Web Technologies
Language of instruction: Polish
Director of studies: Ass. Prof. Przemysław Jacewicz, Ph.D.
Name of lecturer: Ass. Prof. Przemysław Jacewicz, Ph.D.
Ass. Prof. Mariusz Jacyno, Ph.D.
Ass. Prof. Błażej Cichy, Ph.D.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					4
Lecture	15	1	III	Grade	
Laboratory	15	1		Grade	
Project	15	1		Grade	
Part-time studies					
Lecture	9	1	III	Grade	
Laboratory	9	1		Grade	
Project	9	1		Grade	

COURSE OBJECTIVE:

To provide basic knowledge about advanced programming technics for mobile devices working on Android platform.

To give basic skills in programming of touch interfaces.

To provide basic knowledge about limitation in programming of mobile devices.

To give basic skills in designing portable mobile application.

ENTRY REQUIREMENTS:

Java and Web Technologies

COURSE CONTENTS:

Designing mobile applications for Android OS. Determining the ability to satisfy requirements of the application. Prepare test plans for quality control. Selection of source code

management system. Using the numbering system version. Designing for expansion and patching applications. Designing for application interoperability.

Testing of mobile applications for the Android platform. Designing a system for recording errors for programming mobile devices. Environment for test management. Application testing services.

Methods of application publishing. Preparation of code to create an installation package. Generating and signing an application package. Testing the published version of the application package.

Support for end-user applications. Tracking and verification of faults. Testing firmware update target devices.

LEARNING OUTCOMES:

Code	Effects of the course
K_W09 K_W11	Is able to design a mobile application for Android
K_U14	Is able to create mobile apps for Android
K_U14	Is able to testing mobile apps for Android
K_U14	Is able to publish mobile apps for Android
K_K03	Can work individually and in a team

TEACHING METHODS:

Lecture, laboratory exercises and project exercises.

ASSESSMENT CRITERIA:

Lecture – the passing condition is to obtain a positive mark from the final test.

Laboratory – the passing condition is to obtain positive marks from all laboratory exercises to be planned during the semester.

Project – the passing condition is to obtain positive marks for all project tasks as scheduled.

Calculation of the final grade: lecture 40% + laboratory 30% + project 30%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
45	Class participation	1,5
21	Reading of supplementary texts	0,7
21	Preparation for classes	0,7
21	Preparation of reports	0,7
21	Assignment completion	0,7
21	Personal and on-line consultations	0,7
150	**Total**	**5**

RECOMMENDED READING:

1. Lauren Darcey, Shane Conder: Android Wireless Application Development Volume II: Advanced Topics, Addison-Wesley, July 2012.
2. Reto Meier: Professional Android Application Development, Wiley India Pvt. Limited, 2008.

OPTIONAL READING:

1. Mark L. Murphy: The Busy Coder's Guide to Advanced Android Development, CommonsWare, LLC, 2009.

REMARKS: -

NEURAL AND NEURO-FUZZY NETWORKS IN BUSINESS MAGAGEMENT

Course code: 11.3-WE-I-SNiN-PSW_A1_ISI_S2S

Type of course: optional

Language of instruction: Polish

Director of studies: Assoc. Prof. Marcin Mrugalski, Ph.D., D.Sc.

Name of lecturer: Assoc. Prof. Marcin Mrugalski, Ph.D., D.Sc.
Ass. Prof. Marek Kowal, Ph.D.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					7
Lecture	30	2	II	Exam	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	II	Exam	
Laboratory	18	2		Grade	

COURSE OBJECTIVE:

Familiarize students with different architectures of artificial neural networks and neuro-fuzzy networks.

Familiarize students with the learning methods of neural networks and neuro-fuzzy networks.

Development of skills to apply neural networks and neuro-fuzzy networks to modeling and pattern recognition.

ENTRY REQUIREMENTS: -

COURSE CONTENTS:

Introduction to neural networks. History and development of artificial neural networks and neuro-fuzzy networks. Structure of biological neuron. Mathematical model of artificial neuron. Neuron activation functions. Learning algorithm for perceptron. Adaline and Madaline structures. Supervised and unsupervised learning methods. Classical XOR problem.

Feedforward neural networks. Fundamentals of multilayer neural networks. Backpropagation algorithm for neural network learning. Issues and limitations of gradient descent learning algorithms. Adaptive learning rate. Momentum. Sample applications of neural networks. Review of advanced learning algorithms. Evolutionary algorithms for neural network design and learning..

Recurrent neural networks. Dynamic-feedback neural networks. Learning algorithms for feedback neural networks. Mathematical model of dynamic neuron. Locally recurrent globally feed-forward neural networks. GMDH type networks. Hopfield networks. Learning algorithms for Hopfield network.

Self-organizing neural networks. Kohonen self-organizing feature maps. Competitive learning. Neural gas algorithm. Sample applications of Kohonen network.

Neuro-fuzzy systems. Fuzzy sets and fuzzy logic. Fuzzy inference. Mamadani neuro-fuzzy networks. Takagi-Sugeno neuro-fuzzy networks. Learning algorithms for neuro-fuzzy networks.

TEACHING METHODS:

Lecture, laboratory exercises.

LEARNING OUTCOMES:

Code	Effects of the course
K2I_U05	Can name and describe fuzzy sets operations, explain processes occurring in fuzzy reasoning, describe Mamdani and Takagi-Sugeno neuro-fuzzy systems structure, present fundamentals of mathematical algorithms for learning
K2I_W08	Can run learning and simulation of known neural networks and neuro-fuzzy systems in Matlab environment.
K2I_U10	Can formulate proper conclusions resulting from the conducted learning experiments, because they are aware of limitations of particular structures of neural and neuro-fuzzy networks, and learning algorithms.
K2I_W12	Can apply neural networks and neuro-fuzzy systems in modeling and pattern recognition tasks
K2I_W08	Can characterize the properties and describe the structure of feed forward neural networks, recursive networks, self-organizing networks, radial networks and neuro-fuzzy structures

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture – the passing condition is to obtain a positive mark from the final test.

