SPORT I,II

Course code: 6.9-WM-IB-S1-EP-001_13
6.9-WM-IB-S1-EP-002_13

Type of course: obowiązkowy

Language of instruction: Język polski

Director of studies: mgr Tomasz Grzybowski

Name of lecturer: pracownicy Studium Wychowania Fizycznego i Sportu

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					1
Class	30	2	II	Grade	

COURSE AIMS:

Student develops interest in sport and physical activity. The student learns how to maintain physical fitness and to take care of their own health and coddition.

PREREQUISITES:

absence

COURSE CONTENTS:

Ogólna charakterystyka i podstawowe przepisy wybranych dyscyplin sportowych. Praktyczne umiejętności z zakresu wybranych dyscyplin sportowych. Edukacja prozdrowotna poprzez wychowanie fizyczne i sport.

TEACHING METHODS

Pogadanki, ćwiczenia praktyczne, zajęcia w grupach

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence

K_K02	student zna wpływ aktywności fizycznej na prawidłowe funkcjonowanie organizmu, zna zagrożenia dla zdrowia wynikające z niehigienicznego trybu życia. Ma podstawową wiedzę o przepisach i zasadach rozgrywania różnych dyscyplin sportowych.
K_K03	student potrafi zdiagnozować stan swojej sprawności fizycznej. Potrafi zastosować różne formy aktywności w zależności od stanu zdrowia, samopoczucia, warunków atmosferycznych. Student samodzielnie podejmuje różne formy aktywności fizycznej świadomy jej wpływu na funkcjonowanie organizmu
K_K04	student potrafi funkcjonować w grupie z zachowaniem zasad współżycia społecznego, odpowiedzialności za bezpieczeństwo swoje i innych, służąc pomocą mniej sprawnym. Potrafi rywalizować z zachowaniem zasad „fair play", wykazując szacunek dla konkurentów oraz zrozumienie dla różnic w poziomie sprawności fizycznej. Zna zagrożenia dla zdrowia wynikające z niewłaściwego używania sprzętu i urządzeń sportowych.
K_K05	student zna wpływ aktywności fizycznej na prawidłowe funkcjonowanie organizmu, zna zagrożenia dla zdrowia wynikające z niehigienicznego trybu życia. Ma podstawową wiedzę o przepisach i zasadach rozgrywania różnych dyscyplin sportowych.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_K02	indywidualna ocena studenta na podstawie jego postępów, zaangażowania i aktywności w zajęciach oraz umiejętności w zakresie wybranych dyscyplin sportowych.
K_K03	obserwacja zachowań studenta podczas podejmowania aktywności ruchowej
K_K04	Wychowanie fizyczne (poziom standardowy) ocena sprawności fizycznej i umiejętności ruchowych przy zastosowaniu standardowych testów określających poziom rozwoju motorycznego i umiejętności technicznych

K_K05	Wychowanie fizyczne (obniżony poziom sprawności fizycznej), ocena znajomości przez studenta metod diagnozy stanu zdrowia i sprawności fizycznej oraz umiejętności zastosowania ćwiczeń fizycznych dla usprawniania dysfunkcji ruchowych, fizjologicznych i morfologicznych za pomocą indywidualnych (w zależności od rodzaju niepełnosprawności) wskaźników funkcji organizmu.

STUDENT WORKLOAD:

Nakład pracy studenta to 30 godzin (1 ECTS) , w tym godziny kontaktowe: 30 godzin

RECOMMENDED READING:

1. Bondarowicz M.: Zabawy i gry ruchowe w zajęciach sportowych. Warszawa 2002
2. Huciński T., Kisiel E.: Szkolenie dzieci i młodzieży w koszykówce. Warszawa 2008
3. Karpiński R., Karpińska M.: Pływanie sportowe korekcyjne rekreacyjne. Katowice 2011
4. Kosmol A.: Teoria i praktyka sportu niepełnosprawnych. Warszawa 2008
5. Stefaniak T.: Atlas uniwersalnych ćwiczeń siłowych. Wrocław 2002
6. Talaga J.: ABC Młodego piłkarza. Nauczanie techniki. Warszawa 2006
7. Uzarowicz J.: Siatkówka. Co jest grane? Wrocław 2005
8. Woynarowska B.: Edukacja zdrowotna Podręcznik akademicki. Warszawa 2010
9. Wołyniec J.: Przepisy gier sportowych w zakresie podstawowym. Wrocław 2006

INTERPERSONAL COMMUNICATION

Course code: 6.9-WM-IB-S1-EP-003_13

Type of course: optional

Language of instruction: Polish

Director of studies: dr Klaudia Błaszczyk

Name of lecturer: dr Klaudia Błaszczyk

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					2
Class	30	2	V	Grade	

COURSE AIMS:

The aim of the course is to acquire by the students knowledge and skills in interpersonal communication and to develop the use of it in both professional and private life.

COURSE CONTENTS:

Communication and its role in interpersonal relations.
The types of communication-verbal and non-verbal.
Art of Listening and its importance in human life.
Conditions for effective communication.
Communication barriers and ways to overcome them.
Relationship management in the group.
Conflicts and their resolution. Negotiations-art of achieving agreement.
Public speaking.
Communicating in the family.
Ability to communicate in social situations-premature judgments.

