COMPUTER SCIENCE AND ECONOMETRICS

STUDIES OF FIRST DEGREE

COURSE DIRECTORY

Since 2013/2014

ALGORITHMS AND DATA STRUCTURES

Course code: 11.3-WK-IiE-SP-ASD
Type of course: optional
Language of instruction: English/Polish
Director of studies: dr Florian Fabiś
Name of lecturer: dr Florian Fabiś,
mgr Katarzyna Jesse-Józefczyk

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	30	2	V	Exam	
Laboratory	30	2		Grade	

COURSE AIM:

The knowledge and skills in basics of analysis of algorithms.
The knowledge of and ability to implement sorting and selection algorithms, searching algorithms and elementary graph algorithms.
The knowledge of NP-completeness problem and its practical aspects.

ENTRY REQUIREMENTS:

Gaining of basic competences in analysis and linear algebra. Advanced computer operating skills. Skills in computer structured programming.

COURSE CONTENTS:

Lecture

1. Algorithms. Computational complexity of algorithms. Correctness of algorithms. Asymptotics. (4 h)
2. Techniques of constructing effective algorithms: divide and conquer , greedy methods, dynamic programming. (2 h)
3. Algorithms of sorting and searching. (4 h)
4. Data structures for dictionaries: characteristic vector, binary search trees, hashing. External searching - B-trees. The union problem for disjoint sets and its applications. (6 h)
5. Graph algorithms: computer representations of graphs, graph searching, minimum spanning trees, shortest paths in graphs, flows in networks. (4 h)
6. Text algorithms: pattern matching, suffix trees. (4 h)
7. Computational geometry: point localization, convex hull, sweeping. (4 h)
8. NP-completeness: the classes P, NP and NP-complete.

Laboratory

1. Determination of the computational complexity of algorithms. (4 h)
2. Testing of the correctness of algorithms. (4 h)
3. Algorithms of sorting and searching. (4 h)
4. Data structures for dictionaries. (6 h)
5. Graph algorithms. (6 h)
6. Text and computational geometry algorithms. (6 h)

TEACHING METHODS:

Lecture: problem lecture.

Laboratory: laboratory exercises in computer lab – implementation and testing of selected algorithms.

Each student is supposed to realize four projects during the semester. Each project will consist in implementation of the selected algorithm to solve a concrete practical task, writing a program for it, testing it and presenting a documentation in accordance with the assigned specification. On two out of the four projects the students will work in 2-3 person groups. Furthermore the students will write on classes programs implementing other algorithms.

LEARNING OUTCOMES:

Student knows and understands basic concepts and mathematical description used in the analysis of algorithms. [K_W08+++]
Student is able to design and analyze algorithm according to specification assigned [K_U26++].
Student knows the basic data structures for dictionaries and can implement them in programs. [K_W08++]
Student knows the basic sorting, searching, graph, text and computational geometry algorithms and can implement them in programs. [K_U26++, K_W08++]
Student recognizes the problems that can be solved algorithmically and can make a problem specification. [K_U25++].
Student is able to work in project team. [K_K03++]

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture. Written examination verifying the education outcome in area of knowledge and skills.

Laboratory. Final grade is granted based on number of points received during studies. Points are received for written tests, active participation in classes and completed project.

Final course grade consists of laboratory classes' grade (50%) and examination grade (50%). Positive grade from laboratory classes is the necessary condition for participation in examination. The positive grade from examination is the necessary condition for course completion.

STUDENT WORKLOAD:

Contact hours

- Participation in lectures: 15*2 h = 30 h
- Participation in laboratory studies : 15*2 h = 30 h
- Consultations: = 8 h
- Participation in the exam:1*2 h = 2 h

Total: 70 h (3 ECTS)

Independent work

- Preparation for laboratory exercises: 15*1 h = 15 h
- Finishing in house exercise laboratory: 15*1 h = 15 h
- Exam preparation: 20 h

Total: 50 h (2 ECTS)

Total for the course: 120 h (5 ECTS)

RECOMMENDED READING:

1. Aho A., Hopcroft J.E., Ullman J.D., : Projektowanie i analiza algorytmów komputerowych, PWN, Warszawa 1983.
2. Banachowski L., Diks K., Rytter W., Algorytmy i struktury danych, WNT, W-wa 1996.
3. Cormen T.H., Leiserson C.E., Rivest R.L., Wprowadzenie do algorytmów, WNT, Warszawa 1997.

OPTIONAL READING:

1. Aho A., Hopcroft J.E., Ullman J.D., : The Design and Analysis of Computer Algorithms.
2. Aho A., Hopcroft J.E., Ullman J.D., : Data structures and algorithms
3. T.H. Cormen, Ch.E. Leiserson, R.L. Rivest: Introduction to Algorithms, 2001, MIT Press.
4. Knuth D. E.. : The Art of Computer Programming.
5. N. Wirth: Algorithms and Data Structured, 1985.
6. Błażewicz J. : Złożoność obliczeniowa problemów kombinatorycznych, WNT, Warszawa 1988.
7. P. Wróblewski: Algorytmy, struktury danych i techniki programowania, wyd. II popr., Helion, 2001.

COMPUTER PROGRAMMING 1

Course code: 11.3-WK-IiE-SP-PK1

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr inż. Mariusz Hałuszczak

Name of lecturer: dr Florian Fabiś,
dr inż. Mariusz Hałuszczak
mgr Katarzyna Jesse-Józefczyk

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	60	2	I	Exam	
Laboratory	60	2		Grade	

COURSE AIM:

This course aims to teach how to write simple computer programs, using basic commands and data structures, in accordance with the principles of structured programming. One of the important objectives is to introduce students to simple sorting algorithms.

ENTRY REQUIREMENTS:

COURSE CONTENTS:

Lecture:

1. Structured programming paradigm and a structure of the program.
2. Idea of subprograms and modules.
3. Rules of creating identifiers.
4. Primitive types: integer, real, logical, character, and string.
5. Declaration of variables. Assignment statements. Input-output instructions.
6. Defining new data types: enumerations, subranges, and structured data types.
7. Procedures and functions: definitions, local and global variables, parameter-passing mechanisms .
8. Loops and conditional statements. Static and dynamic arrays.
9. Sorting and selection algorithms. Strings processing.
10. Text files and binary files.
11. Properties of algorithms. Computational complexity of algorithms.

Laboratory:

1. Acquainting students with the development environment. Writing and running: simple programs with: assignment and input-output instructions, conditional statements, and loops.
2. Using functions and procedures. Processing of one-dimensional and two-dimensional arrays (static and dynamic). Writing programs using records and arrays of records.

3. Writing programs with algorithms for sorting and selection. Operations on strings.
4. Debugging: tracking step by step instructions of the program and viewing the value of variables.

TEACHING METHODS:

Lecture: Seminar lecture.

Laboratory: Computer laboratory exercises - writing and running programs, independently written by the student, and their analysis.

LEARNING OUTCOMES:

K_W05	Students understand the basic concepts related to procedural programming.
K_W05	Students know how to define and use simple data types.
K_W05	Students know the basic structures of the selected programming language.
K_U20	Students know the elements of the block-diagram description of the algorithm.
	Students know how to write a program containing basic language structures, compile and run it.
K_U25	Students can independently write a program containing basic programming language constructs, compile and run it.
K_U25 K_U26	Students can apply basic programming language constructs selected for the solutions of typical tasks.
K_U20	Students are able to determine the complexity of simple algorithms.
K_U01	Students are able to interpret and analyze a sample program source codes.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture: The exam consists of two parts: written and oral. 50% of points of the written part guarantees passing the exam. Students who obtain less than 50% but at least 30% of the points of the written part, must pass the oral part of the exam.
Laboratory: To pass students must obtain at least 50% of points from four tests written during the semester or 50% of points from one test covering the whole material.
Course degree is an arithmetic average of the exam degree and lab degree. However, a necessary condition for a positive final evaluation is to obtain a positive evaluation of the exam and the laboratory.

STUDENT WORKLOAD:

Contact Hours: 80 hours.
- Participation in lectures: 15 * 2 hours = 30 hours.
- Participation in laboratory classes: 15 * 2 hours = 30 hours.
- Participation in consultations: 8 hours to lecture + 8 hours the lab = 16 hours.
- Participation in the exam: 1 * 4hours = 4 hours.

Working alone: 80 hours.
- Preparation for laboratory classes: 15 * 3 hours = 45 hours.
- Systematic repetition of the material: 5 * 3 hours = 15 hours.
- Preparation for the exam: 20 hours.

Total: 160 hours. (6 ECTS)

RECOMMENDED READING:

1. L. Banachowski, K. Diks, W. Rytter : Algorytmy i struktury danych, WNT, W-wa 1996.
2. K. Koleśnik: Wstęp do programowania z przykładami w Turbo Pascalu, Helion, 1999.
3. W. Kwasowiec: Wprowadzenie do Object Pascal i Delphi, MIKOM, 2002.
4. Sielicki (pod red.): Laboratorium programowania w języku Pascal, Pol. Wr., Wrocław 1996.
5. N. Wirth, Algorithms and Data Structures, 2004.

OPTIONAL READING:

1. T.H. Cormen, Ch.E. Leiserson, R.L. Rivest: Wprowadzenie do algorytmów, WNT, 1997.
2. M. Szmit: Delphi, Helion, 2006
3. P. Wróblewski: Algorytmy, struktury danych i techniki programowania, wyd. II popr., Helion, 2001.

COMPUTER PROGRAMMING 2

Course code: 11.3-WK-IiE-SP-PK2

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr inż. Mariusz Hałuszczak

Name of lecturer: dr Florian Fabiś,
dr inż. Mariusz Hałuszczak
mgr Katarzyna Jesse-Józefczyk

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	60	2	II	Exam	
Laboratory	60	2		Grade	

COURSE AIM:

This course aims to teach how to write programs with complex data structures. This includes implementing programs that use sorting and selection algorithms. The course also aims to acknowledge students with the basic concepts of object-oriented programming and the problem of NP-completeness (classes P, NP, NP-complete).

ENTRY REQUIREMENTS:

Computer programming 1.

COURSE CONTENTS:

Lecture:

1. Dynamic variables: definitions, procedures for creating and deleting dynamic variables.
2. Operations defined on the type of indicator elements, lists, stacks, queues, trees and graphs.
3. Computational complexity classes of decision problems: P, NP, NP-complete.
4. The basic idea of object-oriented programming (object, method, inheritance, encapsulation, polymorphism).

Laboratory:

1. Writing a program that uses files.
2. Writing and running programs with sorting and selection algorithms.
3. The analysis of computational and memory complexity of algorithms.
4. Using simple dynamic and complex dynamic data structures representing: stacks, queues, lists.
5. Creating simple classes and writing simple programs that use them.

TEACHING METHODS:

Lecture: Seminar lecture.

Laboratory: Computer laboratory exercises - writing and running independently written programs and the analysis of these programs.

LEARNING OUTCOMES:

K_W10	Students know how to define and use complex data structures.
K_W10	Students know how to solve a task using complex structures of the selected programming language.
K_W05	Students know the basic sorting algorithms and can specify their complexity.
K_U20	Students can perform basic operations on dynamic structures.
K_W10	Students know the basic concepts associated with the object-oriented programming.
K_U20	Students can present algorithms via diagrams
K_U25	Students can create the class diagram
K_U28	Students are able to model a fragment of reality by defining and using complex data structures.
K_U25	Students are able to use complex constructs of programming language to solve problems.
K_U28	Students can define and use a simple class.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture: The exam consists of two parts: written and oral. 50% of points of the written part guarantees passing the exam. Students who obtain less than 50% but at least 30% of the points of the written part, must pass the oral part of the exam.

Laboratory: To pass students must obtain at least 50% of points from four tests written during the semester or 50% of points from one test covering the whole material.

Course degree is an arithmetic average of the exam degree and lab degree. However, a necessary condition for a positive final evaluation is to obtain a positive evaluation of the exam and the laboratory.

STUDENT WORKLOAD:

Contact Hours: 75 hours.

- Participation in lectures: 15 * 2 hours = 30 hours.
- Participation in laboratory classes: 15 * 2 hours = 30 hours.
- Participation in consultations: 5 hours to lecture + 6 hours the lab = 11 hours.
- Participation in the exam: 1 * 4hours = 4 hours.

Working alone: 65 hours.

- Preparation for laboratory classes: 15 * 2 hours = 30 hours.
- Systematic repetition of material: 5 * 3 hours = 15 hours.
- Preparation for the exam: 20 hours.

Total for course: 140 hours. (6 ECTS)

RECOMMENDED READING:

1. L. Banachowski, K. Diks, W. Rytter: Algorytmy i struktury danych, WNT, 2006.
2. N. Wirth, Algorithms and Data Structures, 2004.
3. W. Kwasowiec: Wprowadzenie do Object Pascal i Delhi, Mikom, 2002.
4. Sielicki (pod red.) : Laboratorium programowania w języku Pascal, Wrocław 1996.
5. P. Coad, E. Yourdon: Analiza obiektowa, ReadMe, Warszawa 1994.

OPTIONAL READING:

1. T.H. Cormen, Ch.E. Leiserson, R.L. Rivest: Wprowadzenie do algorytmów, WNT, 2004.
2. M. Szmit: Delhi, Helion, 2006.
3. P. Wróblewski: Algorytmy, struktury danych i techniki programowania, Helion, 2003.
4. G. Booch, J. Rumbaugh, I. Jacobson, UML: przewodnik użytkownika, WNT, 2002.

COMPUTER SCIENCE IN ECONOMICS

Course code: 11.9-WK-IiE-SP-IE

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr hab. inż. Silva Robak, prof. UZ

Name of lecturer: dr hab. inż. Silva Robak, prof. UZ

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					2
Lecture	30	2	VI	Grade	

COURSE AIM:

Introduction to the information systems basics – their classification, technological infrastructure, life cycle and also support of the strategic aims of the organization, especially in the competitive environment of e-economy.

ENTRY REQUIREMENTS:

Basic knowledge of the information technology and software systems development.

COURSE CONTENTS:

1. Information systems in the enterprise – scope, functions, and classifications: technical and business view. Main business functions: sales and marketing, manufacturing, finances and accounting, and human resources.
2. Information systems as a tool supporting the organization; digital firm; business processes.
3. Technological infrastructure of information systems. Components and IT structure levels; trends and technologies driving the IT infrastructure evolution.
4. Computer networks; Internet. Web 2.0; contemporary platforms.
5. The digital firm – electronic business and electronic commerce. New business models and value propositions.
6. Managing data resources. Organizing data - traditional file environment, the database approach to data management; database trends: multidimensional data analysis, data warehouses and data mining.
7. Managing knowledge in the digital firm. Knowledge work systems.
8. Decision making in the digital firm. Decision-making and decision-support systems; types of decision-support systems. Intelligent technologies.
9. Redesigning the information systems and the organization. Business process reengineering and improvement. Business process integration; CRM and SCM systems. Application software packages.
10. Information systems for the cooperating enterprises; value chains.
11. Information systems security and control. System vulnerability and abuse. Establishing a framework for security and control for information systems. Technologies and tools for security and control.

12. Building information systems. Establishing the organizational information requirements, system development, design and implementation. Alternative system building approaches.
13. Business value of information systems.

TEACHING METHODS:

Traditional lecture.

LEARNING OUTCOMES:

The student:

1. Knows and understands the classification principles and types of information systems, their main functions (K_W09); uses the notion of the business process (K_U24).
2. Knows and understands the information systems technological infrastructure (K_W05, K_W12, K_K01)
3. Knows and understands the principles of managing data resources, data security and control issues, and also knowledge management in the organisation (K_W02).
4. Knows and understands the role of information systems in the competitive business environment of e-economy (K_W01).
5. Knows and understands the basic principles of development, implementation and reengineering of information systems (K_W09, K_W10, K_U20) and the associated organizational change (K_W07, K_U22).
6. Knows how to define the information systems needs for systems supporting the strategic aims of the organization, how to choose software for the needs of the organization (K_U21, K_K01, K_K07).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Final review quiz (graded with points), with comprehension questions at the end of the term - the scoring allows estimating if the student has reached the outlined aims.