Laboratory – the passing condition is to obtain positive marks from all laboratory exercises to be planned during the semester.

Calculation of the final grade: lecture 50% + laboratory 50%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
60	Class participation	2
25	Reading of supplementary texts	0,833
25	Preparation for classes	0,833
25	Preparation of reports	0,833
25	Assignment completion	0,833
25	Personal and on-line consultations	0,833
25	Preparation for exam	0,833
210	**Total**	**7**
Part-time studies		
No. of hours	**Type of workload**	**ECTS**
36	Class participation	1,2
30	Reading of supplementary texts	1
25	Preparation of reports	0,833

39	Preparation for classes	1,3
30	Assignment completion	1
25	Personal and on-line consultations	0,833
25	Preparation for exam	0,833
210	**Total**	**7**

RECOMMENDED READING:

1. Haykin S.: Neural Networks: A Comprehensive Foundation (2nd Edition), Prentice Hall, 1998.
2. Bishop M.: Neural Networks for Pattern Recognition, Oxford University Press 1996.
3. Rutkowska D.:Neuro-Fuzzy Architectures and Hybrid Learning, Springer, 2001

OPTIONAL READING: -

REMARKS: -

IT SYSTEMS IN BUSINESS MANAGEMENT

Course code: 11.3-WE-I-SIwZF-PSW_A3_ISI_S2S
Type of course: optional
Language of instruction: Polish
Director of studies: Ass. Prof. Marek Kowal, Ph.D.
Name of lecturer: Ass. Prof. Marek Kowal, Ph.D.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	II	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	II	Grade	
Laboratory	18	2		Grade	

COURSE OBJECTIVE:

Familiarize students with the principles of the ERP systems and methods of implementation of such systems in the enterprise.

Development of skills in planning and building analytical systems.

Familiarize students with the methods of business data mining.

ENTRY REQUIREMENTS:

Databases

COURSE CONTENTS:

Enterprise resource planning systems: ERP architectures, Characterization of functional modules of ERP systems, Best business practices for ERP systems, ERP implementation methodologies, Overview and characteristics of popular ERP systems.

Analytical systems: Data sources, Data integration, Overview and characteristics of typical data transformation operations, Design and implementation of data transformation processes, Gathering data in a data warehouse, Multidimensional data structures, Presentation of the results of the analysis in the form of reports.

Data mining: Data cleaning, Outlier detection and handling missing data, Discovering association rules and sequences using Apriori and Frequent Pattern Growth, Generalized Sequential Pattern and PrefixSpan algorithms, Data clustering using hierarchical and iterative optimization algorithms,

Data classification using k-nearest neighbor, decision trees and naive Bayes classifier, Time series analysis using parametric models, Overview of systems for data mining.

TEACHING METHODS:

Lecture, laboratory exercises.

LEARNING OUTCOMES:

Code	Effects of the course
K2I_W09	Can name and describe the ERP modules.
K2I_U11	Knows the methods and steps of implementation of ERP systems in the enterprise.
K2I_W09	Knows the architecture of analytic system and can characterize individual components of such a system.
K2I_U07	Can use typical data transformation operations.
K2I_U07	Can design and build a multidimensional cube based on a star schema and snowflake schema.
K2I_U03	Can present the results of data analysis in a report.
K2I_W11	Knows data mining methods, which can apply to discover association and sequence rules, data clustering, classification and time series analysis.
K2I_U13	Can apply known data mining methods for business data

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture – the passing condition is to obtain a positive mark from the final test.

Laboratory – the passing condition is to obtain positive marks from all laboratory exercises to be planned during the semester.

Calculation of the final grade: lecture 50% + laboratory 50%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
60	Class participation	2
50	Reading of supplementary texts	1,67
20	Preparation for classes	0,66
50	Assignment completion	1,67
180	**Total**	**6**
Part-time studies		
No. of hours	**Type of workload**	**ECTS**
36	Class participation	1,2
50	Reading of supplementary texts	1,67
20	Preparation for classes	0,66
50	Assignment completion	1,67
24	Personal and on-line consultations	0,8
180	**Total**	**6**

RECOMMENDED READING:

1. Kimball R., Ross M.: *The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling*, Wiley, 2013.
2. Magal S. R., Word J.: *Integrated Business Processes with ERP Systems*, Wiley, 2011.
3. Wagner B., Monk E.: *Enterprise Resource Planning*, Cengage Learning EMEA, 2008.

4. Witten I. H., Frank E., Hall M. A.: *Data Mining: Practical Machine Learning Tools and Techniques*, Morgan Kaufmann, 2011
5. Kimball R., Caserta J.: *The Data Warehouse ETL Toolkit: Practical Techniques for Extracting, Cleaning, Conforming, and Delivering Data*, Wiley, 2004.
6. Corr L., Stagnitto J.: Agile Data Warehouse Design: Collaborative Dimensional Modeling, from Whiteboard to Star Schema, DecisionOne Press, 2011

OPTIONAL READING:

1. Meer K.: Best Practices in ERP Software Applications: Accounting, Supply Chain Planning, Procurement, Inventory, iUniverse, 2005.
2. Bradford M.:Modern ERP: Select, Implement & Use Today's Advanced Business Systems, lulu.com, 2008.
3. Han J., Kamber M.: Data Mining: Concepts and Techniques, Morgan Kaufmann, 2011.

REMARKS: -

GEOGRAPHICAL INFORMATION SYSTEMS

Course code: 11.3-WE-I-SIP-PSW_A6_ISI_S2S
Type of course: optional
Language of instruction: Polish
Director of studies: Ass. Prof. Marek Kowal, Ph.D.
Name of lecturer: Ass. Prof. Marek Kowal, Ph.D.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					4
Lecture	15	1	III	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	9	1	III	Grade	
Laboratory	18	2		Grade	

COURSE OBJECTIVE:

Familiarize students with the principles of the Geographical Information Systems (GIS).

To develop skills in the creation of GIS systems.

Familiarize students with the methods of spatial data analysis.

ENTRY REQUIREMENTS:

Computer graphics

COURSE CONTENTS:

Fundamentals of GIS: History of GIS development, The main applications of GIS, Definitions of terms related to cartographic coordinate systems, Cartographic coordinate systems in Poland, Digital maps, Data sources for GIS, Types of geographical objects, GIS software.

GIS data models: Discrete and continuous spatial data, Precision of spatial data, Spatial data representation using raster and vector graphics, Qualitative and quantitative properties of geographical objects, Raster to vector transformation, Multi-layered representation of spatial data.

GIS architecture: Entering and verification of spatial data, Spatial databases, Designing spatial databases, Database management systems of spatial data, Spatial data processing procedures, Imaging of the spatial data, Presentation of spatial data on the Internet and on mobile devices.

Spatial data analysis: Sampling of spatial data, Geostatistics, Network analysis, Path finding problems, Spatial relationships and interactions, Spatial interpolation, Spatial regression, Spatial simulations using cellular automata.

TEACHING METHODS:

Lecture, laboratory exercises.

LEARNING OUTCOMES:

Code	Effects of the course
K2I_W09	Can name and characterize components of GIS.
K2I_W08	Knows the types of data structures used in GIS.
K2I_W03	Can name and define methods of spatial data analysis.
K2I_U01	Can enter spatial data into the GIS and generate queries about GIS data
K2I_U01	Can design and create a spatial database
K2I_U13	Knows how to manage and transform spatial data
K2I_U07	Can apply the methods of spatial data analysis and is able to interpret the results of spatial data analysis
K2I_W10	Knows the imaging methods of spatial data.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture – the passing condition is to obtain a positive mark from the final test.

Laboratory – the passing condition is to obtain positive marks from all laboratory exercises to be planned during the semester.

Calculation of the final grade: lecture 50% + laboratory 50%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
45	Class participation	1,5
15	Reading of supplementary texts	0,5
15	Preparation for classes	0,5
15	Preparation of reports	0,5
15	Assignment completion	0,5
15	Personal and on-line consultations	0,5
120	**Total**	**4**
Part-time studies		
No. of hours	**Type of workload**	**ECTS**
27	Class participation	0,9
15	Reading of supplementary texts	0,5
15	Preparation of reports	0,5
24	Preparation for classes	0,8
18	Assignment completion	0,6
21	Personal and on-line consultations	0,7
120	**Total**	**4**

RECOMMENDED READING:

1. Bivand R.S., Pebesma E.J., Gómez-Rubio V.: Applied Spatial Data Analysis with R, Springer, 2008.
2. Kolvoord R., Keranen K.: Making Spatial Decisions Using GIS, A Workbook, ESRI, 2011.
3. Bolstad P.: GIS Fundamentals: A First Text on Geographic Information Systems, Eider Press, 2004

OPTIONAL READING:

1. Haining R.: Spatial Data Analysis. Theory and Practice, Cambridge University Press, 2003.
2. Riple B. D.: Spatial statistics John Wiley & Sons, 2004.
3. Gorr W. L, Kurland K. S: GIS Tutorial Basic Workbook, ESRI, 2007.
4. Kolvoord R., Keranen K.: Making Spatial Decisions Using GIS, A Workbook, ESRI, 2011.

REMARKS: -

DATA WAREHOUSES

Course code: 11.3-WE-I-HD-PSW_A6_PSI_S2S

Type of course: optional

Language of instruction: Polish

Director of studies: Assoc. Prof. Wiesław Miczulski, Ph.D., D.Sc.

Name of lecturer: Ass. Prof. Robert Szulim, Ph.D.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					7
Lecture	30	2	II	Exam	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	II	Exam	
Laboratory	18	2		Grade	

COURSE OBJECTIVE:

acquaint students with architectures of data warehouses and multidimensional data models,
acquaint students with the basic methods of data mining,
shaping basic skills in the practical construction of the data warehouse.

ENTRY REQUIREMENTS:

Probabilistic methods, Experiment technique, Databases, Elements of artificial intelligence.

COURSE CONTENTS:

Introduction. Decision support systems. Operational processing versus analytical processing.

Data warehouses. Definition of Data Warehouse. Features of Data Warehouse. Exemplary applications. Architectures of Data Warehouses. Layered structure of the Warehouse: data sources, extraction layer, cleaning, transformation and data loading, data access layer. Tools for designing, building, maintaining and administering of the Data Warehouse.

Multidimensional data models. Models: MOLAP, ROLAP, HOLAP. Building of exemplary data cube.

Data Mining. Data preparation process. Selected Data Mining methods: classification, grouping, regression, discovering association and sequences, time series. Knowledge representation forms: logical rules, decision trees, neural nets, Exemplary Data Mining applications.

TEACHING METHODS:

Lecture, laboratory exercises.