STUDENT WORKLOAD:

Contact hours:

Lecture – 30h.

Consultations -1h.

Own work:

Preparing for the lecture – 2h.

Preparing for the test – 17h.

Together for the whole item: 50h. (2 ECTS)

RECOMMENDED READING:

1. A. Januszewski, Funkcjonalność systemów informacyjnych zarządzania, Tom I i II. PWN, Warszawa, 2008.
2. W. Flakiewicz , Systemy informacyjne w zarządzaniu. Uwarunkowania, technologie, rodzaje, C.H. Beck, Warszawa, 2002.
3. P. Adamczewski, Zintegrowane systemy informatyczne w praktyce, Wyd. II. Mikom, Warszawa, 2000.

OPTIONAL READING:

1. K.C. Laudon, J P. Laudon, Management Information Systems. Managing the Digital Firm. Pearson Prentice Hall, New Jersey, ninth edition, 2006.
2. A. Michalski (red.), Zarządzanie informacjami w przedsiębiorstwie. Systemy informatyczne a reinżynieria organizacji, Politechnika Śląska, Gliwice, 2001.
3. A. Nowicki, J. Unold (red.), Organizacyjne aspekty doskonalenia systemów informacyjno – decyzyjnych zarządzania, AE, Wrocław, 2002.
4. A. Rokicka-Broniatowska (red.), Wstęp do informatyki gospodarczej, SGH, Warszawa, 2002.
5. S. Wrycza, B. Marcinkowski, K. Wyrzykowski, Analiza i projektowanie systemów informatycznych zarządzania. Metodyki, techniki, narzędzia, PWN, Warszawa, 1999.

DATABASES 1

Course code: 11.3-WK-IiE-SP-BD1

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr inż. Mariusz Hałuszczak

Name of lecturer: prof. dr hab. Mieczysław Borowiecki,
dr Anna Fiedorowicz,
dr inż. Mariusz Hałuszczak

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	30	2	III	Exam	
Laboratory	20	2		Grade	

COURSE AIM:

The course introduces basic notions, definitions and problems related to the relational models of databases. At the end of the course each student should be able to design and create both database and database application.

ENTRY REQUIREMENTS:

Fundamentals of logic. Programming skills.

COURSE CONTENTS:

Lecture:

1. The basic notions and definitions related to the relational databases.
2. Operations on relation (union, difference, intersection, complement, projection, selection, join, division).
3. The functional dependencies and Armstrong's axioms.
4. Relational schemes.
5. Decompositions.
6. Normalization through decomposition (1NF, 2NF, 3NF,B-CNF, 4NF).
7. Multivalued dependencies.
8. Inference axiom for multivalued dependencies.
9. Structured Query Language.
    a. Data Manipulation Language,
    b. Data Definition Language,
    c. Data Control Language.

10. Creating the project of a database.
    d. Data-Flow Diagram,
    e. Entity-Relationship Diagrams,
    f. Creating Database Scheme.

Laboratory:

1. The use of SQL.
2. Data types, expressions and operators, conditions, functions, procedures.
3. SELECT statement:
    a. inner join,
    b. outer join,
    c. simple subqueries,
    d. correlated subqueries,
    e. grouping and aggregate functions.
4. Defining the database structure:
    a. domain,
    b. tables,
    c. views,
    d. indexes,
    e. sequences/generators,
    f. triggers,
    g. referential integrity constraints.
5. Database user management and control of transactions.

TEACHING METHODS:

Lecture: Seminar lecture.

Laboratory: Computer laboratory exercises

LEARNING OUTCOMES:

K_W08	Students understand the basic concepts and knows the theoretical basis of relational databases.
K_W05	Students know the basic syntax of SQL commands.
K_W08	Students know the method of normalization of a scheme up to 2NF, 3NF and BCNF.
K_U29	Students are able normalize a scheme up to 2NF, 3NF and BCNF.
K_U26	Students are able to extract the information stored in the database using SQL commands, using joins, subqueries and grouping.
K_U23, K_U30	Students are able to design a simple database schema and generate it using computer tools like CASE.
K_U35	Students are able to present the basic concepts and theorems related to the relational data model.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture: The exam consists of two parts, written and oral, access to the oral part is getting 30% of the points of the written part, 50% of the points from the written part guarantees a positive evaluation.

Laboratory: condition pass is 50% of the points of the four planned tests or final test covering all the material processed.

Final evaluation of the course is the arithmetic mean of the lecture and laboratory. However, a prerequisite for a positive final assessment is to obtain positive evaluations of the lecture and laboratory.

STUDENT WORKLOAD:

Contact time with the teacher:

Participation in lectures - 30 hours.

Participation in the lab - 30 hours.

Participation in consultations - 8 hours.

Examination - 4 hours.

total: 72 hours.

Standalone student work:

Preparation for the lecture - 9 hours.

Preparation for the lab - 21 hours.

Preparation for the exam - 20 hours.

total: 50 hours.

Total for the course: 122 hours. (4 ECTS)

RECOMMENDED READING:

1. T. Pankowski, Podstawy baz danych, Wydawnictwo Naukowe PWN, W-wa, 1992.
2. D. Maier, The theory of relational databases, Computer Science Press, 1983.
3. M. Gruber, SQL, Helion, 1996.
4. M. Wybrańczyk, Delphi 7 i bazy danych, Helion, 2003.
5. G.Reese, Java. Aplikacje bazodanowe. Najlepsze rozwiązania, Helion, 2003.

OPTIONAL READING:

1. W. Kim, Wprowadzenie do obiektowych baz danych, WNT, Warszawa, 1996.
2. J.D. Ullman, Podstawowy wykład z systemów baz danych, WNT, Warszawa, 1999.
3. P. Neil Gawroński, InterBase dla ,,delfinów", Helion, 2001.
4. Jakubowski: SQL w InterBase dla Windows i Linuksa, Helion, Gliwice 2001.
5. R. Barker, CASE* Method. Modelowanie związków encji, WNT, Warszawa 2005
6. M. Marzec, JBuilder i bazy danych, Helion, 2005.
7. Mościcki, I. Kruk, Oracle 10g i Delphi. Programowanie baz danych, Helion, 2006.

DATABASES 1 PROJECT

Course code: 11.3-WK-IiE-SP-BDP1

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr inż. Mariusz Hałuszczak

Name of lecturer: dr Anna Fiedorowicz,
dr inż. Mariusz Hałuszczak

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
Project	15	1	IV	Grade	

COURSE AIM:

Students design a relational database modelling and create applications for its use.

ENTRY REQUIREMENTS:

Database 1. Programming skills.

COURSE CONTENTS:

Students create a system on a selected topic. Students implement and document the process of creating an information system. The final effect will be a working system, working in a client-server architecture, and documentation.

During the course, students shall analyse the present area, do conceptual data model, SQL script, creating database structure, if it is necessary then create a description of the system using the selected UML diagrams (class, use case, state, activity, implementation), create an application to operate on this database.

Projects are done individually or in groups.

TEACHING METHODS:

Practical

LEARNING OUTCOMES:

K_W03	Students have the theoretical knowledge to design average complex database.
K_W05, K_W10	Students know how to create an application that supports the database.
K_U23, K_U30	According to a given specification, students are able to analyze, design and implement a simple database system using properly selected methods, techniques and tools.
K_U26	Students can create an application that supports the database.
K_U30	Students can create technical documentation of the project.
K_K05	Students understands necessity of systematic work on the project.
K_K08	Students are able to expand their knowledge, which is necessary to realize the project

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Total score: 40% for the project database, 40% of the created program, 20% of the documentation.

STUDENT WORKLOAD:

Contact time with the teacher:

Participation in consultations - 15 hours.

Participation in project lessons - 15 hours.

Total: 30 hours.

Standalone student work: 60 hours.

Total for all items: 90 hours. (3 ECTS)

RECOMMENDED READING:

1. M. Wybrańczyk, Delphi 7 i bazy danych, Helion, 2003.
2. M. Marzec, JBuilder i bazy danych, Helion, 2005.
3. G.Reese, Java. Aplikacje bazodanowe. Najlepsze rozwiązania, Helion, 2003.
4. Mościcki, I. Kruk, Oracle 10g i Delphi. Programowanie baz danych, Helion, 2006.
5. M. Cantù , Mastering Delphi 6, Sybex Inc.,2001

OPTIONAL READING:

1. P. Neil Gawroński, InterBase dla ,,delfinów", Helion, 2001.
2. Jakubowski: SQL w InterBase dla Windows i Linuksa, Helion, Gliwice 2001.
3. R. Barker, CASE Method - Entity Relationships Modelling, Oracle Corporation UK Limited, Addison-Wesley Publishing Company, 1990.

DATABASES 2

Course code: 11.3-WK-IiE-SP-BD2
Type of course: optional
Language of instruction: English/Polish
Director of studies: dr inż. Mariusz Hałuszczak
Name of lecturer: dr inż. Mariusz Hałuszczak

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	30	2	IV, VI	Exam	
Laboratory	30	2		Grade	

COURSE AIM:

Familiarize students with the ORACLE database and PL/SQL. At the end of the course students should be able to independently design and develop dynamic website using database.

ENTRY REQUIREMENTS:

Programming skills. Basic knowledge of relational databases and SQL, and HTML.

COURSE CONTENTS:

Lecture:

1. PL/SQL
   - Structure of programme, variables, data types, expressions, comparisons and control structures.
   - Using collections and records.
   - Performing SQL operations from PL/SQL.
   - Procedures, functions, packages in PL/SQL.
   - Handling PL/SQL errors.
   - Dynamic PL/SQL.
2. PHP
   - Operations on text and numbers.
   - Creating interactive forms.
   - Communication with databases.
   - Sessions and cookies.
   - File operations.
3. Object-oriented databases and XML
   i. Structure of the XML document.
   ii. DTD and XML-Schema.
   iii. XSLT.

4. JavaScript
    - Syntax,
    - Classes, objects, JSON format,
    - AJAX and XML support,
    - Examples of frameworks.

Laboratory:

1. SQL in Oracle.
2. Tree structures in Oracle databases.
3. PL/SQL, create stored procedures, functions, triggers, and packages.
4. Views describes schema objects in the database.
5. Transforming XML data with XSLT and JavaScript.

TEACHING METHODS:

Lecture: Seminar lecture.

Laboratory: Computer laboratory exercises.

LEARNING OUTCOMES:

K_W05	Students know the syntax of SQL commands and PL/SQL.
K_U26	Students are able to extract and present data that are stored in XML format.
K_U26	Students can collect and extract the information stored in databases with web applications.
K_K008	Students can search for relevant information.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture: The exam consists of two parts, written and oral, access to the oral part is getting 30% of the points of the written part, 50% of the points from the written part guarantees a positive evaluation.

Laboratory: condition pass is 50% of the points of the four planned tests or final test covering all the material processed, for the preparation of the talk, you can get up to an additional 20%..

Final evaluation of the course is the arithmetic mean of the lecture and laboratory. However, a prerequisite for a positive final assessment is to obtain positive evaluations of the lecture and laboratory.

STUDENT WORKLOAD:

Contact time with the teacher:

Participation in lectures - 30 hours.

Participation in the lab - 30 hours.

Participation in consultations - 18 hours.

Examination - 4 hours.

Total: 82 hours.

Standalone student work:

The systematic repetition of material - 18 hours.

Preparation for the lab - 30 hours.

Preparation for the Exam - 20 hours.

Total: 68 hours.

Total for the course: 150 hours. (5 ECTS)

RECOMMENDED READING:

1. D. Maier, The theory of relational databases, Computer Science Press, 1983.
2. E. Balanescu, M. Bucica, Cristian Darie, PHP 5 i MySQL. Zastosowania e-commerce, Helion, 2005.
3. J. Clark, XSL Transformations (XSLT), http://www.w3.org/TR/xslt7.

4. L. Quin, Extensible Markup Language (XML), http://www.w3.org/XML.
5. T. Converse, J. Park, C. Morgan, PHP5 i MySQL. Biblia, Helion, 2005.
6. S. Urman, R. Hardman, M. McLaughlin, Oracle Database 10g. Programowanie w języku PL/SQL, Helion, 2007.

OPTIONAL READING:

1. E. Naramore, J. Gerner, Y. Le Scouarnec, J. Stolz, M.K. Glass, PHP5, Apache i MySQL. Od podstaw, Helion, 2005.
2. B. Basham, K. Sierra, B. Bates, Head First Servlets & JSP, Helion, 2005.
3. W. Kim, Wprowadzenie do obiektowych baz danych, WNT, Warszawa, 1996.

DATABASES 2 PROJECT

Course code: 11.3-WK-IiE-SP-BDP2
Type of course: optional
Language of instruction: English/Polish
Director of studies: dr inż. Mariusz Hałuszczak
Name of lecturer: dr inż. Mariusz Hałuszczak

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
Project	30	2	V	Grade	

COURSE AIM:

Students design a relational database model and create WEB applications for its use.

ENTRY REQUIREMENTS:

Databases 2. Programming skills.

COURSE CONTENTS:

Students create a system on a selected topic. Students implement and document the process of creating an information system. The final effect will be a working WEB application, working in a client-server architecture, and documentation.

During the course, students shall analyze the present area, do conceptual data model, SQL script, creating database structure, if it is necessary then create a description of the system using the selected UML diagrams (class, use case, state, activity, implementation), create an application to operate on this database.

Projects are done individually or in groups.

TEACHING METHODS:

Practical

LEARNING OUTCOMES:

K_W03	Students have the theoretical knowledge to design average-complex database.
K_W05	Students know how to create a WEB application that supports the database.
K_U23	Students can, in accordance with specifications, analyze, design and implement a simple database system using properly selected methods, techniques and tools. Students can create technical documentation of the project.
K_K03	Students understand the need for systematic work on the project.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Total score: 40% for the project database, 40% of the created program, 20% of the documentation.

STUDENT WORKLOAD:

Contact time with the teacher:

Participation in project lessons - 30 hours.

Participation in consultations - 15 hours.

Total: 45 hours.

Standalone student work: 60 hours.

Total for all items: 105 hours. (4 ECTS)

RECOMMENDED READING:

1. E. Balanescu, M. Bucica, Cristian Darie, PHP 5 i MySQL. Zastosowania e-commerce, Helion, 2005.
2. J. Clark, XSL Transformations (XSLT), http://www.w3.org/TR/xslt7.
3. L. Quin, Extensible Markup Language (XML), http://www.w3.org/XML.
4. T. Converse, J. Park, C. Morgan, PHP5 i MySQL. Biblia, Helion, 2005.
5. S. Urman, R. Hardman, M. McLaughlin, Oracle Database 10g. Programowanie w języku PL/SQL, Helion, 2007.
6. E. Naramore, J. Gerner, Y. Le Scouarnec, J. Stolz, M.K. Glass, PHP5, Apache i MySQL. Od podstaw, Helion, 2005.

OPTIONAL READING:

1. Bryan Basham, Kathy Sierra, Bert Bates, Head First Servlets & JSP. Helion, 2005
2. Wojciech Romowicz, Java Server Pages oraz inne komponenty JavaPlatform, Helion, 2001

DESCRIPTIVE AND ECONOMIC STATISTICS

Course code: 11.2-WK-IiE-SP-SOE

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr Ewa Synówka-Bejenka

Name of lecturer: dr Ewa Synówka-Bejenka

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					2
Laboratory	30	2	IV	Grade	

COURSE AIM:

Aim of the course is to familiarize students with basics of statistical research, i.e. purposefulness of it, data mining, analysis of data, its graphical presentation and description by appropriate measures.

ENTRY REQUIREMENTS:

Mathematical analysis, probability theory and economics.

COURSE CONTENTS:

1. Data structures - an introduction to chosen statistical package (e.g. R-project). (2 teaching hrs.)
2. Classification of statistical data, their grouping and depiction in tabular format. (3)
3. Graphical presentation of the given data values. Polygons of the counts. Histograms. Pie charts. Bar charts. (3)
4. Some measures of central tendency: arithmetic mean, geometric mean, harmonic mean, median, moda. Sample quantiles. Empirical cumulative distribution function. Quantile-quantile plot and box-and-whisker plot. (4)
5. Some measures of dispersion: range, variance, standard deviation and coefficient of variation. (2)
6. Measures of skewness. Sample kurtosis. (2)
7. Test. (2)
8. The Lorenz curve. The Gini coefficient. (2)
9. Correlation between two variables. Scatter diagram. The Pearson correlation coefficient. Linear regression. (3)
10. Dependence of the nominal variables. Contingency table. Some measures of association: the Pearson coefficient, the Cramer coefficient and the Yula coefficient. (3)
11. The Paasche index. The Laspeyres index. The Fisher index. (2)
12. Test. (2)

TEACHING METHODS:

Application of the statistical package (e.g. R-project) and the relevant theoretical tools to analyse the data. Students present some statistical problem in the form of a project, which contains appropriate theory and tasks to the theory.

LEARNING OUTCOMES:

1. A student shall know how to plan statistical survey, i.e. objective and methods of analysis. (K_W04, K_U03)
2. A student can organize the statistical data to analysis, e.g. from statistical yearbooks. (K_W06)
3. A student knows how to present data graphically and can use the chosen statistical package to make it. (K_W04, K_U33)
4. A student know how to calculate and interpret the value of the appropriate measures to describe the basic properties of the empirical distribution. (K_W04, K_U15)
5. A student knows and knows how to properly apply the appropriate measures to describe correlation between two variables. (K_W04, K_U15)
6. A student can use the appropriate measures of the dynamics. (K_W03, K_W05)
7. A student is able to create a raport of the chosen topic and can present it understandable. (K_U33, K_U35, K_K02, , K_K04, , K_K09)
8. A student can use the chosen statistical package. (K_U33)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

1. Checking students knowledge and their active participation in laboratory.
2. Tests with the tasks of different difficulty.
3. Project evaluation.

The condition of a positive grade from laboratory is to obtain of at least 50% of the maximum sum of points from the written tests and a positive grade from the report. A grade from laboratory consists of a grade from the written tests (70%) and of a grade from report (30%).

STUDENT WORKLOAD:

laboratory - 30 teaching hrs.

consultation - 15 teaching hrs.

preparation for the laboratory - 20 teaching hrs. (5 teaching hrs. to the referat, 15 teaching hrs. to the written test)

Total: 65 teaching hrs. (2 ECTS)

RECOMMENDED READING:

1. I. Bąk, I. Markowicz, M. Mojsiewicz, K. Wawrzyniak, Statystyka w zadaniach, część I, Statystyka opisowa, WNT, 2002.
2. T. Górecki, Podstawy statystyki z przykładami w R, Wydawnictwo BTC, Legionowo 2011.
3. T. Hastie, R. Tibshirani, J. Friedman, The elements of statistical learning, Springer, 2009.
4. M. Sobczyk, Statystyka, Wydawnictwo Naukowe PWN, Warszawa 1996.
5. A. Zeliaś, Metody statystyczne, Polskie Wydawnictwo Ekonomiczne, Warszawa 2000.

OPTIONAL READING:

1. J. Koronacki, J. Mielniczuk, Statystyka dla studentów kierunków technicznych i przyrodniczych, WNT, Warszawa 2001.

DISCRETE MATHEMATICS 1

Course code: 11.1-WK-IiE-SP-MD1
Type of course: compulsory
Language of instruction: English/Polish
Director of studies: dr Anna Fiedorowicz
Name of lecturer: dr hab. Ewa Drgas-Burchardt
dr Anna Fiedorowicz

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	30	2	II	Grade	
Class	30	2		Grade	

COURSE AIM:

The aim of the course is to introduce basic notions and ideas of discrete mathematics both in theoretic and algorithmic aspects.

ENTRY REQUIREMENTS:

Introduction to Mathematic, Linear algebra 1.

COURSE CONTENTS:

1. Fundamental counting rules, Inclusion-Exclusion Principle, Pigeonhole Principle.
2. Recursion.
3. Generating functions.
4. Basic notions of graph theory: neighbourhood, adjacency, isomorphism, paths, cycles, connectivity, subgraphs. Representations of graphs.
5. Selected basic classes of graphs (paths, cycles, complete graphs, complete *k*-partite graphs). Graph operations (union, join and complement).
6. Trees, binary trees and their properties.
7. BFS and DFS algorithms.
8. Vector spaces of the graph.
9. *n*-connectivity of graphs.
10. Eulerian graphs. Hamiltonian Graphs. Algorithms for constructing an eulerian tour, a Hamiltonian cycle.
11. Planar graphs, the characterization of planar graphs .
12. Covers, independence and domination.
13. System of distinct representatives, Hall's Theorem, perfect matching in bipartite graphs.

TEACHING METHODS:

Lecture; classes.

LEARNING OUTCOMES:

K_W03 K_W05	The student knows fundamental counting rules and is able to recognize combinatorial objects, also in practical problems. The student uses known formulas and counting methods to count those objects.
K_U09	The student has the ability to define a recurrence relation for a given practical problem. Student is able to solve linear homogeneous recurrence relations.
K_W03 K_U10	The student knows basic notions and concepts from graph theory as well as the representations of graphs.
K_W01 K_W03 K_U01	The student is able to present and prove selected theorems concerning the properties and characterization of trees, eulerian and hamiltonian graphs, planar graphs, and systems of distinct representatives and matchings in bipartite graphs.
K_U07 K_U10	The student is able to use previously studied properties and theorems to find parameters of a graph. The student is able to determine the vector space of a given graph.
K_U20	The student is able to use an appropriate algorithm, chosen from the ones introduced during the course, to solve a particular problem from discrete mathematics.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

1. The verification includes
    a. checking the activity of the students during the classes;
    b. at least two tests, with exercises of different difficulty levels, to check the students' knowledge and skills in the field of discrete mathematics;
    c. the test from the lecture, with several exercises, both theoretical and practical, to check the theoretical knowledge of the students as well as their practical skills in the field of discrete mathematics.
2. The final grade consists of the grade from the classes (in 40%) and from the lecture (in 60%). Before taking the test from the lecture, the student has to get a positive grade from the classes.

STUDENT WORKLOAD:

Contact hours with the teacher:

- lecture – 30 h.
- classes – 30 h.
- consultations: – 20 h.

Total: 80 h. (3 ECTS)

Students individual work:

- preparation for the lecture: 20 h.
- preparation for classes: 20 h.
- preparation for tests: 10 h.
- preparation to pass the test from the lecture: 10 h.

Total: 60 h. (2 ECTS)

Total for the course: 140 h. – (5 ECTS).

RECOMMENDED READING:

1. R.J. Wilson, Wprowadzenie do teorii grafów, PWN, Warszawa, 1998.
2. V. Bryant, Aspekty kombinatoryki, WNT, Warszawa, 1997.
3. Z. Palka, A. Ruciński, Wykłady z kombinatoryki, vol. 1, WNT, Warszawa, 1998.
4. D. West, Introduction to Graph Theory, 2nd ed., Prentice Hall, Upper Saddle River, 2001.

OPTIONAL READING:

1. W. Lipski, Kombinatoryka dla programistów, WNT, Warszawa, 2005.
2. W. Lipski, W. Marek, Analiza kombinatoryczna, PWN, Warszawa, 1989.
3. K.A. Ross, Ch.R.B. Wright, Matematyka dyskretna, PWN, Warszawa, 1996.

ECONOMETRICS

Course code: 11.9-WK-IiE-SP-E

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr Ewa Synówka-Bejenka

Name of lecturer: dr Ewa Synówka-Bejenka

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	30	2	V	Exam	
Class	15	1		Grade	
Laboratory	15	1		Grade	

COURSE AIM:

Aim of the course is to familiarize students with basics of formulation (construction) and verification of econometric models.

ENTRY REQUIREMENTS:

Linear algebra, mathematical analysis, probability theory and mathematical statistics.

COURSE CONTENTS:

Lecture

1. Econometric model. Classification of econometric models. Classical linear model with multiple independent variables. Matrix representation of linear model. Least squares estimation of vector of structural parameters of the model. (4 teaching hrs.)
2. Properties of least squares estimator. The Gauss-Markov theorem. (2)
3. Properties of residuals. Decomposition of the total sum of squares (corrected by mean). (2)
4. Measures of model fitting: the coefficient of determination and convergence. Unbiased estimator of variance of random errors. Coefficient of random variation. Unbiased estimator of the covariance matrix of OLS estimator. Standard error of estimation of parameters of linear model. (2)
5. Confidence intervals for parameters of the linear model with multiple explanatory variables. Tests for linear combinations of the structural parameters of the linear model. The use of Student's t-statistic for testing. (2)
6. The adequacy of the model - the F-Snedecor test. The definition of p-value and the use of statistical packages for testing. (2)
7. Statistical verification of model assumptions. Some tests of normality, e.g. the Shapiro-Wilk test and the classical Jarque-Bera test. (2)
8. The Durbin-Watson test for autocorrelation and the Breusch-Godfrey test for higher-order autocorrelation. (2)

9. Heteroskedasticity. The Goldfeld-Quandt test, the Breusch-Pagan test and the White test. (2)
10. The runs test for randomness. Predictions. Confidence intervals for predictions. (2)
11. Variable selection. The method of graphs and the Hellwig method. Forward stepwise regression and backward stepwise regression. Selection methods based on the Akaike's information criterion. (4)
12. Generalized linear model. Linear equations of parameters. Non-linear equations. (4)

Class

1. Matrix representation of linear model with one variable and also with multiple independent variables. Least squares estimation of parameters. "Common sense" verification of the fitting model and interpretation of its parameters. (2 teaching hrs.)
2. Goodness of fit. Some measures of model fitting. (2)
3. Confidence intervals for parameters of the linear model. Tests for the structural parameters of the linear model. (2)
4. The use of some tests to verify the model assumptions. Predictions. Confidence intervals for predictions. (3)
5. Variable selection. The method of graphs and the Hellwig method. (2)
6. Estimation of the parameters of the models transformed into to linear models. (2)
7. Test. (2)

Laboratory

1. Scatter diagram. Interpretation of the sample covariance and the Pearson correlation coefficient. The estimation of parameters in a linear model with one independent variable (in particular linear trend). (2 teaching hrs.)
2. Linear model with multiple independent variables. Matrix representation of linear model. Least squares estimation of vector of structural parameters of the model. Fitted values and residuals. Measures of model fitting. (2)
3. Confidence intervals for parameters of the linear model. The statistical significance of the parameters in the model (2)
4. Statistical verification of model assumptions. Prediction. (4)
5. Forward stepwise regression and backward stepwise regression. (1)
6. Nonlinear models. (2)
7. Test. (2)

TEACHING METHODS :

Part of a lecture is presented on slides, and some in the traditional form (e.g. derivation of some results, proofs and examples). Class - solving problems and exercises given respectively earlier. Laboratory - using the statistical package (e.g. R-project) to analysis data.

LEARNING OUTCOMES:

1. A student is able to formulate an econometric model and can use the method of least squares estimators to estimate of its structural parameters. (K_W03, K_U02, K_U07, K_U12)
2. A student is able to interpret of parameters of the model and can make a "common sense" verification of the fitting model (i.e. checking whether it is compatible with economic knowledge). (K_W02, K_U02, K_U15, K_K07)
3. A student know how to calculate and interpret the value of the appropriate measures of model fitting. (K_U15)
4. A student is able to appropriately select and correctly apply the tests to verify the model assumptions. (K_W04, K_U16)
5. A student is able to apply the econometric model to prediction. (K_W01, K_K07, K_U16)
6. A student can use the chosen statistical package. (K_U33)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

1. Checking students prepare for class and their active participation in class.
2. Tests with the tasks of different difficulty.
3. A written test that verifies knowledge of the lecture.

The condition of taking part in the exam is a positive grade from class (on receipt of at least 50% of the maximum number of points from the written test). The condition of a positive grade from laboratory is to obtain of at least 50% of the maximum number of points from the written test. To complete the course one has to obtain positive grades from: exam, class and laboratory. The course grade is the arithmetic mean of class, laboratory and the written exam grades .

STUDENT WORKLOAD:

lecture – 30 teaching hrs.

class - 15 teaching hrs.

laboratory - 15 teaching hrs.

consultation - 25 teaching hrs. (5 teaching hrs. to the lecture, 10 teaching hrs. to the class, and 10 teaching hrs. to the laboratory)

participation in the exam - 2 teaching hrs.

preparation for the lecture - 5 teaching hrs.

preparation for the class - 15 teaching hrs.

preparation for the laboratory - 5 teaching hrs.

preparation for the exam - 10 teaching hrs.

Total: 122 teaching hrs. (4 ECTS)

RECOMMENDED READING:

1. B. Borkowski, H. Dudek, W. Szczesny, Ekonometria. Wybrane zagadnienia, Wydawnictwo Naukowe PWN, Warszawa 2003.
2. J. Dziechciarz (red.), Ekonometria. Metody, przykłady i zadania, Wydawnictwo AE, Wrocław 2003.
3. A. S. Goldberger, Econometric Theory, Wiley, New York 1964.
4. M. Gruszczyński, T. Kuszewski, M. Pogórska, Ekonometria i badania operacyjne, Wydawnictwo Naukowe PWN, Warszawa 2007.
5. G. S. Maddala, Ekonometria, Wydawnictwo Naukowe PWN, Warszawa 2008.
6. A. Welfe, Ekonometria. Metody i ich zastosowanie, Polskie Wydawnictwo Ekonomiczne, Warszawa 1998.
7. A. Welfe (red.), Ekonometria. Zbiór zadań, Polskie Wydawnictwo Ekonomiczne, Warszawa 1997.

OPTIONAL READING:

1. G. C. Chow, Ekonometria, PWN, Warszawa 1995.
2. C. R. Rao, Modele liniowe statystyki matematycznej, PWN, Warszawa 1982.

ENGLISH 1

Course code: 09.0-WK-IiE-SP-JA1

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: mgr Grażyna Czarkowska

Name of lecturer: mgr Grażyna Czarkowska

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					2
Laboratory	30	2	II	Grade	

COURSE AIM:

The course aims to enable students to improve speaking, reading and writing skills, as well as listening comprehension in English. It will help the students to develop their ability to apply language functions to effective communication in everyday life. The course also aims to further develop ability to use grammar structures which describe present and past activities and are used to form questions.

The course will introduce elements of the language of mathematics – basic vocabulary used in number theory, and expressions used to describe basic operations in mathematics.

ENTRY REQUIREMENTS:

A2 of the Common European Framework of Reference for Languages specified by the Council of Europe

COURSE CONTENTS:

During the course students will learn how to:

- describe present and past activities using appropriate grammar tenses (8 hours)
- form basic questions in English - question words and auxiliary verbs (2 hours)
- exchange and get information in everyday life situations (3 hours)
- have a simple conversation in English (3 hours)
- read and understand texts describing present and past (4 hours)
- develop listening comprehension (2 hours)
- express opinions on social phenomena in a discussion in English (2 hours)
- read numbers – ordinal, cardinal, fractions (common, decimal)
- read dates and mathematical operations (4 hours)
- read with understanding simple mathematical texts concerning number theory (2 hours)

TEACHING METHODS:

The course focuses on communication activities in functional and situational context. It encourages students to speak with fluency and develop the four skills of reading, writing, listening and speaking by means of group and pair work, discussion , presentation, listening, oral and written exercises.

LEARNING OUTCOMES:

Achieving language skills and competence on level A2+ of the Common European Framework of Reference for Languages. K_W13

Upon successful completion of the course, the students:

- are able to describe present and past activities using simple grammar structures-tenses
- can form simple questions in English
- give basic information concerning everyday life – personal data, habits, preferences
- are able to get information concerning everyday life
- are able to have simple conversations
- understand non-specialist texts describing present and past activities
- can read numbers – cardinal, ordinal, fractions
- can read dates and basic mathematical operations
- understand simple specialist texts concerning number theory
- are able to work in a team

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Classes – grade: a condition for receiving a credit are positive marks for tests, taking part in discussions and giving a short presentation in English.