LEARNING OUTCOMES:

Code	Effects of the course
K2I_W08,K2I_W12	Describes the structure of data warehouse.
K2I_K01	Can work individually and in a team.
K2I_W08	Can characterize data models used in data warehouses.
K2I_W08, K2I_W12	Can indicate in the life cycle of a data warehouse the activities leading to the improvement of its quality.
K2I_U05, K2I_U13	Applies selected informatics tools in data exploration
K2I_U05	Creates example data warehouses

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture – obtaining a positive grade from exam.

Laboratory – the passing condition is to obtain positive marks from all laboratory exercises to be planned during the semester.

Calculation of the final grade: lecture 50% + laboratory 50%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
60	Class participation	2
30	Reading of supplementary texts	1
30	Preparation for classes	1
36	Preparation of reports	1,2
24	Assignment completion	0,8
30	Personal and on-line consultations	1
210	**Total**	**7**
Part-time studies		
No. of hours	**Type of workload**	**ECTS**
36	Class participation	1,2
39	Reading of supplementary texts	1,3
36	Preparation for classes	1,2
36	Preparation of reports	1,2
24	Assignment completion	0,8
39	Personal and on-line consultations	1,3
210	**Total**	**7**

RECOMMENDED READING:

1. Hand D., Mannila H., Smyth P.: *Principles of Data Mining*. Massachusetts Institute of Technology, 2001.
2. Jarke M., Lenzerini M., Vassiliou Y., Vassiliadis P.: *Fundamentals of Data Warehouses*. Springer-Verlag, Berlin, 2002.
3. Larose D.T.: *Discovering Knowledge in Data. An Introduction to Data Mining.* John Wiley & Sonc, Inc., 2005.
4. Larose D.T.: *Data Mining Methods and Models.* John Wiley & Sonc, Inc., 2006.
5. Poe V., Klauer P., Brobst S.: *Building a Data Warehouse for Decision Support.* Prentice-Hall, Inc., a Simon & Schuster Company, 1999.

OPTIONAL READING: -

REMARKS: -

COMPUTER-AIDED DESIGN

Course code: 11.9-WE-I-KWP-PSW_B7_PSI_S2S
Type of course: compulsory
Language of instruction: Polish
Director of studies: Ass. Prof. Janusz Kaczmarek, Ph.D.
Name of lecturer: Ass. Prof. Janusz Kaczmarek, Ph.D.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	15	1	II	Grade	
Laboratory	30	2		Grade	
Project	15	1		Grade	
Part-time studies					
Lecture	9	1	II	Grade	
Laboratory	18	2		Grade	
Project	9	1		Grade	

COURSE OBJECTIVE:

Know-how and competences in the field of applying Electronic Design Automation software supporting the process of designing electronic circuits with emphasis on embedded microprocessor systems.

ENTRY REQUIREMENTS:

Digital systems design , Microprocessor systems, Principles of programming

COURSE CONTENTS:

Introduction to the computer-aided design of electronic circuits. Historical outline. Overview of Electronic Design Automation systems. Basic notions and definitions. Imperial and metric system of units.
Methodology of designing an electronic circuit using EDA system. Basic concepts on capturing a circuit as a schematic diagram: netlist, wires and buses. Component library structure: part, symbol, package and padstack. Creating schematic diagrams with hierarchical and multipage techniques. Printed Circuit Board designing using layout editor. Methods of placing components and routing traces. Designing one, two and multilayer PCB. Automatic routing of PCB traces with an autorouter tool. Design rule check in EDA systems.

Printed Circuit Board designing for EMC requirements. Basic knowledge of RF emissions and susceptibility of electronic circuits. PCB EMC techniques: circuit zoning, suppressing interfaces between circuit zones, ground system, power routing and decoupling, signal routing and line termination. Signal integrity and transmission lines on PCB.
Computer simulation of electronic circuits. SPICE simulation fundamentals. Types of simulation analysis: nonlinear dc, small signal ac, transient, sensitivity and distortion. Models of electronic devices. Schematic-level simulation of embedded microprocessor systems. Analysis of simulation results.
Computer simulation of thermal and electromagnetic properties of printed circuit boards.
Producing design documentation and CAM files in EDA systems.

TEACHING METHODS:

Lecture, laboratory exercises, project.

LEARNING OUTCOMES:

Code	Effects of the course
K1I_W10	Is open to new technologies and is ready to implement them
K2I_W09, K2I_U14, K2I_K03, K2I_K04	Can design and study microprocessor systems using EDA program
K2I_K04	Can create technical documentation of a designed device and generate the files needed to produce the printed circuit board
K2I_W09, K2I_K0	Can design printed circuit boards with manual and automatic routing
K2I_K03, K2I_K04	Knows design methodology of electronic devices with EDA type software

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture – the passing condition is to obtain a positive mark from the final test.

Laboratory – the passing condition is to obtain positive marks from all laboratory exercises to be planned during the semester.