STUDENT WORKLOAD:

Contact time:

- classes – 30 hours
- consultation – 5 hours

Private study – 25 hours

RECOMMENDED READING:

1. C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Student's Book,* Oxford University Press 2007
2. C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Workbook,* Oxford University Press 2007

OPTIONAL READING:

1. *FCE Use of English* by V. Evans
2. Internet articles
3. L. Szkutnik, *Materiały do czytania – Mathematics, Physics, Chemistry,* Wydawnictwa Szkolne i Pedagogiczne
4. J. Pasternak-Winiarska, *English in Mathematics*, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2006

ENGLISH 2

Course code: 09.0-WK-IiE-SP-JA2

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: mgr Grażyna Czarkowska

Name of lecturer: mgr Grażyna Czarkowska

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					2
Laboratory	30	2	III	Grade	

COURSE AIM:

The course aims to enable students to improve speaking, reading and writing skills, as well as listening comprehension in English. It will help the students to develop their ability to apply language functions to effective communication in everyday life. The course also aims to further develop ability to use grammar structures which describe future and life experiences. It will help students to revise structures used to talk about present and past. The course provides an opportunity to learn the skill of writing informal letters.

The students will be able to deepen their knowledge of mathematical language used in number theory and learn specialist vocabulary in order to discuss problems connected with the development of information technology.

ENTRY REQUIREMENTS:

A2+ of the Common European Framework of Reference for Languages specified by the Council of Europe

COURSE CONTENTS:

During the course students will learn to:

- describe present and past activities using more complex language structures -continuous tenses (2 hours)
- describe future activities – predictions, plans (4 hours)
- express offers, suggestions (2 hours)
- talk about life experiences using appropriate grammar tense (4 hours)
- exchange and get information concerning future in everyday life situations (3 hours)
- have longer conversations using familiar vocabulary and language structures (3 hours)
- understand non-specialist texts describing future (4 hours)
- participate in class discussions, express opinions with confidence (2 hours)
- write informal letters (2 hours)
- improve listening comprehension (2 hours)
- present problems connected with the development of information technology (2 hours)

TEACHING METHODS:

The course focuses on communication activities in functional and situational context. It encourages students to speak with fluency and develop the four skills of reading, writing, listening and speaking by means of group and pair work, discussion , presentation, oral and written exercises.

LEARNING OUTCOMES:

Achieving language skills and competence on level A2+ of the Common European Framework of Reference for Languages.

Upon successful completion of the course, the students:

- are able to describe present and past activities using complex grammar structures and recognize situational context for their application
- are able to talk about future plans and predictions
- are able to describe life experience using appropriate grammar tenses
- are able to express offers and suggestions
- are able to get detailed information concerning everyday life.
- can have longer conversations using more complex structures and vocabulary
- understand non-specialist texts describing future
- have developed listening comprehension to understand longer dialogues
- know expressions and rules used in informal letters
- are able to give simple definitions of natural, rational, etc. numbers
- are able to get information about topics from number theory
- understand and can present problems connected wih the development of information technology
- are able to work in a team

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Classes – grade: a condition for receiving a credit are positive marks for tests, participating in class discussions, dialogues, delivering a presentation in English, getting information.

STUDENT WORKLOAD:

Contact time:

- classes – 30 hours
- consultation – 5 hours

Private study – 25 hours

RECOMMENDED READING:

1. C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Student's Book,* Oxford University Press 2007
2. C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Workbook,* Oxford University Press 2007

OPTIONAL READING:

1. FCE Use of English by V. Evans
2. L. Szkutnik, Materiały do czytania – Mathematics, Physics, Chemistry, Wydawnictwa Szkolne i Pedagogiczne
3. Internet articles
4. J. Pasternak-Winiarska, *English in Mathematics*, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2006

ENGLISH 3

Course code: 09.0-WK-IiE-SP-JA3
Type of course: compulsory
Language of instruction: English/Polish
Director of studies: mgr Grażyna Czarkowska
Name of lecturer: mgr Grażyna Czarkowska

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					2
Laboratory	30	2	IV	Grade	

COURSE AIM:

The course aims to enable students to improve speaking, reading and writing skills, as well as listening comprehension in English. It will help the students to develop their ability to apply language functions to effective communication in everyday life. The course also aims to develop ability to compare objects, people, phenomena, to express necessity, prohibition and orders. The course provides an opportunity to learn the skill of writing formal letters, improve listening and reading comprehension. It helps students to further develop conversational skills, and gives basic knowledge of giving a presentation in English. It introduces specialist vocabulary used in computer science.

ENTRY REQUIREMENTS:

B1 of the Common European Framework of Reference for Languages specified by the Council of Europe.

COURSE CONTENTS:

During the course students will learn to:

- compare people, objects (4 hours)
- use modal verbs to express prohibition and orders (3 hours)
- write formal letters (4 hours)
- use verb forms – gerund, infinitive (3 hours)
- make a longer dialogue using structures and vocabulary learned earlier in the course – comparison, modals to express prohibition, etc. (2 hours)
- prepare and deliver a short presentation in English (4 hours)
- understand longer and more difficult texts (2 hours)
- develop listening comprehension of long conversations (2 hours)
- master vocabulary of logic and set theory (2 hours)
- master vocabulary used in computer science describing input and output devices (2 hours)
- understand simple specialist texts describing operating systems (2 hours)

TEACHING METHODS:

The course focuses on communication activities in functional and situational context. It encourages students to speak with fluency and develop the four skills of reading, writing, listening and speaking by means of group and pair work, discussion, presentation, oral and written exercises.

LEARNING OUTCOMES:

Achieving language skills and competence on level B1+ of the Common European Framework of Reference for Languages.

Upon successful completion of the course, the students:

- can compare people, objects, and phenomena
- can express prohibition, orders using modal verbs
- know the rules and can write formal letters
- use verb forms (gerund, infinitive) according to the rules
- have long dialogues using complex language structures and vocabulary
- are able to deliver a short presentation on a chosen topic in mathematics or computer science
- are familiar with vocabulary used in logic and set theory
- understand specialist texts concerning logic
- can, using basic vocabulary, describe operating systems
- understand simple specialist texts concerning information technology
- can cooperate with members of a group, exchange information, and discuss problems
- understand the need for self-study
- are able to find information on different topics

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Classes – grade: a condition for receiving a credit are positive marks for tests, participating in class discussions, dialogues, delivering a presentation in English, getting information on different topics.

STUDENT WORKLOAD:

Contact time:

- classes – 30 hours
- consultation – 5 hours

Private study – 25 hours, students systematically prepare for the examination.

RECOMMENDED READING:

1. C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Student's Book,* Oxford University Press 2007
2. C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Workbook,* Oxford University Press 2007
3. E. H. Glendinning, J. Mc Ewan, *Oxford English for Information Technology*, Oxford University Press 2002

OPTIONAL READING:

1. *FCE Use of English* by V. Evans
2. L. Szkutnik, *Materiały do czytania – Mathematics, Physics, Chemistry,* WSiP
3. Internet articles
4. R. Murphy *English Grammar in Use*.

ENGLISH 4

Course code: 09.0-WK-IiE-SP-JA4

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: mgr Grażyna Czarkowska

Name of lecturer: mgr Grażyna Czarkowska

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					2
Laboratory	30	2	V	Exam	

COURSE AIM:

The course aims to enable students to improve speaking, reading and writing skills, as well as listening comprehension in English. It will help the students to develop their ability to apply language functions to effective communication in everyday life. The course also aims to develop ability to describe hypothetical situations, express probability, give advice and use Passive Voice properly. The course provides an opportunity to learn the skill of writing formal letters, improve listening and reading comprehension. It helps students to further develop conversational skills, and ability to deliver a presentation in English.

The course helps students to develop specialist vocabulary used in Information Technology.

ENTRY REQUIREMENTS:

B1+ of the Common European Framework of Reference for Languages specified by the Council of Europe.

COURSE CONTENTS:

During the course students will learn to:

- describe hypothetical situations, use conditional sentences referring to present, future and past (6 hours)
- use clauses of time introduced by *when, as soon as, till, before, after* (2 hours)
- use modal verbs to express probability (1 hour)
- understand and form correct sentences in Passive Voice (4 hours)
- understand long and difficult non-specialist texts describing hypothetical situations, as well as discussing social issues (5 hours)
- prepare and deliver a presentation in English using language structures studied during the course (6 hours)
- develop listening skills (2 hours)
- understand and use specialist vocabulary - Information Technology (types of computers, computer architecture) (2 hours)
- analyse and understand specialist texts (2 hours)

TEACHING METHODS:

The course focuses on communication activities in functional and situational context. It encourages students to speak with fluency and develop the four skills of reading, writing, listening and speaking by means of group and pair work, discussion, presentation, oral and written exercises.

LEARNING OUTCOMES:

Achieving language skills and competence on level B2 of the Common European Framework of Reference for Languages.

Upon successful completion of the course, the students:

- can describe hypothetical situations with the use of adequate language structures
- use modal verbs to express probability and give advice
- use with understanding Passive Voice
- can prepare and deliver a presentation on a topic concerning Information Technology
- are familiar with and can use specialist vocabulary from Information Technology
- know and can present problems connected with application of computers
- can find in the Internet and understand simple specialist texts concerning Information Technology
- can cooperate with members of a group, exchange information, and discuss problems
- understand the need for self-study

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Classes – exam: a condition for receiving a credit is a positive mark for the exam.

STUDENT WORKLOAD:

Contact time:

- classes – 30 hours
- consultation – 5 hours

Private study – 25 hours, students systematically prepare for the examination.

RECOMMENDED READING:

1. C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Student's Book,* Oxford University Press 2007
2. C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Workbook,* Oxford University Press 2007
3. E. H. Glendinning, J. Mc Ewan, *Oxford English for Information Technology*, Oxford University Press 2002

OPTIONAL READING:

1. *FCE Use of English* by V. Evans
2. L. Szkutnik, *Materiały do czytania – Mathematics, Physics, Chemistry,* Wydawnictwa Szkolne i Pedagogiczne
3. Internet articles
4. R. Murphy *English Grammar in Use*.

FINANCIAL AND ACTUARIAL MATHEMATICS

Course code: 1.5-WK-IiE-SP-MFU

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr hab. Longin Rybiński, prof. UZ

Name of lecturer: dr hab. Longin Rybiński, prof. UZ

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	30	2	V	Grade	
Laboratory	30	2		Grade	

COURSE AIM:

The student should accomplish basic tools for money time-value analysis, investment analysis, asset pricing and risk analysis, as well as the usage of lifetime tables for calculating single and periodic premium in life insurance policies.

ENTRY REQUIREMENTS:

Calculus 1, 2, Probability Theory

COURSE CONTENTS:

1. Simple, compound and continuous interest. Nominal and effective rates.
2. Mathematical models for varying rates.
3. Standard and nonstandard annuities and perpetuities.
4. Cash flows – present value, future value, internal rate of return, modified internal rate of return; investment cash flows.
5. Payment of a debt – schedule for a short term and long term debts; actual percentage rate.
6. Term structure of interest rates and yield curves. Bonds – zero-coupon bonds and coupon bonds; duration and convexity; immunization and matching assets and liabilities.
7. Pricing derivative securities – Black Scholes formula and Cox-Ross_Rubinstein formula.
8. Information on portfolio theory; Capital Asset Pricing Model and Arbitrage Pricing Theory.
9. Basic life insurance contracts and elementary life annuities.
10. The future lifetime, life tables.
11. Single net premium and annual net premiums of constant amount for whole life and term insurance.

TEACHING METHODS:

Lectures – with conversation and online usage of financial and insurance data. Laboratory – the use of spreadsheet functions, individual problem solving, individual project report.

LEARNING OUTCOMES:

Student knows how:

- interpret functional relationships, tables, formulas and aply mathematical models to practical problems,

- project and compare investment strategies, using the basic notions of financial mathematics and spreadsheets,

- calculate single and periodic premiums for life insurance contracts,

- explore relevant literature and databases.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Assessment of written test, ongoing review of laboratory work, project assessment. The final grade is a weighted mean of lecture grade (60%) and laboratory grade (40%).

STUDENT WORKLOAD:

Lectures 30 h.

Individual literature study and web data exploration 10 h.

Preparation for written test 10 h.

Laboratory 30 h.

Unassisted preparation for laboratory work 10 h.

Project consulting 10 h.

The work on project and report 20 h.

Total: 120 h (4 ECTS)

RECOMMENDED READING:

1. M. Dobija, E. Smaga, Podstawy matematyki finansowej i ubezpieczeniowej, PWN, Warszawa 1995.
2. E. Nowak (red.), Matematyka i statystyka finansowa, Fundacja Rozwoju Rach., Finanse, Warszawa, 1994.
3. M. Podgórska, J. Klimkowska, Matematyka finansowa, PWN, Warszawa 2005.
4. M. Skałba, Ubezpieczenia na życie, WNT, Warszawa, 2001.

OPTIONAL READING:

1. H.U. Gerber, Life Insurance Mathematics, Springer, Berlin, 1990.
2. A..Weron, R. Weron, Inżynieria finansowa, WNT, Warszawa 1998.
3. P. Brandimarte, Numerical Methods in Finanace, John Wiley & Sons, New York 2002

GAME THEORY

Course code: 11.1-WK-IiE-SP-TG
Type of course: optional
Language of instruction: English /Polish
Director of studies: prof. dr. hab. Andrzej Nowak
Name of lecturer: prof. dr. hab. Andrzej Nowak

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	IV	Exam	
Class	30	2		Grade	

COURSE AIM:

Knowledge of foundations of game theory, and significance of game theory in modern economics.

ENTRY REQUIREMENTS:

Mathematical analysis 1 i 2, linear algebra, probability theory

COURSE CONTENTS:

Lectures

I. Static non-cooperative games:

1. 1. Normal form games - definition and examples (1hr)
2. Zero-sum games. Von Neumann minmax theorem. (3 hrs)
3. n-person game and Nash equilibrium. Prisoners dilemma, battle of sexes, other examples.
4. Solutions of selected games (6 hrs)
5. Non-cooperative games in economics: Bertrand competition and Cournot oligopoly, Diamond game in macroeconomics. (2 hrs)
6. Nash bargaining model. (3 hrs.)

II. Extensive form games (dynamic games):

1. Games with perfect information. Kuhn theorem. (2 hrs)
2. Kuhn algorithm. (1 hr)
3. Incomplete information models. (2 hrs)

III. Cooperative games:

1. Examples: voting games, linear production games. (2 hrs)
2. Core of cooperative games, examples of core in economics. (2 hrs)
3. Shapley value, Banzhaf value (examples and application in social sciences). (3 hrs)

IV. Incomplete information games:

1. Bayesian games. Auctions. (3 hrs)

Class

I. Static noncooperative games:

1. Solutions of zero-sum games. (3 hrs)
2. n-person games and Nash equilibria. Examples: Prisonier Dilemma. The best response map. (6 hrs)
3. Non-cooperative games in economics: examples of Bertrand competition and Cournot oligopoly. (2 hrs)
4. Nash bagaining model. Searching for solution. (3 hrs)

II. Extensive form games (dynamic games):

1. Complete information games. Application of Kuhn algorithm for construction of Nash equilibria. (2 hrs)
2. Examples of incomplete information games. (2 hrs)

III. Cooperative games:

1. Examples of voting games, linear - production games. (1 hr)
2. Core of cooperative games, examples. (2 hrs)
3. Shapley value, Banzhaf value (computing). (3 hrs)

IV. Game Theory with imperfect information:

1. Bayesian games. Auctions. Examples of games (3 hrs)

V. Colloquium: (4 hrs).

TEACHING METHODS:

Lectures and classes

LEARNING OUTCOMES:

Student

1. understands importance of mathematics for modelling conflicts and cooperation in economic models (K_W01, K_W03),
2. Knows basic minmax theorems and Nash equilibrium and their applications. (K_W04),
3. Understands idea of Nash bargaining model (K_W01),
4. Can construct and analyze game tree in simple problems. (K_U25, K_U26),
5. Knows basic models of cooperative games. (K_W01),
6. Knows Shapley and Banzhafs solution for cooperative games (K_W03),
7. Knows how to use simple stochastic models in game analysis (K_U32),

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Evaluation of individual exercises, final exam and grade.

STUDENT WORKLOAD:

Contact hours
Lecture – 30 hrs
Class – 30 hrs
Office hours – 15 hrs (5 hrs for lecture and 10 for class)
Total 75 hrs (3 ECTS)
Individual work
Preparing to lecture – 25 hrs
Preparing to class – 35 hrs
Preparing to exam – 40 hrs
Total: 100 hrs (4 ECTS)
Total hours and points per course: 175 hrs (7 ECTS)

RECOMMENDED READING:

1. Fudenberg, D. Game theory. MIT Press, Boston, 1991.
2. Owen, G. Teoria gier. PWN, Warszawa, 1975.
3. Osborne, M.J. A course in game theory. MIT Press, Boston, 1994.
4. Płatkowski, T. Wstęp do teorii gier. Uniwersytet Warszawski, Warszawa 2011.
5. Straffin, P.D. Teoria gier. Scholar, Warszawa, 2004.

OPTIONAL READING:

1. Myerson, R.B. Game theory: an analysis of conflict. Harvard University Press, 1997.
2. Owen, G. Game theory. EG Publishing, New York, 1995.

INFORMATICS SYSTEMS DESIGN

Course code: 11.3-WK-IiE-SP-PSI
Type of course: compulsory
Language of instruction: English/Polish
Director of studies: dr inż. Janusz Jabłoński
Name of lecturer: dr inż. Janusz Jabłoński

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	30	2	V	Exam	
Laboratory	30	2		Grade	

COURSE AIM:

Introduction to theoretical and practical aspects analysis, projecting and imlementation informative systems used to methodologies and CASE tools in development.

ENTRY REQUIREMENTS:

Computers programming, Informative Technologies.

COURSE CONTENTS:

Lecture

1. Introduction, literature and requirement to pass the course (2h).
2. Techniques and methodology informative systems development. (4h)
3. Life cycle of informative systems: cascade, incremental development, (2h)
4. The stages of life cycle (2h)
5. The life cycle modifications and "Agile" software development methodology (2h).
6. Planning computer systems: aims, process, strategy, project team (2h).
7. The structural method and the technique computer systems development (4h).
8. The diagrams: DFD, FHD, ERD, STD in systems development (2h)
9. The social method and techniques (2)
10. The objects methodology in computer systems development (2h).
11. The Unified Modeling Language in computer systems development (2h).
12. The CASE tools in computer systems development (2h).
13. The projects management and helpful tools (2h).

Laboratory

1. The introduction, area of knowledge, form of pass the laboratory (2h)
2. The functionality and the configuration of system variables for environment (2h)
3. Added processing and added programming (2h).
4. Computer systems in economic practice (2h)
5. The life cycle of computer system - the Gant Diagram in Microsoft Project (2h)
6. The stages of lifecycle and project documentations - the examples (2 h).
7. The transaktional system modeling: "Shop" - MSVisio in modelling (2 h)
8. Requirements and the DataBase projecting - example for customer's profile (2 h)
9. Projecting user's interface and interaction programming in MS Excel (2 h)
10. The implementation the system "Shop" in VisualBasic - at (2 h).
11. The system modeling in Eclipse use the UML diagrams (2 h)
12 JDBC and use the database operations in Java and Eclipse (2h).
13. GUI and event-driven programing in Java (2 h).
14. Testing and the system "Shop" verification of (2h).
15. Knowledge checking and grade the laboratory (2 h).

TEACHING METHODS:

The lecture with multimedia presentations, talk, discussion and work in groups.

The laboratory based at developing the system "Shop" - realized by each students, as exercises in CASE software.

Work with packets: MSProject, MSExcell, MSAcces, Eclipse. Programming in Java.

LEARNING OUTCOMES:

1. it possesses the general knowledge on subject of computer systems develops (K_W01)
2. it knows basic software life cycles as well as the technique of structural methodologies and object-oriented in production the software (K_W09)
3. it knows the basis of the law and the suit approach in realization of informative systems, assimilated the basic knowledge about restructuring and processes restructuring, knows how to use VisualBasic in Excell to implementation systems for required functionalities. know the Eclipse environment as well assimilate there basic knowledge in range of implementation of data bases applications in JAVA (K_W05, K_W10).
4. possesses the basic knowledge about directions of development of services based at Internet using (K_W12)
5. it knows to analyse and to specify users' requirement placed computer system (K_U01)
6. knows how software life cycle use to realize requirements and limitations (K_U21).
7. it possesses the skill of analysis and projecting computer systems from utilization tools CASE (K_U23)
8. it uses to aims with notion of business process the projecting the informative systems (K_U24)
9. it be able to explain the conception of three-layer architecture (K_U28)
10. the reason the need of learning by whole life (K_K01)
11. it be able to co-operate and to work in team (K_K09)
12. the reason the necessity of systematic work, also in team, over projects about long-wave character (K_K05)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture: Written examination use to verifying the education outcome in area of knowledge and skills.

Laboratory: Final grade is granted based on receipt for: written tests, activity, completed project and documentation.

Final course grade consists of laboratory (60%) and examination (40%) by presumption, that student obtained all the founded effects of education in sufficient degree.

STUDENT WORKLOAD:

Contact hours

Participation in lectures: 15*2 h = 30 h

Participation in laboratory studies : 15*2 h = 30 h

Consultations: = 15 h (5h - lectures and 10h laboratory)

Total: 75 h (2 ECTS)

Independent work

Preparation for lectures: 15*2 h = 30 h

Preparation for laboratory: 15*3 h = 45 h

Exam preparation: 30 h

Total: 105 h (2 ECTS)

Total for the course: 180 h (4 ECTS)

RECOMMENDED READING:

1. R. Barker, C. Longman, CASE Method, function and processes modelling, WNT, 1996.
2. V. Sthern, *C*++ Software Engineering, Helion, Gliwice 2004.
3. J. Cogswell, Useful software creating, Warszawa 2005.
4. J. Górski, The Software Engineering in computer project, Warszawa 2000

OPTIONAL READING:

1. P. Benon-Davies, The Informative Systems Engineering, WNT, 1999.
2. J. Roszkowski, Analysis and structural projecting, Wydawnictwo Helion, 1998.
3. C. L. Hall, The technical bases of the client-server systems, WNT, 1996.

INFORMATION TECHNOLOGY

Course code: 11.3-WK-IiE-SP-TI

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: mgr inż Andrzej Majczak

Name of lecturer: mgr inż Edward Ciaś
mgr inż Andrzej Majczak

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					2
Laboratory	30	2	I	Grade	

COURSE AIM:

Repetition and complete information of the basis of computer science: computer construction, operating systems, word processing, spreadsheets, presentation creating, basis of web pages design and Internet services.

ENTRY REQUIREMENTS:

Basis of computer skill knowledge at the secondary school scope.

COURSE CONTENTS:

Laboratory

1. Construction and the basics of computer.
2. Operating systems.
3. Word processing.
4. Spreadsheets.
5. Presentation creating.
6. Creating web pages and Internet services.
7. Basis of the JavaScript language.
8. Colloquium.

TEACHING METHODS:

Individual work at the computer. Processed material according to instructions that every student gets at the beginning of class. Discussions leading to deepen knowledge and understanding of the processed material.

LEARNING OUTCOMES:

Student:

1. Knows the basics of computer construction. (K_W08+)
2. Knows and understands the concept of an operating system, and can name operating system examples, know their types and application. (K_W08+)
3. Is able using text editors correctly format the text containing among others mathematical formulas, tables, charts. (K_U28+)

4. Knows at least two spreadsheets and their basic functionality. (K_W08+); (K_U28+)
5. Is able to develop their own presentation using programs to create presentations. (K_K05+)
6. Is able to create a simple web page, which contains interaction with user. (K_U26+)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

1. Checking the degree of student preparation and their activities during the classes.
2. Performing two tasks to assess.
3. Written colloquium at the end of the course.

STUDENT WORKLOAD:

Contact hours

laboratory – 30 hours

consultations – 2 hours

Together: 32 hours (1 ECTS)

Individual work

preparation for laboratory – 12 hours

preparation to colloquium – 8 hours

Together: 20 hours (1 ECTS)

Together: 52 hours (2 ECTS)

RECOMMENDED READING:

1. Aksoy P., Denardis L., Information technology in theory, Cengage Learning, 1 edition, 2007.
2. Czarny P., Komputer PC w biurze i nie tylko, Helion, 2008.
3. Danowski B., Tworzenie stron WWW w praktyce, Wydanie II, Helion, 2007.
4. Sokół M., Internet. Kurs, Wydanie III, Helion, 2011.
5. Sokół R., ABC Linux, Wydanie II, Helion, 2010.
6. Wrotek W., Informatyka Europejczyka. Technologia informacyjna, Helion, 2006.

OPTIONAL READING:

1. Diller A., LaTex. Wiersz po wierszu, Helion, 2001.
2. Gajda W., HTML, XHTML i CSS. Praktyczne projekty, Wydanie II, Helion, 2011.
3. Glass G., Ablem K., Linux dla programistów i użytkowników, Helion, 2007.
4. Howil W., Po prostu OpenOffice.ux.pl 3.x, Helion, 2010.Lampart L., LaTex. System opracowywania dokumentów, WNT, 2004.Mendrala D., Szeliga M., Swiatelski M., ABC systemu Windows XP PL, Wydanie II, Helion, 2006.
7. Nisan N., Schocken S., Elementy systemów komputerowych. Budowa nowoczesnego komputera od podstaw, WNT, 2008.Rychlicki-Kicior K., Podstawy obsługi komputera. Pierwsza pomoc, Wydanie II, Helion, 2011.
9. Silberschatz A., Galein P.B., Gagne G., Podstawy systemów operacyjnych, WNT, 2006.
10. Sokół M., Tworzenie stron WWW. Ćwiczenia praktyczne, Wydanie III, Helion, 2011.
11. Sokół M., OpenOffice.ux.pl 3.1. Ćwiczenia praktyczne, Helion, 2010.
12. Sokół M., Sokół R., XHTML, CSS i JavaScript. Pierwsza pomoc, Helion, 2009.

INTRODUCTION TO NUMERICAL METHODS

Course code: 11.0-WK-IiE-SP-WMN
Type of course: optional
Language of instruction: English/Polish
Director of studies: dr Maciej Niedziela
Name of lecturer: dr Maciej Niedziela

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	V	Exam	
Class	15	1		Grade	
Laboratory	15	1		Grade	

COURSE AIM:

The goal of this course is to teach the basic theories and fundamentals of numerical methods and to give the student knowledge how to implement these methods for computer solutions of mathematical problems. Most of the applications are based on the use of mathematical software package (Matlab, Octave or Scilab). The course also provides an introduction to Matlab as well as practice in computer programming. Topics include analysis of errors, numerical linear algebra, solution of linear systems of equations and nonlinear equations, interpolation and approximation by polynomials and numerical integration. Examples are taken from a wide variety of engineering situations.

ENTRY REQUIREMENTS:

Students attending classes are expected to pass the following courses:

1. Mathematical Analysis 1,2;
2. Linear Algebra 1,2;

COURSE CONTENTS:

Lecture

1. Computer Arithmetic
   - Floating-point numbers and round-off errors (1 hour).
   - Absolute and relative errors, loss of significance (2 hours).
   - Stable and unstable computations (1 hour).
2. Solution of Nonlinear Equations
   - Bisection method, Newton's method, secant method, Steffensen's method (5 hours).
   - Computing zeros of polynomials (1 hour).
3. Solving Systems of Linear Equations
   - Matrix algebra, norms and the analysis of errors (2 hours).
   - LU and Cholesky factorizations (2 hours).
   - Gaussian elimination (2 hours).
   - Solution of equations by iterative methods (2 hours).
   - Steepest descent and conjugate gradient methods (2 hours).

4. Interpolation and Polynomial Approximation
   - Taylor polynomials, Newton's Divided-Difference Interpolating Polynomials, Lagrange Interpolating Polynomial, Hermite interpolation, cubic spline interpolation, Chebyshev polynomials (6 hours).
5. Numerical Integration
   - Simpson's rule, trapezoidal rule, Gaussian quadrature (4 hours).

Class

1. Computer Arithmetic
   - Floating-point numbers and round-off errors, absolute and relative errors (1 hour).
   - Stable and unstable algorithms (1 hour).
2. Solution of Nonlinear Equations
   - Bisection method, Newton's method, secant method – application of appropriate formulas and convergence theorems (4 hours).
3. Solving Systems of Linear Equations
   - Matrix norms, condition number (1 hour).
   - Mid-term test (1 godz.).
   - LU and Cholesky factorizations – application of appropriate formulas and convergence theorems (2 hours).
   - Jacobi method, Gauss-Seidel method, relaxation methods – application of appropriate formulas and convergence theorems (2 hours).
4. Interpolation and Polynomial Approximation
   - Interpolation methods – application of appropriate formulas and convergence theorems (2 hours).
   - Mid-term test (1 hour).

Laboratory

1. Computer Arithmetic
   - Introduction to mathematical software package (Matlab, Octave or Scilab) (2 hours).
   - Construction and implementation of simple algorithms – numerical solutions and stability problem (2 hours).
2. Solution of Nonlinear Equations
   - Bisection method, Newton's method, secant method – implementation of algorithms, numerical solution of the problems, interpretation of the results, the use of mathematical software package (4 hours).
3. Solving Systems of Linear Equations
   - LU and Cholesky factorizations, Jacobi method, Gauss-Seidel method, relaxation methods – implementation of algorithms, numerical solution of the problems, interpretation of the results, the use of mathematical software package (5 hours).
4. Interpolation and Polynomial Approximation
   - Interpolation methods - implementation of algorithms, numerical solution of the problems, interpretation of the results, the use of mathematical software package (2 hours).

TEACHING METHODS:

Solving appropriate selected problems in the class and laboratory students can familiarize themselves with numerical methods provided during the lectures.

LEARNING OUTCOMES:

1. Student is able to solve simple mathematical problems by selecting and applying appropriate numerical method and using a mathematical package. (K_W05+)
2. Student knows a basic mathematical package used for numerical computations. (K_U20+)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Verifying the level of preparation of students and their activities during the classes and laboratories.

Tests with tasks of different difficulty which help to assess whether students have achieved effects of the course in a minimum degree.

The assessment of the course consists of the grades of the exercises and laboratories (40%) and the written exam (60%). Student takes an exam under the condition of a positive evaluation of the exercise. Student passes the course under the condition of a positive evaluation of the exercise, laboratory and written exam.

STUDENT WORKLOAD:

Contact hours

lecture – 30 hours

class – 15 hours

laboratory – 15 hours

consultation – 5 hours (lecure) + 2,5 hours (class) + 2,5 hours (laboratory)=10 hours

Sum: 70 hours (3 ECTS)

Independent work

preparing to lecture – 40 hours

preparing to class – 20 hours

preparing to laboratory – 20 hours

preparing to exam – 30 hours

Sum: 110 hours (4 ECTS)

Sum for the course: 180 hours (7 ECTS)

RECOMMENDED READING:

1. A.Björck, G.Dahlquist, Numerical Methods in Scientific Computing, SIAM, 2008.;
2. R.L.Burden, J.D.Faires, Numerical analysis, Prindle, Weber & Schmidt, Boston, Massachusetts, 1981;
3. J.Stoer, R.Bulirsch, Introduction to Numerical Analysis, Springer, 1993;

OPTIONAL READING:

1. A.Quarteroni, R.Sacco, F.Saleri, Numerical mathematics, Springer, 2002;
2. A.Quarteroni, F.Saleri, Scientific Computing with Matlab and Octave, Springer, 2006;
3. P.Deuflhard, A.Hohmann Numerical analysis in modern scientific computing. An introduction, Springer, 2003;

REMARKS:

The participation in this course is obligatory. Written exam.