Project - the project documentation and oral presentation

Calculation of the final grade: lecture 30% + laboratory 40% + project 30%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
60	Class participation	2
28	Reading of supplementary texts	0,93
36	Preparation for classes	1,2
26	Preparation of reports	0,87
15	Assignment completion	0,5
15	Personal and on-line consultations	0,5
180	**Total**	**6**
Part-time studies		
No. of hours	**Type of workload**	**ECTS**
45	Class participation	1,5
30	Reading of supplementary texts	1
42	Preparation for classes	1,4
28	Preparation of reports	0,93

15	Assignment completion	0,5
20	Personal and on-line consultations	0,67
180	**Total**	**6**

RECOMMENDED READING:

1. Williams T.: *The Circuit Designer's Companion,* Newnes, 2005
2. Kundert K. S.: *The Designer's Guide to Spice and Spectre,* Kluwer Academic Publishers, 2003
3. Archambeault B. R., Drewniak J.: *PCB Design for Real-World EMI Control,* Kluwer Academic Publishers, 2004
4. Rymarski Z.: *Materials technology and construction of electronic circuits. Designing and production of electronic circuits*, Wydawnictwo Politechniki Śląskiej, Gliwice, 2000 (in Polish)
5. Sidor T.: *Computer analysis of electronic measurement circuits*, Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH, Kraków, 2006 (in Polish)

OPTIONAL READING: -

REMARKS: -

DIGITAL SIGNAL PROCESSING

Course code: 11.9-WE-I-CPS-PSW_C8_PSI_S2S

Type of course: compulsory

Language of instruction: Polish

Director of studies: Assoc. Prof. Ryszard Rybski, Ph.D., D.Sc.

Name of lecturer: Assoc. Prof. Ryszard Rybski, Ph.D., D.Sc.
Ass. Prof. Mirosław Kozioł, Ph.D.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					7
Lecture	30	2^E	II	Exam	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2^E	II	Exam	
Laboratory	18	2		Grade	

COURSE OBJECTIVE:

To provide basic knowledge about fundamentals of spectral analysis and filtration of discrete signals.

To provide knowledge about formal description of discrete systems.

To provide knowledge about digital filters design.

To give skills in practical implementation of spectral analysis and filtration of discrete signals.

ENTRY REQUIREMENTS:

Mathematical analysis, Principles of programming, Numerical methods

COURSE CONTENTS:

Fundamentals of signal theory. Notion of signal. Classifications of signals. Mathematical models of selected signals.

Fourier series and Fourier transform for continuous time signals. Fourier series representation of continuous-time signals with examples. Synthesis of continuous-time signals on the basis of the Fourier coefficients. Gibbs phenomenon. Dirichlet conditions of the Fourier series representation of signals. Fourier series properties. The Fourier transform. Dirichlet conditions for Fourier transform. Fourier transform properties. An influence of a signal observation in finite time interval on its spectrum.

Analog-to-digital and digital-to-analog conversion. Chain of signal processing during analog-to-digital and digital-to-analog conversion. Sampling, quantization and coding. Quantization

error. Spectrum of a sampled signal. Aliasing. Sampling theorem. Anti-aliasing filter. Recovery of an analog signal from samples.

Discrete Fourier transform (DFT). Derivation of Fourier transform for discrete-time signals. DFT properties. Derivation of amplitude and phase spectrum. Leakage. Parametric and non-parametric spectral windows. Spectrum resolution improvement by zero padding. Examples of spectral analysis of discrete-time signals and their interpretation.

Fast Fourier transform (FFT). Basic butterfly computation in radix-2 FFT algorithm. Computational profit. Different aspects of practical implementation of radix-2 FFT. Computation of inverse DFT using FFT.

Linear causal time-invariant (LTI) systems. Definitions of discrete, linear and time-invariant system. Convolution. Stability of LTI systems in BIBO sense. Definition of causal system. Difference equation.

Z-transform. The Z-transform definition. Region of convergence for Z-transform. The inverse Z-transform and methods of its evaluation. Z-transform properties. The transfer function. Poles and zeros of transfer function. Pole locus and stability of system.

Digital filters. Finite and infinite impulse response systems. Processing discrete-time signals by digital filters. Basic structures of filters. Determination and interpretation of the frequency response of digital filters. Significance of linear phase response in the processing of signal. Group delay.

IIR digital filter design. Bilinear transformation method.

FIR digital filter design. Method based on windowed Fourier series

TEACHING METHODS:

Lecture, laboratory exercises.

LEARNING OUTCOMES:

Code	Effects of the course
K2I_W03 K2I_U17	Can design programs in C language, which realize signal spectral analysis and their filtering with the application of filters with finite and infinite impulse response
K2I_W03 K2I_U17	Can set tests selection for a simple combinatory and sequential system with the application of structural and functional model, and also evaluate the given tests selection quality with analytical analysis and with CAD tools
K2I_W03 K2I_U17	Understands the need to ensure high reliability of digital system, knows mechanisms affecting this reliability and risks related to such mechanisms
K2I_W03 K2I_U17	Can describe a discrete system using differential equations and transmittance

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture – to receive a final passing grade student has to receive positive grade from examination.

Laboratory – to receive a final passing grade student has to receive positive grades in all laboratory exercises provided for in the laboratory syllabus.

Calculation of the final grade: lecture 50% + laboratory 50%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
60	Class participation	2,00
40	Reading of supplementary texts	1,33
50	Preparation for classes	1,67
30	Preparation of reports	1
30	Preparation for exam	1
210	**Total**	**7**

Part-time studies		
No. of hours	**Type of workload**	**ECTS**
36	Class participation	1,20
60	Reading of supplementary texts	2,00
54	Preparation for classes	1,80
30	Preparation of reports	1,00
30	Preparation for exam	1,00
210	**Total**	**7**

RECOMMENDED READING:

1. Antoniou A.: Digital Signal Processing. Signals, Systems and Filters, McGraw-Hill, 2006
2. Lyons R.G.: Understanding Digital Signal Processing, Prentice Hall, 2004
3. Mitra S.: Digital Signal Processing: A Computer-Based Approach, McGraw-Hill, 2005
4. Orfanidis S.J.: Introduction *to Signal Processing*, Prentice Hall, 1999
5. Oppenheim A.V., Schafer R.W., Buck J.R.: *Discrete-Time Signal Processing*, Prentice Hall, 1999
6. Oppenheim A.V., Willsky A.S., Nawab H.: *Signals & Systems*, Prentice Hall, 1997
7. Owen M.: *Practical signal processing*, Cambridge University Press, 2007
8. Smith S.W.: Digital Signal Processing: A Practical Guide for Engineers and Scientists, Newnes, 2002