LINEAR ALGEBRA 1

Course code: 11.1-WK-IiE-SP-AL1

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr Elżbieta Sidorowicz

Name of lecturer: dr Elżbieta Sidorowicz

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	
Class	30	2		Grade	

COURSE AIM:

Students should acquire a good knowledge of topics that will be discussed during the lectures and should achieve the ability to apply linear algebra for econometrics and informatics.

ENTRY REQUIREMENTS:

Secondary school mathematics

COURSE CONTENTS:

Lecture

1. Complex numbers: conjugation, modulus, trigonometric forms, de Moivre's formula, roots. (6 hours)
2. Matrices: matrices operations, properties of determinants, matrix inversion, the rank of the matrix. (6 hours)
3. The system of linear equations, Kronecker – Capelli theorem, Cramer's rule, Gaussian elimination. (4 hours)
4. The three-dimensional geometry: Cartesian coordinate system, the scalar, the cross product, lines and planes in the tree-dimensional space. (6 hours)
5. Binary relations (properties, types and examples), equivalence relations, abstract classes, partially ordered sets. Lattices. (5 hours)
6. Algebra and subalgebra. Boolean's algebra. Groups, fields (basic properties and examples). (3 hours)

Class

1. Complex numbers: conjugation, modulus, trigonometric forms, de Moivre's formula, roots. (6 hours)
2. Matrices: matrices operations, properties of determinants, matrix inversion, the rank of the matrix. (6 hours)
3. The system of linear equations, Kronecker – Capelli theorem, Cramer's rule, Gaussian elimination. (4 hours)
4. The three-dimensional geometry: Cartesian coordinate system, the scalar product, the cross product, lines and planes in the tree-dimensional space. (6 hours)
5. Binary relations (properties, types and examples). (2 hours)

TEACHING METHODS:

Lecture: the traditional oral essay, the participatory lecture.

Class: solving selected problems, applying the theory for solving problems.

LEARNING OUTCOMES:

1. Student can perform calculation on complex numbers. Student knows and can prove de Moivre's formula. (K_U01,K_U07)
2. Student knows matrices operations. Student determines the value of a determinant and the rank of a matrix. Student knows properties of a determinant. (K_W03,K_U07)
3. Student is able to find a solution of systems of linear equations. (K_W03, K_U01, K_U08)
4. Student knows Kronecker – Capelli theorem. Student is able to discuss the number of solutions of a system of linear equations. (K_W03, K_U01, K_U07, K_U08)
5. Student can apply the scalar product, the cross product for solving selected problems. (K_U07)
6. Student knows the definition of a binary relation its properties. (K_W03, K_U07)
7. Student can verify the properties of a relation. (K_W03, K_U01, K_U07)
8. Student knows the definition of a group, a field and is able to give basic examples of groups and fields. (K_U07)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

1. Verifying the level of preparation of students and their activities during the classes.
2. Two written tests.
3. The written and oral exam.

Assessment criteria:

the mean of the assessment and evaluation of lectures and exams (written and oral)

The necessary condition for taking the exam is positive assessment of two tests (with tasks of different difficulty which help to assess whether students have achieved effects of the course in a minimum degree) and active participation in the classes.

The necessary condition for passing the course is the positive assessment of exam.

STUDENT WORKLOAD:

lecture – 30 hours

class – 30 hours

consultation – 8 hours

exam – 3 hours

preparing to class – 45 hours

preparing to tests – 15 hours

preparing to lectures – 9 hours

preparing to exam – 20 hours

Sum for the course: 160 hours (6 ECTS)

RECOMMENDED READING:

1. J. Klukowski, I. Nabiałek, Algebra, WNT, 1999.
2. T. Jurlewicz, Z. Skoczylas, Algebra liniowa 1, Oficyna Wydawnicza GiS, Wrocław.
3. Aleksiei I. Kostrikin, Introduction to algebra, Springer, 1982.
4. A.I. Kostrikin, Y. I. Manin, Linear algebra and geometry, Gordon and Breach Science Publishers, 1997.

OPTIONAL READING:

1. G. Banaszak, W. Gajda, Elementy algebry liniowej, cz. I, WNT, 2002.W.
2. W. Dubnicki, L. Fikus, H. Sosnowska, Algebra liniowa w zadaniach, PWN, 1985.
3. A. Ostoja-Ostaszewski, Matematyka w ekonomii, Modele i metody, cz.I, Algebra elementarna, PWN, Warszawa.

LINEAR ALGEBRA 2

Course code: 11.1-WK-IiE-SP-AL2

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr Elżbieta Sidorowicz

Name of lecturer: dr Elżbieta Sidorowicz

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	30	2	II	Exam	
Class	30	2		Grade	

COURSE AIM:

Students should acquire a good knowledge of topics that will be discussed during the lectures and should achieve the ability to apply linear algebra for econometrics and informatics.

ENTRY REQUIREMENTS:

Linear Algebra 1

COURSE CONTENTS:

Lecture

1. Linear spaces and subspace: the linear combination, the span of vectors,the linear independence of vectors. Basis and the dimension of a linear space. Steinitz Theorem. (7 hours)
2. Linear transformations, the kernel and image of a linear transformation, the matrix of a linear transformation. (6 hours)
3. Euclidean spaces. Orthogonal vectors, orthonormal basis. (4 hours)
4. Eigenvalues and eigenvectors of matrices and linear transformations. (7 hours)
5. Bilinear forms and quadratic forms, diagonalization of a quadratic forms, signature of quadratic forms. (6 hours)

Class

1. Linear spaces and subspace: the linear independence of vectors. Basis and the dimension of a linear space. (6 hours)
2. Linear transformations, the kernel and image of a linear transformation, the matrix of a linear transformation. (6 hours)
3. Euclidean spaces. Orthogonal vectors, Gram-Schmidt algorithm, orthonormal basis. (4 hours)
4. Eigenvalues and eigenvectors of matrices and linear transformations. (6 hours)
5. Bilinear forms and quadratic forms, diagonalization of a quadratic forms, signature of quadratic forms. (4 hours)

TEACHING METHODS:

Lecture: the traditional oral essay, the participatory lecture.

Class: solving selected problems, applying the theory for solving problems.

LEARNING OUTCOMES:

1. Student knows the definition of the linear space, the vector and the linear transformation. Student is able to solve simple problems related with these topics. (K_W03, K_U07)
2. Student can verify whether vectors are independent or not. Student determines the coordinates of vectors in a base. (K_W07,K_U07)
3. Student determines the kernel and the image of a linear transformation. (K_W03, K_U07)
4. Student is able to find the matrix of a linear transformation. Student understands the relation between matrix operations and linear transformation operations. ((K_W03,K_U01, K_U07)
5. Student knows the definition and examples of a scalar product. (K_W03, K_U07)
6. Student is able to diagonalize a quadratic form. (K_W03, K_U07)
7. Student determines a signature of quadratic form. (K_W03, K_U07)
8. Student understand the need for lifelong education. (K_K01)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

1. Verifying the level of preparation of students and their activities during the classes.
2. Two written tests.
3. The written and oral exam.

Assessment criteria:

the mean of the assessment and evaluation of lectures and exams (written and oral)

The necessary condition for taking the exam is positive assessment of two tests (with tasks of different difficulty which help to assess whether students have achieved effects of the course in a minimum degree) and active participation in the classes.

The necessary condition for passing the course is the positive assessment of exam.

STUDENT WORKLOAD:

lecture – 30 hours

class – 30 hours

consultation – 8 hours

exam – 3 hours

preparing to class – 30 hours

preparing to tests – 15 hours

preparing to lectures – 9 hours

preparing to exam – 20 hours

Sum for the course: 145 hours (5 ECTS)

RECOMMENDED READING:

1. J. Klukowski, I. Nabiałek, Algebra, WNT, 1999.
2. T. Jurlewicz, Z. Skoczylas, Algebra liniowa 2, Oficyna Wydawnicza GiS, Wrocław.
3. Aleksiei I. Kostrikin, Introduction to algebra, Springer, 1982.
4. A.I. Kostrikin, Y. I. Manin, Linear algebra and geometry, Gordon and Breach Science Publishers, 1997.

OPTIONAL READING:

1. G. Banaszak, W. Gajda, Elementy algebry liniowej, cz. I, WNT, 2002.W.
2. W. Dubnicki, L. Fikus, H. Sosnowska, Algebra liniowa w zadaniach, PWN, 1985.
3. A. Ostoja-Ostaszewski, Matematyka w ekonomii, Modele i metody, cz.I, Algebra elementarna, PWN, W-wa.

MATHEMATICAL ANALYSIS 1

Course code: 11.1-WK-IiE-SP-AM1

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr Jan Szajkowski

Name of lecturer: dr Jan Szajkowski

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	Exam	
Class	30	2		Grade	

COURSE AIM:

The aim of this course is to provide students with skills and competences for them to understand basic mathematical issues listed under a subject scope of the course, and to use the gained knowledge as a tool of mathematical analysis in econometrics and computer science.

ENTRY REQUIREMENTS:

Knowledge of mathematics on a secondary school level.

COURSE CONTENTS:

LECTURES

1. Elements of logic and set theory (3 hrs)
   • Elements of sentential calculus. • Elements of predicate calculus. • Set calculus. • Relationships and functions.
2. Real and complex numbers. Elementary functions (5 hrs)
   • Properties of real number sets. • Complex numbers. • Elementary functions. • Examples of functions applied in economic studies.
3. Sequences (5 hrs)
   • Sequences of real numbers. • Convergences of numerical sequences (basic theorems on limits of numerical sequences, “e” number, improper limit, subsequence and its limit, extreme limits). • Metric space. • Convergence of points in the metric space. • Sets of points in the metric space.
4. Limit and continuity of a mapping (5 hrs)
   • Limit of a function and its properties. Limits of some elementary functions. • Continuity of a mapping. • Properties of continuous functions on compact sets. • Properties of continuous functions in an interval. • Monotonic and convex functions.
5. Elementary differential calculus (12 hrs)
   • Definitions and interpretations of a derivative of a function in points. • Differentiability of functions on a set. Continuity and differentiability. Basic rules of differential calculus. • Mean values theorems and their applications. • L`Hospital’s rule. • Derivatives of higher orders. Approximation by polynomial. Approximate solving of equations. • Extreme values. Economic applications. • Characteristics of convex functions. • Pace of changing functions’ values.

CLASSES

1. Elements of logic and set theory (2 hrs)

   • Examining tautology. • Examining equality in a set calculus.

2. Real and complex numbers. Elementary functions (6 hrs)

   • Proving basic equations and inequalities with the use of a total induction method. • Solving equations and inequalities with absolute figures. • Examples of functions applied in economic studies.

3. Sequences (4 hrs)

   • Calculating elementary limits with the use of calculations on limits, the theorem of three sequences and those related to the "e" number. • Calculating improper limits, proving that a sequence does not have its limit, on basic examples.

4. Limit and continuity of a mapping (6 hrs)

   • Calculating limits of elementary functions. • Calculating elementary one-sided limits, infinite limits and limits at infinity. • Examining continuity of elementary functions at a point and on a set. Distinguishing discontinuous functions. • Using Darboux property to prove the existence of with continuous functions. • Examples of continuous functions in economy.

5. Elementary differential calculus (12 hrs)

   • Calculating derivatives of elementary functions f: R→ R at a point on a basis of a definition and with the use of elementary rules of a differential calculus. • Examining monotonicity of elementary functions f: R→ R. • Application of L`Hospital's rule in calculating elementary limits. • Applications of a differential calculus in calculating local extrema and global elementary functions, and examining convexity and concavity of such functions. • Examples of economic applications of a derivative. Pace of changing function's values.

TEACHING METHODS:

Conventional lecture; a seminar; problem solving lecture.

Classes: solving typical tasks illustrating a course's subject, applying theories in practice, solving problems.

LEARNING OUTCOMES:

1. A student knows the most important limits of sequences and functions, and can define continuous functions. (K_W03+); (X1A_W01+ ; X1A_W02+; X1A_W03+; X1A_W04+; X1A_W06+)
2. A student can calculate elementary limits of sequences and functions, and examines continuity of elementary functions. (K_U11+,); (X1A_U01+ , X1A_U02+)
3. A student can define a function derivative and can give basic examples illustrating the interpretations of a derivative, and can describe the application of a derivative. (K_W03+); (X1A_W01+; X1A_W02+; X1A_W04+; X1A_W06+)
4. A student can use theorems and methods of a differentia calculus of a one variable function in problems related to optimization, searching local and global extrema (on basic examples). (K_U012+); (X1A_U01+; X1A_U02+, X1A_U03+, X1A_U04+)
5. A student can find information in literaturę and in the Internet on their own. (K_K02+); (X1A_K01+)

VERIFYING LEARNING OUTCOMES AND ASSESSMENT CRITERIA:

1. Evaluating students' preparation and their activeness during classes.
2. Three tests.
3. Written and oral exam.

Form of receiving a credit for the course:

arithmetic average of grades in classes and the grade in the written and oral exam.

In order to take the exam a student has to obtain a positive grade in classes (out of three written tests containing tasks at a variable difficulty level, which enable to check if a student has achieved a minimal learning outcome).

Active participation in classes is also evaluated.

In order to obtain a credit for the course a student has have a positive grade in the exam.

STUDENT WORKLOAD:

160 hrs, incl.:

- participation in the lecture: 30 hrs; participation in practice classes: 30 hrs;
- preparation for practice classes: 45 hrs;
- preparation for tests: 15 hrs; participation in consultation: 8 hrs;
- preparation for exams: 20 hrs ; participation in the exam: 2 hrs;
- a student's individual preparation for lectures: 10 hrs.

RECOMMENDED READING:

1. G. Decewicz, W. Żakowski, Matematyka, Analiza matematyczna, cz. I, WNT, W-wa, 2005
2. W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach, cz. I, PWN, W-wa, 2008
3. W. Leksiński, J. Nabiałek, W. Żakowski, Matematyka (zadania), WNT, W-wa, 2004
4. M. Lassak, Matematyka dla studiów technicznych, WM, Bydgoszcz, 2010
5. M. Gewert, Z. Skoczylas, Analiza matematyczna 1, Gis,Wrocław, 2007.

OPTIONAL READING:

1. R. Rudnicki, Wykłady z analizy matematycznej, PWN, W-wa, 2004
2. W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, cz. IB, PWN, W-wa, 2006
3. E.W. Swokowski, Calculus, Prindle,Weber&Schmidt, Boston, Massachusetts, 1979.

MATHEMATICAL ANALYSIS 2

Course code: 11.1-WK-IiE-AM2
Type of course: compulsory
Language of instruction: English/Polish
Director of studies: dr Jan Szajkowski
Name of lecturer: dr Jan Szajkowski

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	Exam	
Class	30	2		Grade	

COURSE AIM:

The aim of this course is to provide students with skills and competences for them to understand basic mathematical issues listed under a subject scope of the course, and to use the gained knowledge as a tool of mathematical analysis in econometrics and computer science.

ENTRY REQUIREMENTS:

Calculus 1.

COURSE CONTENTS:

LECTURES

1. Numerical series (3 hrs)
   - Numerical series and its convergence.
   - Criteria for convergence of a positive term series.
   - Alternating series.
   - Operations on series.
2. Differential calculus of a function of several variables (8 hrs)
   - Partial derivatives.
   - The Frechet derivative.
   - The directional derivative.
   - Applications of a differential and a derivative. Economic applications of differentiability.
   - A derivative of a composite function. Partial derivatives and differentials of higher order.
   - Local and global extrema.
   - Inverse function theorem and implicit function theorem.
   - Conditional extrema.
3. Indefinite integral (6 hrs)
   - Primitive function. Definition of an indefinite integral. Basic methods of defining indefinite integrals.

4. Elementary integral calculus (5 hrs)
   - Riemann`s integral and its basic properties. Geometrical and economic interpretation of a finite integral.
   - Basic theorems of integral calculus.
   - Estimating finite integrals. Improper integrals. Applications of Riemann`s integral. Cavalieri`s principle.
5. Multiple integrals (8 hrs)
   - Definition and properties of a multiple integral. Iterated integral and Fubini formula.
   - Multiple integral on any set. Change of variables in multiple integrals.
   - Applications of multiple integrals.

CLASSES

1. Numerical series (3 hrs)
   - Numerical series and its convergence.
   - Criteria for convergence of a positive term series.
   - Alternating series.
   - Operations on series.
2. Differential calculus of a function of several variables (7 hrs)
   - Partial derivatives.
   - The Frechet derivative.
   - The directional derivative.
   - Applications of a differential and a derivative. Economic applications of differentiability.
   - A derivative of a composite function. Partial derivatives and differentials of higher order.
   - Local and global extrema.
   - Inverse function theorem and implicit function theorem.
   - Conditional extrema.
3. Indefinite integral (7 hrs)
   - Primitive function. Definition of an indefinite integral. Basic methods of defining indefinite integrals.
4. Elementary integral calculus (6 hrs)
   - Riemann`s integral and its basic properties. Geometrical and economic interpretation of a finite integral.
   - Basic theorems of integral calculus.
   - Estimating finite integrals. Improper integrals. Applications of Riemann`s integral. Cavalieri`s principle.
5. Multiple integrals (7 hrs)
   - Definition and properties of a multiple integral. Iterated integral and Fubini formula.
   - Multiple integral on any set. Change of variables in multiple integrals.
   - Applications of multiple integrals.

TEACHING METHODS:

Conventional lecture; a seminar, problem solving lecture.

Practice: solving typical problems illustrating the course's subject, applying theories in practice, solving problems.

LEARNING OUTCOMES:

1. A student can characterize convergent and divergent series. (K_U11+); (X1A_U01+ , X1A_U02+)
2. A student can integrate one variable functions by parts and by substitution (within elementary scope). (K_U12+); (X1A_W02+ , X1A_U01+)
3. A student can give basic examples illustrating interpretations of a definite integral and describe its applications. (K_W03+); (X1A_W01+; X1A_W02+; X1A_W03+)
4. A student can use theorems and methods of differential calculus of two-variable functions in problems related to optimization, searching for local and global extrema, as well as conditional extrema (on basic examples). (K_U12+); (X1A_W02+, X1A_W03+,X1A_U01+,X1A_U02+, X1A_U03+, X1A_U04+)
5. A student knows his/her limits and understands the need for further education. (K_K01+); (X1A_K01+, X1A_K05+,S1A_K01+)
6. A student can find information in literature and in the Internet on their own. (K_K02+); (X1A_K01+)

VERIFYING LEARNING OUTCOMES AND ASSESSMENT CRITERIA:

1. Evaluating students' preparation and their activeness during classes.
2. Three tests.
3. Written and oral exam.

Form of receiving a credit for the course:
arithmetic average of grades in classes and the grade in the written and oral exam.

In order to take the exam a student has to obtain a positive grade in classes (out of three written tests containing tasks at a variable difficulty level, which enable to check if a student has achieved a minimal learning outcome) and has to participate in classes actively.

In order to obtain a credit for the course a student has have a positive grade in the exam.

STUDENT WORKLOAD:

145 hrs, incl.
participation in the lecture: 30 hrs; participation in classes: 30 hrs;
preparation for classes: 30 hrs;
preparation for tests: 15 hrs; participation in consultation: 8 hrs;
preparation for exams: 20 hrs ; participation in the exam: 2 hrs;
a student's individual preparation for lectures: 10 hrs;

RECOMMENDED READING:

1. 1.W. Żakowski,W. Kołodziej, Matematyka, Analiza matematyczna, cz.II, PWN, W-wa, 2006
2. W. Żakowski, W. Leksiński, Matematyka IV, PWN, W-wa, 1998
3. W. Krysicki, Analiza matematyczna w zadaniach,cz.II,PWN, W-wa, 2008
4. M. Lassak, Matematyka dla studiów technicznych, WM, Bydgoszcz, 2010
5. W. Leksiński, J. Nabiałek, W. Żakowski, Matematyka (zadania), WNT, W-wa, 2004
6. M. Gewert, Z. Skoczylas, Analiza matematyczna 2, GiS, Wrocław, 2008

OPTIONAL READING:

1. R. Rudnicki, Wykłady z analizy matematycznej, PWN, W-wa, 2004
2. W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, cz. I B, PWN, W-wa, 2006.
3. E.W. Swokowski, Calculus, Prindle,Weber&Schmidt, Boston, Massachusetts, 1979

MATHEMATICAL STATISTICS

Course code: 11.2-WK-IiE-SP-SM

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr hab. Stefan Zontek, prof. UZ

Name of lecturer: prof. dr hab. Roman Zmyślony (lecture)
dr hab. Stefan Zontek, prof. UZ (lecture)
dr Jacek Bojarski (lecture, class)
dr Ewa Synówka-Bejenka (class)
dr Magdalena Wojciech (lecture, class)

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	30	2	IV	Exam	
Class	30	2		Grade	

COURSE AIM:

Theoretical background of statistical inference.

ENTRY REQUIREMENTS:

Passed lecture on probability theory.

COURSE CONTENTS:

Lecture

1. Normal distribution and other connected distributions.
   Random variable and its basic characteristics, normal random variable (revision). (2 hours)
   Chi-square distribution, t-Student's distribution, F-Snedecor's distribution. (1 hour)
2. Statistical model.
   Aim of statistical research, statistical space, random sample, theorem on convergence of empirical distribution functions. (3 hours)
   Distributions of same sample statistics, Fisher theorem. (2 hours)
   Sufficient statistics, factorial theorem. Complete statistics. (4 hours)
   Exponential family of distributions, natural space of parameters, a general form of sufficient statistic, Lehmann theorem. (2 hours)
3. Theory of estimation.
   The best unbiased estimator, Lehmann-Scheffe theorem, Rao-Blackwell theorem. (4 hours)

Moments method, maximum likelihood method. (3 hours)

Confident intervals. (2 hours)

4. Theory of testing statistical hypothesis.

   Introduction. (2 hour)

   Most powerful tests, Neyman-Pearson lemma. (3 hours)

   Most powerful tests for models with monotonic likelihood ratio, Karlin-Rubin Theorem. (2 hour)

Class

1. Revision and amplification information from probability theory. Normal distribution and its properties. Using statistical tables. Distribution of random vectors and its basic characteristics. Distribution of a function of random vector. (2 hours)
2. Independence of random variables. Distribution of a random sample. Examples of random variables, which are not statistic. Application of Fisher theorem. (3 hours)
3. Conditional distribution. Proving sufficiency by definition and by factorial criterion. (3 hours)
4. Examples of models from the exponential family of distributions, a form of sufficient statistics, problem of completeness.
5. Calculation of the expected value and the variance of selected estimators, problem of unbiasedness. (1 hour)
6. Test. (2 hours)
7. Construction of the best unbiased estimator using Lehmann-Scheffe theorem and Rao-Blackwell theorem. (2 hours)
8. Application of moments method and maximum likelihood method to estimation. (3 hours)
9. Construction of confidence intervals for parameters of selected statistical models. Calculations of interval estimates with using proper statistical tables. (4 hours)
10. Calculation of power functions. (2 hour)
11. Construction of the most powerful tests for testing selected statistical hypothesis. (3 hours)
12. Test. (2 hours)

TEACHING METHODS:

Lecture traditional. Class - solving problems from prepared lists.

LEARNING OUTCOMES:

1. Student know that statistical research give approximate knowledge on studied phenomenon. (K_W01, K_U13, K_K03)
2. Student can specify distribution of some statistics for normal model. (K_W07, K_U14, K_U15)
3. Student can give nontrivial sufficient statistics for selected models using the factorial theorem. (K_W04, K_U14)
4. Student can check assumptions of Lehmann theorem. (K_W04, K_U14)
5. Student can show that usually used estimators are unbiased or not. (K_W04, K_U15)
6. Student can obtain estimators using moments method and maximum likelihood method for selected models. (K_W04, K_U14)
7. Student is able to properly interpret confidence intervals and can obtain its using method of central function. (K_W04, K_W07, K_U14, K_U15, K_U16)
8. Student can take a decision on acceptation or not for testing selected hypothesis using statistical tables. (K_W04, K_W07, K_U16)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

1. Class - tests with problems on different level of difficulties, which allow to assess, that student posses learning outcomes on minimal level.
2. Lecture – exam (I – written, II – oral) with questions from theory (definitions, theorems and its applications).

To take an exam student has to obtain positive grade from class. To complete the course one has to obtain positive grade form exam. The course grade consists of a grade from class (40%) and a grade from exam (60%).

STUDENT WORKLOAD:

contact hours

lecture – 30 hours

class – 30 hours

consultation – 11 hours (lecture - 4 hours; class - 7 hours)

summarize: 71 hours (2.5 ECTS)

homework

lecture – 4 hours

class – 15 hours

exam – 20 hours

summarize: 39 hours (1.5 ECTS)

globally: 110 hours **(4 ECTS)**

RECOMMENDED READING:

1. Jarosław Bartoszewicz, Wykłady ze statystyki matematycznej, PWN, Warszawa 1989.
2. Mirosław Krzyśko, Statystyka matematyczna, Wydawnictwo Naukowe UAM, Poznań 1996.

OPTIONAL READING:

1. J.B. Barra, Matematyczne podstawy statystyki, PWN, Warszawa 1982.
2. W. Krysicki, J. Bartos, W. Dyczka, W. Królikowska, W. Wasilewski, Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach, część I i II, wydanie V, PWN, Warszawa 1995.
3. E.L. Lehmann, Testing statistical hypothesis, Second edition. Wiley, New York 1986 (polski przekład pierwszego wydania: Testowanie hipotez statystycznych, PWN, Warszawa1968).

MATHEMATICAL STATISTICS - LABORATORY

Course code: 11.3-WK-IiE-SP-SML
Type of course: optional
Language of instruction: English/Polish
Director of studies: dr Ewa Synówka-Bejenka
Name of lecturer: dr Ewa Synówka-Bejenka

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					2
Laboratory	30	2	IV, VI	Grade	

COURSE AIM:

Aim of the course is to familiarize students with basics of statistical inference.

ENTRY REQUIREMENTS:

Probability theory.

COURSE CONTENTS:

1. An introduction to chosen statistical package (e.g. R-project). (3 teaching hrs.)
2. Properties of some probability distributions. Calculation of probabilities. Calculation of critical values and quantiles random variables. (5)
3. Use of the central limit theorem and illustration of its effects. (3)
4. Illustrate the impact of parameters of the normal distribution on sample.(simulations). (1)
5. Test. (2)
6. Illustrate the theorem on the convergence of empirical distribution function. (1)
7. Use and illustrate the Fisher theorem. (2)
8. Confidence intervals for parameters of a normal distribution. Analysis of the impact of the confidence level and the size of the sample on length of confidence intervals. (3)
9. Calculating the probability of type I error and the probability of type II error. The power of a test. (3)
10. Tests for the mean and the variance of a normal distribution. The definition of p-value. Use of confidence intervals for testing. (5)
11. Test. (2)

TEACHING METHODS:

Laboratory - using the statistical package (e.g. R-project) to analysis data.

LEARNING OUTCOMES:

1. A student knows that the statistical surveys give an approximate knowledge of the unknown distributions of variables. (K_W01, K_W03, K_W04, K_W06, K_U34)
2. A student knows the distributions of the basic statistics of sample from the normal distribution, and use them to calculate probabilities. (K_W04, K_W07, K_U14)
3. A student knows how to obtain confidence intervals for chosen parameters and interpret the result (K_W04, K_U16, K_U33)
4. Using statistical tests, a student knows how to make a decision on acceptance or rejection of statistical hypotheses. (K_U16, K_U33)
5. A student can calculate the probability of type I and II error and is able to determine the power of a test. (K_U14, K_U16)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

1. Checking students prepare for class and their active participation in class.
2. Tests with the tasks of different difficulty.

The condition of a positive grade from laboratory is to obtain of at least 50% of the maximum sum of points from the written tests.

STUDENT WORKLOAD:

laboratory - 30 teaching hrs.

consultation - 15 teaching hrs.

preparation for the laboratory - 15 teaching hrs.

Total: 60 teaching hrs. (2 ECTS)

RECOMMENDED READING:

1. T. Górecki, Podstawy statystyki z przykładami w R, Wydawnictwo BTC, Legionowo 2011.
2. M. Sobczyk, Statystyka, Wydawnictwo Naukowe PWN, Warszawa 1996.
3. J. Verzani, Using R for Introductory Statistics, Champan & Hall/CRC, 2005.
4. M. Walesiak, E. Gatnar, Statystyczna analiza danych z wykorzystaniem programu R, Wydawnictwo Naukowe PWN, Warszawa 2009.
5. Zeliaś, Metody statystyczne, Polskie Wydawnictwo Ekonomiczne, Warszawa 2000.

OPTIONAL READING:

1. J. Koronacki, J. Mielniczuk, Statystyka dla studentów kierunków technicznych i przyrodniczych, WNT, Warszawa 2001.

OPERATIONS RESEARCH 2

Course code: 11.1-WK-IiE-SP-BO2

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr hab. Zbigniew Świtalski

Name of lecturer: dr hab. Zbigniew Świtalski
dr Robert Dylewski

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	30	2	V	Exam	
Laboratory	30	2		Grade	

COURSE AIM:

Knowledge of selected methods, models and applications of operations research.

ENTRY REQUIREMENTS:

Basic Linear Algebra, Discrete Mathematics, Probability Theory, Operations Research 1.

COURSE CONTENTS:

1. Mathematical modelling in operations research. Applications of operations research. (2 h.)
2. Selected models of discrete optimization and their applications. (6 h.)
3. Methods of solving the problems of discrete optimization. (2 h.)
4. Genetic algorithms. (2 h.)
5. Maximal flow problem. Ford-Fulkerson algorithm (2 h.)
6. Project scheduling methods. CPM method. (4 h.)
7. Travelling salesman problem. Little's algorithm. (4 h.)
8. Multicriteria programming. Interactive methods. (2 h.)
9. Dynamic programming. Decision trees. (2 h.)
10. Decision making under uncertainty. Stochastic programming. (4 h.)

TEACHING METHODS:

Lecture, laboratory classes

LEARNING OUTCOMES:

Student:

1. Knows basic models of discrete optimization. (K_W06)
2. Knows basic methods of solving the problems of discrete optimization, understands range and possibilities of their application. (K_W06)
3. Knows basic methods of multicriteria optimization (K_W06)

4. Is able to analyze a flow network and apply the F-F algorithm to finding maximal flow in a network. (K_U19, K_U20)
5. Is able to analyze a project network, to determine critical paths and slack times for nodes and activities. (K_U19, K_U20)
6. Is able to apply the Little's algorithm for solving the travelling salesman problem. (K_U19, K_U20)
7. Is able to apply basic decision rules under risk and uncertainty. (K_U19)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

1. Verification of activity of students during the laboratory classes.
2. Writing tests during the lab classes.
3. Writing exam.

Final score = Activity + writing tests (50 %), exam (50 %).

STUDENT WORKLOAD:

Contact hours:

Lecture – 30 h.

Laboratory – 30 h.

Consulting – 2 h. (lecture), 3 h. (lab.)

Self work:

Preparation for the lecture – 15 h.

Preparation for the lab. – 20 h.

Preparation for the exam – 20 h.

Total: **120 h**. (4 p. ECTS)

RECOMMENDED READING:

1. A.Cegielski, *Programowanie matematyczne - część 1 - Programowanie liniowe*, Uniwersytet Zielonogórski, Zielona Góra, 2002.
2. T. Trzaskalik, *Wprowadzenie do badań operacyjnych z komputerem*, PWE, Warszawa, 2003.
3. *Badania operacyjne* (red. W. Sikora), PWE, Warszawa, 2008.
4. F.S. Hiller, G.J. Lieberman, *Introduction to Operations Research,* McGraw-Hill, 2005.

OPTIONAL READING:

1. W. Grabowski, *Programowanie matematyczne*, PWE, Warszawa, 1982.
2. *Decyzje menedżerskie z Excelem* (red. T. Szapiro), PWE, Warszawa, 2000.
3. A.A. Korbut, J.J. Finkelsztejn, *Programowanie dyskretne*, PWN, Warszawa, 1974.