OPTIONAL READING: -

REMARKS: -

EXPERT SYSTEMS

Course code: 11.9-WE-I-SE-PSW_E10_PSI_S2S
Type of course: optional
Language of instruction: Polish
Director of studies: Ass. Prof. Robert Szulim, Ph.D.
Name of lecturer: Ass. Prof. Robert Szulim, Ph.D.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	III	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	III	Grade	
Laboratory	18	2		Grade	

COURSE OBJECTIVE:

To familiarize with the basics of construction, operation and types of expert systems.

To familiarize with the different methods of artificial intelligence, types of knowledge bases and foundations of their creation.

To form basic skills in designing, building and running expert systems.

ENTRY REQUIREMENTS:

Principles of programming, Algorithms and data structures.

COURSE CONTENTS:

Ideas of the modelling of intellectual acts of the man. Intelligent systems and their differentiation. Artificial intelligence tendencies. Interpretation of notions information, knowledge.

Expert systems. Structure of expert system. Categories of expert systems. Properties of expert systems.

Expert systems design. Methods of the expert system design.

Knowledge acquisition. Knowledge acquisition from experts. Knowledge acquisition from databases.

Knowledge base of expert system. Rule representation of the knowledge. Knowledge base design. Knowledge base verification.

Exact knowledge evaluation in expert systems. Forward reasoning. Backward reasoning. Cases based reasoning.

Machine learning. Notions and definitions. Strategies of machine learning

The interface of the communication the user-the system. Graphic user interface. Dialogue design. Explanations system

Approximate representation of the knowledge. Forms of knowledge uncertainty. Fuzzy sets basics.
Approximate knowledge processing. Fuzzyfication and defuzzyfication. Fuzzy reasoning.
Other forms of artificial intelligence General characterization of artificial neural networks. General characterization of genetic algorithm.
The evolution of systems of artificial intelligence. Hybrid structures. Development tendencies.
Selected tools and program libraries for building expert systems.
Integration of expert systems with control-measurement systems, databases and WWW.

TEACHING METHODS:

Lecture, consultation, laboratory exercises, team work, discussion.

LEARNING OUTCOMES:

Code	Effects of the course
K2I_W12	Is aware of the growing role of the systems based on the application of AI methods.
K2I_U05, K2I_U13	Can build and run a simple expert system and integrate it with other systems
K2I_U05, K2I_U13	Can design a knowledge base for the expert system
K2I_W08	Has the basic knowledge in the area of the construction, operation and types of expert systems
K2I_W08, K2I_W12	Knows and understands chosen AI methods and can identify selected areas of their application

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture - the main condition to get a pass are sufficient marks in written or oral tests conducted at least once per semester.

Laboratory – a condition of the credit is the obtainment of affirmative estimations all laboratory exercises.

Calculation of the final grade: lecture 40% + laboratory 60%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Typeof workload**	**ECTS**
60	Class participation	1,34
24	Reading of supplementarytexts	0,53
36	Preparation for classes	0,8
24	Preparation of reports	0,53
36	Assignmentcompletion	0,8
180	**Total**	**4**
Part-time studies		
No. of hours	**Typeof workload**	**ECTS**
36	Class participation	0,8
29	Reading of supplementarytexts	0,64
29	Preparation of reports	0,64
36	Preparation for classes	0,8
36	Assignmentcompletion	0,8
14	Personal and on-line consultations	0,32
180	**Total**	**4**

RECOMMENDED READING:

1. Hand D., Mannila H., Smyth P.: Principles of Data Mining, MIT Press, 2001
2. Siler W., Buckley J., Fuzzy Expert Systems and Fuzzy Reasoning, John Wiley & Sons, 2005
3. Larase D.: Discovering Knowledge in Data. An Introduction to Data Mining, John Wiley & Sons, 11 lut 2005
4. Giarratano J., Riley G., Expert systems: principles and programming, Thomson Course Technology, 2005
5. Gallant S., Neutral network learning and expert systems, MIT Press, 1993
6. Korbicz J., Koscielny J., Kowalczuk Z., Cholewa W. Fault Diagnosis: Models, Artificial Intelligence, Applications, Springer-Verlag, 2004
7. Schalkof R., Intelligent Systems: Principles, Paradigms and Pragmatics, Joness and Bartlet, 2011

OPTIONAL READING: -

REMARKS: -

SOFTWARE FOR MEASUREMENT AND CONTROL EQUIPMENT

Course code: 06.0-WE-I-OSPS-PSW_F11_PSI_S2S
Type of course: compulsory
Language of instruction: Polish
Director of studies: Ass. Prof. Leszek Furmankiewicz, Ph.D.
Name of lecturer: Ass. Prof. Leszek Furmankiewicz, Ph.D.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					3
Laboratory	30	2	3	Grade	
Part-time studies					
Laboratory	18	2	3	Grade	

COURSE OBJECTIVE:

Forming the design skills of software for local and distributed measurement systems and measurement and control systems

ENTRY REQUIREMENTS:

Principles of programming

COURSE CONTENTS:

Programmable Automatic Controllers (PAC). Creating software and visualization for PAC of B&R company.
Software for Data Acquisition Systems using LabView. Creating software for measurement and control system based on NI USB -6008 acquisition system.
Software for Data Acquisition Cards. Creating software for Lab PC-1200 DAQ for measuring tasks.
Standard Commands for Programmable Instruments (SCPI). Creating software for IEEE-488.2 controller for cooperation with HP34401 multimeter.
Internet technology in measurement systems. Application of TCPIP and UDP protocol to send data collected from the measuring instruments.
Software for embeded WWW Server. TINI server programming technology. TINI server software to cooperate with the measuring instrument.

TEACHING METHODS:

Laboratory exercises.

LEARNING OUTCOMES:

Code	Effects of the course
K2I_W11 K2I_U06 K2I_U14	Can design software for measurement-control systems based on PLC and PAC controllers

K2I_W11 K2I_U06 K2I_U14	Can design communication software for measurement systems based on fundamental communication and network interfaces

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Laboratory – the passing condition is to obtain positive marks from all laboratory exercises to be planned during the semester.

Calculation of the final grade: laboratory 100%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
30	Class participation	1,00
12	Reading of supplementary texts	0,40
18	Preparation for classes	0,60
18	Preparation of reports	0,60
12	Assignment completion	0,40
90	**Total**	**3**
Part-time studies		
No. of hours	**Type of workload**	**ECTS**
18	Class participation	0,60
15	Reading of supplementary texts	0,50
21	Preparation of reports	0,70
22	Preparation for classes	0,73
14	Assignment completion	0,47
90	**Total**	**3**

RECOMMENDED READING:

1. Winiecki W.: *The Organization of Computer Measuring Systems*. Warsaw University of Technology Press, Warsaw, 1997 (in Polish)
2. Mielczarek W.: *Measuring Instruments and Systems with SCPI Compatibility*, Helion, Gliwice 1999 (in Polish)
3. Rak R., J.: *Virtual Measuring Instrument - Real Tool of Present Metrology,* Warsaw University of Technology Press, Warsaw, 2003 (in Polish)
4. Nawrocki W.: *Distributed Measuring Systems*, WKŁ, Warsaw 2006 (in Polish)
5. Pietrusiewicz K., Dworak P.: *Programmable Automation Controllers* PAC. Nakom, Poznań, 2007 (In Polish)
6. Caristi A., J.: *IEEE-488 General Purpose Instrumentation Bus Manual,* Academic Press, INC., San Diego, California, 1992
7. Johnson G.W, Jennings R.: *LabVIEW Graphical Programming.* McGraw-Hill Professional, 2006
8. Khalid S.F.: *LabWindows/CVI Programming for Beginners.* Prentice Hall PTR, 2000.

OPTIONAL READING: -

REMARKS: -

VISUALISATION SYSTEMS

Course code: 06.0-WE-I-SW-PSW_D9_PSI_S2S
Type of course: optional
Language of instruction: Polish
Director of studies: Ass. Prof. Adam Markowski, Ph.D.
Name of lecturer: Ass. Prof. Adam Markowski, Ph.D.
WIEA Staff

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	15	1	2	Grade	
Laboratory	30	2		Grade	
Project	15	1		Grade	
Part-time studies					
Lecture	9	1	2	Grade	
Laboratory	18	2		Grade	
Project	9	1		Grade	

COURSE OBJECTIVE:

To familiarize students with the basic functions and structure of visualization systems.
To shape basic skills in the creation of applications for visualization of industrial processes.
To shape basic skills in designing applications for visualization of industrial processes.

ENTRY REQUIREMENTS:

Experiment methodology I and II, Principles of programming, Object-oriented programming, Microprocessor systems, Computer networks I and II

COURSE CONTENTS:

Introduction. Monitoring and visualisation of industrial processes. The genesis of visualization systems. Structure and functions of visualisation systems - HMI, SCADA. Requirements put forward for visualisation systems. Visualisation systems in the information structure of an enterprise SCADA, MES, ERP. Exemplary applications of visualisation systems.

Elements of visualisation systems. Intelligent measurement-control devices in visualisation systems. Architecture of a communication layer of visualisation systems. Communication protocols in visualisation systems. The use of radio modems in visualization system.

The use of visualization systems. Configuring visualization systems in developing synoptic screens, defining variables, scripting and animation links, configuring alarms and trends, archiving variables, creating reports in text files. The use of advanced modules to create recipes and conduct statistical process control.

Object-oriented technologies in visualization systems. The integration of visualization systems with database systems. The use of object-oriented technology for the exchange of data between the visualization application and industrial automation devices (PLCs).

The procedure for designing visualization systems. Strategies of designing synoptic screens of visualization systems.

TEACHING METHODS:

Lecture, laboratory exercises, project.

LEARNING OUTCOMES:

Code	Effects of the course
K2I_W10 K2I_U06	Can apply the right strategy in industrial process visualization application design
K2I_U06	Can apply functions related to receipts and static process control
K2I_W10 K2I_U06	Understands the need for application of visualization systems, can present basic functions and visualization system structure
K2I_W10 K2I_U06	Can make a simple application for visualization of industrial processes containing synoptic images
K2I_U06	Knows and can apply variable alarm mechanisms, real-time variable value tracking and historic variables servicing mechanisms

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture – the credit is given for obtaining a positive grade in written or oral tests carried out at least once in the semester.

Laboratory – the credit is given for positive grades in all laboratory exercises to be carried out according to the laboratory syllabus.
Project – the credit is given for positive grades in project exercises to be carried out according to the syllabus.