PRACTICAL METHODS OF STATISTICS

Course code: 11.2-WK-IiE-SP-PMS
Type of course: optional
Language of instruction: English/Polish
Director of studies: dr Ewa Synówka-Bejenka
Name of lecturer: dr Ewa Synówka-Bejenka

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	30	2	VI	Exam	
Laboratory	30	2		Grade	

COURSE AIM:

Aim of the course is to familiarize students with different methods of statistical inference.

ENTRY REQUIREMENTS:

Mathematical analysis, probability theory and mathematical statistics.

COURSE CONTENTS:

Lecture

1. Statistical model. Sample space. The definition of random sample and statistics. Basic elements of estimation and hypothesis testing. (2 teaching hrs.)
2. Statistical inference concerning the mean and the variance of a normal distribution. (2)
3. Statistical inference concerning the probability of success in a binomial trials. (1)
4. Testing goodness of fit. (4)
5. Tests and confidence intervals for the difference in means of two normal populations (including a paired t-test). The F test to compare the variances of two samples from normal populations. A test to compare the proportions (probabilities of success) in two groups. (4)
6. Analysis of variance. The 1-way classification and the 2-way classification. (4)
7. Rank methods. Rank tests for independence. The Spearman correlation coefficient and Kendall's coefficient. The Wilcoxon test. (5)
8. Analysis of nominal variables, (4)
9. Factor analysis. (4)

Laboratory

1. Statistical inference concerning the mean and the variance of a normal distribution. (2 teaching hrs.)
2. Point estimation, confidence intervals and tests for the probability of success in a binomial trials. (2)
3. Testing goodness of fit. (4)
4. Comparison the two populations (including matched pair experiments). (4)
5. Analysis of variance. The 1-way classification. (2)

6. Test. (2)
7. Analysis of variance. The 2-way classification. (2)
8. Correlation between two variables. The Spearman correlation coefficient and Kendall's coefficient. (2)
9. The Wilcoxon test. (2)
10. Contingency table. Some measures of association: the Pearson coefficient, the Cramer coefficient and the Yula coefficient. Tests for independence. (4)
11. Factor analysis. (2)
12. Test. (2)

TEACHING METHODS:

Part of a lecture is presented on slides, and some in the traditional form (e.g. derivation of some results, proofs and examples). Laboratory - using the statistical package (e.g. R-project) to analysis data.

LEARNING OUTCOMES:

1. A student knows that the statistical surveys give an approximate knowledge of the unknown distributions of variables. (K_W01, K_W03, K_W04, K_W06, K_U34)
2. A student can select and correctly apply the discussed methods of statistical inference. (K_W04, K_U14, K_U16)
3. A student is able to verify the assumptions required for the used methods. (K_W04, K_U16, K_U33)
4. A student is able to interpret the results and to formulate conclusions about the distribution of statistical variables. (K_U15, K_U16)
5. A student can use the chosen statistical package. (K_U33)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

1. Checking students prepare for class and their active participation in class.
2. Tests with the tasks of different difficulty.
3. Written exam with some questions, which verify knowledge of the theory and some questions, which verify skill to apply known methods of statistical inference.

The condition of taking part in the exam is a positive grade from laboratory (on receipt of at least 50% of the maximum sum of points from the written tests). To complete the course one has to obtain positive grade from exam. The course grade consists of a grade from laboratory (60%) and of a grade from exam (40%).

STUDENT WORKLOAD:

lecture – 30 teaching hrs.
laboratory - 30 teaching hrs.
consultation - 30 teaching hrs. (10 teaching hrs. to the lecture, 20 teaching hrs. to the laboratory)
preparation for the lecture - 5 teaching hrs.
preparation for the laboratory - 15 teaching hrs.
preparation for the exam - 15 teaching hrs.

Total: 125 teaching hrs. (5 ECTS)

RECOMMENDED READING:

1. P. J. Bickel, K.A. Doksum, Mathematical Statistics, Holden-Day, Inc. San Francisco, 1977.
2. Cz. Domański, Testy statystyczne, PWE, Warszawa 1990.
3. T. Górecki, Podstawy statystyki z przykładami w R, Wydawnictwo BTC, Legionowo 2011.
4. J. Koronacki, J. Mielniczuk, Statystyka dla studentów kierunków technicznych i przyrodniczych, WNT, Warszawa 2001.
5. M. Walesiak, E. Gatnar, Statystyczna analiza danych z wykorzystaniem programu R, Wydawnictwo Naukowe PWN, Warszawa 2009.
6. A. Zeliaś, Metody statystyczne, Polskie Wydawnictwo Ekonomiczne, Warszawa 2000.

OPTIONAL READING:

1. Mirosław Krzyśko, Statystyka matematyczna, Wydawnictwo Naukowe UAM, Poznań 1996.

PROBABILITY THEORY

Course code: 11.1-WK-IiE-SP-RP

Type of course: compulsory

Language of instruction: English/Polish

Director of studies: dr Marta Borowiecka-Olszewska

Name of lecturer: dr Marta Borowiecka-Olszewska

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	30	2	III	Exam	
Class	30	2		Grade	

COURSE AIM:

Familiarizing students with the basic concepts, theorems and methods of reasoning related to the probability theory.

ENTRY REQUIREMENTS:

Getting a pass in Mathematical Analysis 1 and 2.

COURSE CONTENTS:

Lecture

1. Events and the probability
   - The revision of combinatorics. The classical definition of the probability. (2 hrs.)
   - The general definition of the probability. The definition and examples of the probability space and the event. Basic properties of the probability. Different interpretations of the probability – frequentist, personalistic. (3 hrs.)
   - The geometrical probability. The conditional probability, the law of total probability and Bayes' rule. (3 hrs.)
   - The independence of events. The Bernoulli scheme, the most likely number of successes in the Bernoulli scheme. (2 hrs.)
2. Random variables and their distributions
   - The definition, examples and properties of the random variable. The distribution of the random variable. The cumulative distribution function of the random variable and its properties. The cumulative distribution function and types of distributions. (4 hrs.)
   - Absolutely continuous and discrete distributions. The probability density function and its property. Overview of the most important absolutely continuous and discrete distributions. Mixed distributions. The independence of random variables. (4 hrs.)
   - Multidimensional random variables. The joint and marginal distributions, multidimensional and marginal cumulative distribution functions, marginal probability density functions. Connections with independent random variables. Distributions of sums of independent random variables. (3 hrs.)

3. The expectation and moments of random variables
    - The expectation and moments of a random variable. Examples of basic absolutely continuous and discrete distributions. The expectation and moments of random variables of mixed distribution, basic properties and interpretations. The variance and the standard deviation of random variables, basic properties and interpretation. (4 hrs.)
    - The concept of the covariance and the correlation coefficient of random variables, their connections with independent random variables. Parameters of random vectors. The multidimensional normal distribution. (2 hrs.)
    - The moment generating function and its properties (for information). (1 hr.)
4. Limit theorems
    - Chebyshev's inequality, the law of large numbers, the central limit theorem and their applications. (2 hrs.)

Class

1. Events and the probability
    - The binomial coefficient and its interpretation. The use of basic combinatorial schemes to exercises related to the classical definition of the probability. (4 hrs.)
    - Determination of elementary events and events. Basic properties of the probability. (2 hrs.)
    - Exercises that use the geometric probability, the conditional probability, the law of total probability and Bayes' rule. (2 hrs.)
    - Checking the independence of events. The calculation of probabilities of events with the assumption of independence. Exercises that use the Bernoulli scheme. (2 hrs.)
    - Colloquium (2 hrs.)
2. Random variables and their distributions, the expectation and moments of random variables
    - The verification whether some functions are random variables, cumulative distribution functions of some random variables. The determination of the cumulative distribution function of a random variable. The analysis of the distribution of a random variable on the basis of the cumulative distribution function. The verification whether some functions are probability density functions. The application of different types of discrete and absolutely continuous distributions in mathematical models. The application of normal distribution in exercises. (7 hrs.)
    - The determination of the joint and marginal distributions of two-dimensional random vectors using the tabular method. The determination of two-dimensional and marginal cumulative distribution functions, marginal probability density functions. The verification of the independence of random variables. Distributions of sums of independent random variables. (3 hrs.)
    - The determination of the expectation, moments and the variance of random variables. The properties of the expectation and the variance. The application in exercises. Calculations of the covariance and the correlation coefficient of random variables and their connections with the independence. The parameters of two-dimensional random vectors and two-dimensional normal distribution. (4 hrs.)
3. Limit theorems
    - The application of Chebyshev's inequality to estimate the probability of random variables. The application of the law of large numbers and the central limit theorem in exercises. (2 hrs.)

Colloquium (2 hrs.)

TEACHING METHODS:

A traditional lecture. Solving previously given tasks (exercises and short proofs) during the classes.

LEARNING OUTCOMES:

1. The student is able to explain concepts and give examples of the elementary event, the event, the probability measure, the probability space and the random variable. (K_W03+, K_U13++)
2. He is able to use the conditional probability, the law of total probability and Bayes' rule. He is able to check the independence of events and use the Bernoulli scheme. (K_U14++)

3. He is able to analyse the distribution of random variables on the basis of e.g. a cumulative distribution function or a probability density function. He is able to apply different types of discrete and absolutely continuous distributions in mathematical models. (K_W07++, K_U13++)
4. He is able to calculate the probability of events, the expectation and the variance of random variables. He knows and is able to use limit theorems to estimate probabilities. (K_W04+, K_U03+, K_U14++)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

1. Checking the level of preparation of students and their activity during the classes.
2. Two colloquia with tasks of varying difficulty which allow to assess whether students have reached a minimum level of learning outcomes.
3. The exam in the form of a multiple-choice test, consisting of several dozen statements that require the verification on the basis of the acquired knowledge. The verification of statements is connected with the use of the theory or making simple calculations. The possible answers are Yes or No. The student may receive +1,-1 or 0 points for each statement.

To pass the class it is necessary to get passing scores in two colloquia. To take the exam it is necessary to pass the class. In order to pass the course it is necessary to get passing score in the exam. The final course grade is based on graded components: the class grade – 50% and the exam grade – 50%.

STUDENT WORKLOAD:

Contact hours

lecture – 30 hrs.

class – 30 hrs.

consultation – 5 hrs. for the lecture + 5 hrs. for the class = 10 hrs.

Total: 70 hrs.

Individual work

preparation for the lecture – 5 hrs.

preparation for the class – 30 hrs.

preparation for the exam – 15 hrs.

Total: 50 hrs.

Total for the whole course: 120 hrs. (4 ECTS)

RECOMMENDED READING:

1. J. K. Misiewicz, Wykłady z rachunku prawdopodobieństwa z zadaniami, SCRIPT, Warszawa 2005.
2. J. Jakubowski, R. Sztencel, Wstęp do teorii prawdopodobieństwa, SCRIPT, Warszawa 2000.
3. T. Inglot, T. Ledwina, Z. Ławniczak, Materiały do ćwiczeń z rachunku prawdopodobieństwa i statystyki matematycznej, PWR, Wrocław 1984.
4. E. Plucińscy, Elementy probabilistyki, PWN, Warszawa 1982.
5. G. Grimmett, D. Welsh, Probability: an introduction, Oxford University Press, 1986.
6. G. Roussas, Introduction to probability, Elsevier Science, 2006.

OPTIONAL READING:

1. J. Jakubowski, R. Sztencel, Rachunek prawdopodobieństwa dla (prawie) każdego, SCRIPT, Warszawa 2002.
2. W. Krysicki, J. Bartos, W. Dyczka, K. Królikowska, M. Wasilewski, Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach, część I, PWN, Warszawa 1999.
3. A. Plucińska, E. Pluciński, Zadania z probabilistyki, PWN, Warszawa 1983.

SECURITY OF IT SYSTEMS

Course code: 11.3-WK-IiE-SP-BSI
Type of course: eligible
Language of instruction: English/Polish
Director of studies: dr inż. Janusz Jabłoński
Name of lecturer: dr inż. Janusz Jabłoński

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	30	2	VI	Exam	
Laboratory	30	2		Grade	

COURSE AIM:

The student be becomes introduced in problems of protection of data and the computer systems as well as method of solving these problems.

ENTRY REQUIREMENTS:

Computers system projecting and programming. Computer Nets.

COURSE CONTENTS:

Lecture

1. Legal conditioning of safety and security(2h).
2. The acts about protection of data as well as the personal data protection. (2h)
3. The danger of computer systems: confidentiality, integrality accessibility (4h)
4. The models and the class of safety for computer systems (2h)
5. Cryptology as cryptography and crypt-analysis. (6h).
6. Telecommunicational law and act about digital signature (2h).
7. The models of authenticating and the strategies of ACL (2h).
8. Viruses, trojany, rotkity - the method of defence (2h)
9. Environment about raised safety and tool services (2h)
10. Incidents and attacks - the systems of detecting as well as the protection (2h).
11. Defining the policy of safety (2h).
12. The Public Key Infrastructure and the electronic signature (2h).

Laboratory

1. The operating system - the functions in range of protection of data (2h)
2. Operating system and configuration the accounts of users (2h)
3. Advanced services of operating system (2h).
4. Cryptographical tools in protecting data and users accounts (2h)
5. ACL and VPN - the tools configuration to " the work remote" and the access control (2h)
6. Improvement of coding efficiency - the examples (2h).
7. "Buffer overflow" - results and counteraction (2h)

8. Protection before: "SQL Injection", "Phishing", ... (2h)
9. The "Port-knocking" counteraction as well as the control of activity in net (4h)
10. Antivirus - installation and the configuration (4h).
11. Defining the policy of safety (2h)
12 Certificates - the examples of installing and the use (2h).
13. Passive and active systems of network protections (2h).

TEACHING METHODS:

The lecture with multimedia presentations, talk, the students' studies, laboratory practice, discussion.

LEARNING OUTCOMES:

1. It knows basic conditioning the legal protections as well as the threat of safety of data in computer systems (K_W02)
2. it knows basic techniques and the tools used in counteraction the threats of computer safety and the data security (K_W14)
3. be able prepare the safe profile for user of computer system as well as the computer system, be able to protect the suitable programme (K_U33).
4. It knows to choose tool for remote work and to configure the safe VPN channel (K_U21).
5. knows the meaning of intellectual property in own and different persons workings as well as know the warnings and the law for personal data protection (K_K04, K_K07)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture: Written examination use to verifying the education outcome in area of knowledge and skills.
Laboratory: Final grade is granted based on receipt for: written tests, activity, completed project and documentation.
Final course grade consists of laboratory (50%) and examination (50%) by presumption, that student obtained all the founded effects of education in sufficient degree.

STUDENT WORKLOAD:

Contact hours
Participation in lectures: 15*2 h = 30 h
Participation in laboratory studies : 15*2 h = 30 h
Consultations: = 5 h (5h - lectures and 5h laboratory)
Total: 70 h (3 ECTS)

Independent work
Preparation for lectures: 10*2 h = 30 h
Preparation for laboratory: 10*2 h = 45 h
Exam preparation: 30 h
Total: 60 h (2 ECTS)

Total for the course: 130 h (5 ECTS)

RECOMMENDED READING:

1. J. Pieprzyk, T. Hardjono, J. Seberry, Teoria bezpieczeństwa systemówomputerowych, Helion, Gliwice 2005.
2. A. Lukatsky, Wykrywanie włamań i aktywna ochrona danych, Helion, Gliwice 2004.
3. A. Białas, Bezpieczeństwo informacji i usług w nowoczesnej instytucji i firmie, WNT, Warszawa 2006.
4. W. Stallings, Computer Security: Principles and Practice, Prentice Hall; 2011

OPTIONAL READING:

1. 1.E. Cole, R.L. Krutz, J. Conley, Bezpieczeństwo sieci, Helion, Gliwice 2005.
2. R. Anderson, Inżynieria zabezpieczeń, WNT Warszawa 2005
3. M. Sokół, R. Sokół, Internet. Jak surfować bezpiecznie, Helion Łódz 2005
4. D.E. Denning, Wojna informacyjna i bezpieczeństwo informacji, WNT Warszawa 2002