Calculation of the final grade: lecture 40% + laboratory 30% + project 30%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
60	Class participation	2,0
24	Reading of supplementary Texas	0,8
24	Preparation for classes	0,8
24	Preparation of reports	0,8
24	Assignment completion	0,8
24	Personal and on-line consultations	0,8
180	**Total**	**6**

Part-time studies		
No. of hours	**Type of workload**	**ECTS**
36	Class participation	1,2
29	Reading of supplementary Texas	0,96
29	Preparation of reports	0,96
29	Preparation for classes	0,96
29	Assignment completion	0,96
28	Personal and on-line consultations	0,93
180	**Total**	**6**

RECOMMENDED READING:

1. Winiecki W., Nowak J., Stanik S.: Graphic integrated software environments for designing measuring – controlling systems, Mikom, Warszawa, 2001 (in Polish).
2. Kwaśniewski J.: PLC in engineering practice, BTC, Legionowo, 2008 (in Polish).
3. Kwiecień R.: Computer systems for industrial automation, Helion, Gliwice, 2012 (in Polish).
4. InTouch 9.0 User manual, Astor, Kraków, 2004 (in Polish).
5. InTouch 9.0 Description of system fields and variables. Astor, Kraków, 2002 (in Polish).
6. InTouch 9.0 Recipe Manager, Astor, Kraków, 2002 (in Polish).
7. InTouch9.0 SQL Access Module, Astor, Kraków, 2002 (in Polish).
8. InTouch 9.0 SPC PRO Module, Astor, Kraków, 2002 (in Polish).
9. Bailey D., Wright E.: Practical SCADA for Industry, Elsevier, London, 2003.

OPTIONAL READING: -

REMARKS: -

PROCESS VISUALISATION SYSTEMS

Course code: 11.3-WE-I-PS-SWP_A6_ZSI_S2S
Type of course: optional
Language of instruction: Polish
Director of studies: Ass. Prof. Adam Markowski, Ph.D.
Name of lecturer: Ass. Prof. Adam Markowski, Ph.D.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					4
Lecture	15	1	III	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	9	1	III	Grade	
Laboratory	18	2		Grade	

COURSE OBJECTIVE:

To familiarize students with the basic functions and structure of visualization systems.

To shape basic skills in the creation of applications for visualization of industrial processes.

ENTRY REQUIREMENTS:

Experiment methodology I and II, Principles of programming, Object-oriented programming, Microprocessor systems, Computer networks I and II

COURSE CONTENTS:

Introduction. Monitoring and visualisation of industrial processes. The genesis of visualization systems. Structure and functions of visualisation systems - HMI, SCADA. Requirements put forward for visualisation systems. Visualisation systems in the information structure of an enterprise SCADA, MES, ERP. Exemplary applications of visualisation systems.

Elements of visualisation systems. Intelligent measurement-control devices in visualisation systems. Architecture of a communication layer of visualisation systems. Communication protocols in visualisation systems. The use of radio modems in visualization system.

The use of visualization systems. Configuring visualization systems in developing synoptic screens, defining variables, scripting and animation links, configuring alarms and trends, archiving variables, creating reports in text files. The use of advanced modules to create recipes and conduct statistical process control.

Object-oriented technologies in visualization systems. The integration of visualization systems with database systems. The use of object-oriented technology for the exchange of data between the visualization application and industrial automation devices (PLCs).

TEACHING METHODS:

Lecture, laboratory exercises, project.

LEARNING OUTCOMES:

Code	Effects of the course
K2I_W10 K2I_U06	Can use the functions associated with formulas and statistical process control in the applications for visualization of industrial processes
K2I_W10 K2I_U06	Knows and can apply variable alarm mechanisms, real-time variable value tracking and historic variables servicing mechanisms
K2I_W10 K2I_K01	Understands the need for application of visualization systems, can present basic functions and visualization system structure
K2I_W10 K2I_U06	Can make a simple application for visualization of industrial processes containing synoptic images

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture – the credit is given for obtaining a positive grade in written or oral tests carried out at least once in the semester.

Laboratory – the credit is given for positive grades in all laboratory exercises to be carried out according to the laboratory syllabus.
Calculation of the final grade: lecture 50% + laboratory 50%

STUDENT WORKLOAD:

Full-time studies		
No. of hours	**Type of workload**	**ECTS**
45	Class participation	1,5
15	Reading of supplementary Texas	0,5
15	Preparation for classes	0,5
15	Preparation of reports	0,5
15	Assignment completion	0,5
15	Personal and on-line consultations	0,5
120	**Total**	**4**
Part-time studies		
No. of hours	**Type of workload**	**ECTS**
27	Class participation	0,9
19	Reading of supplementary Texas	0,63
19	Preparation of reports	0,63
19	Preparation for classes	0,63
18	Assignment completion	0,6
18	Personal and on-line consultations	0,6
120	**Total**	**4**

RECOMMENDED READING:

1. Winiecki W., Nowak J., Stanik S.: Graphic integrated software environments for designing measuring – controlling systems, Mikom, Warszawa, 2001 (in Polish).
2. Kwaśniewski J.: PLC in engineering practice, BTC, Legionowo, 2008 (in Polish).
3. Kwiecień R.: Computer systems for industrial automation, Helion, Gliwice, 2012 (in Polish).
4. InTouch 9.0 User manual, Astor, Kraków, 2004 (in Polish).
5. InTouch 9.0 Description of system fields and variables. Astor, Kraków, 2002 (in Polish).
6. InTouch 9.0 Recipe Manager, Astor, Kraków, 2002 (in Polish).
7. InTouch9.0 SQL Access Module, Astor, Kraków, 2002 (in Polish).
8. InTouch 9.0 SPC PRO Module, Astor, Kraków, 2002 (in Polish).
9. Bailey D., Wright E.: Practical SCADA for Industry, Elsevier, London, 2003.

OPTIONAL READING: -

REMARKS: -