TEACHING METHODS:

Talk in the classroom, preparing the presentation of a selected topic.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_K01	The student understands the need for lifelong learning; is able to inspire and organize the learning process of others
K_K03	The student can interact and work in a group, adopting different roles

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_K01	The attitude creating during the classes, talk in the classroom.
K_K03	Work in a group, talk in the classroom, preparing the presentation of a selected topic.

STUDENT WORKLOAD:

The student workload of 50 hours (2 ECTS), including a course 30 hours, learning literature sources 10 hours, preparing the presentation 5 hours, including consultation 5 hours.

RECOMMENDED READING:

1. Cialdini R. B., Wywieranie wpływu na ludzi. Teoria i praktyka, GWP, Gdańsk 2007.
2. Edelman R. J.: konflikty w pracy, GWP, Gdańsk, 2003.
3. Kamiński J.: Negocjowanie. Techniki rozwiązywania konfliktów, POLTEXT, Warszawa 2003.
4. Leary M.: Wywieranie wrażenia na innych. O sztuce autoprezentacji, GWP, Gdańsk, 2003.
5. McKay M., Davis M., Fanning P., Sztuka skutecznego porozumiewania się, GWP, Gdańsk 2001.
6. Morreale S.P., Spitzberg B. H., Barge J. K., Komunikacja między ludźmi. Motywacja, wiedza i umiejętności, WN PWN, Warszawa 2007.
7. Nęcki Z.: Komunikacja międzyludzka, Antykwa, Kraków 2000
8. Steward J. (red.), Mosty zamiast murów. Podręcznik komunikacji interpersonalnej, WN PWN, Warszawa 2007.

OPTIONAL READING:

1. Balbin R. M., Twoja rola w zespole, GWP, Gdańsk 2003.
2. Fisher R., Ury W.: Dochodząc do tak. Negocjowanie bez poddawania się, PWE, Warszawa 1992.
3. Friedemann Schulz von Thun, Sztuka rozmawiania. Tom 1,2,3, WAM, Kraków 2001.

4. Głodowski W., Bez słów. Komunikacyjne funkcje zachowań niewerbalnych, HANSA COMMUNICATION, Warszawa 1999.
5. Kennedy G., Negocjacje doskonałe, Rebis, Poznań 2000.
6. Horn S., Tongue Fu! Sztuka walki językiem, Studio Emka, Warszawa 1999.

INFORMATION TECHNOLOGY

Course code: 6.9-WM-IB-S1-EP-004_13

Type of course: Subsidiary

Language of instruction: Polish l

Director of studies: dr inż. Grzegorz Łabiak

Name of lecturer: dr inż. Grzegorz Łabiak

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					2
Laboratory	**30**	2	I	Grade	

COURSE AIMS:

After completion of this course students will posses skills and competences within the scope of operation of computer connected to the Internet and its using in everyday life and in educational process, according to ECDL (European Computer Driving Licence), preparation of multimedia materials and presentations.

PREREQUISITES:

None.

COURSE CONTENT:

Text editing. Working with text editor, rules of text editing, styles using, combining graphics with text.

Presentation graphics. Preparing materials and presentation and their releasing in Internet.

Services in Internet. Internet Fundamentals: electronic mail, searching Internet resources, getting content from WWW pages, files uploading and downloading.

Spreadsheet application. Spreadsheet fundamentals (workbook, sheets, row, column, address). Calculation in sheet. Data presentation and analysis. Macros. Data editing and entering. Content, value and cell format. Sheet formatting. Copying and moving data. Charts. Data base functions in a sweet.

Data Bases. Data Bases fundamentals. Consistency, accuracy of information's.

TEACHING METHODS:

Laboratory classes with the computers.

LEARNING OUTCOMES:

Field specific learning outcomes	description
K_W07	The student has an elementary knowledge of computer design and operations, has an ordered knowledge of operational systems, technologies, protocols and services in computer networks
K_W07	The student has an elementary knowledge in computer architecture

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Reference to learning outcomes for the field study	The method of learning outcome verification
K_W07	Laboratory classes are credited with a mark. In order to get a credit it is necessary to earn positive grades for all laboratory works defined by tutor

Laboratory - In order to get a credit it is necessary to earn positive grades for all laboratory works defined by tutor.

STUDEN WORKLOAD:

Student workload is 30 hours (2 ECTS) , including contact hours: 20 hours

RECOMMENDED READING:

1. Altman Rick, Altman Rebecca: *Po prostu PowerPoint 2003 PL* (*PowerPoint 2003 Visual* QuickStart *Guide*), Wydawnictwo Helion, Gliwice, 2004.
2. Date C. J.: *Wprowadzenie do systemów baz danych,* Wydawnictwa Naukowo-Techniczne, 2000.
3. Kowalczyk G.: *Word 2003 PL. Ćwiczenia praktyczne*, Wydawnictwo Helion, Gliwice, 2004.
4. Langer M.: *Po prostu Excel 2003 PL*, Helion, Gliwice, 2004.
5. Sportach M.: *Sieci komputerowe - księga eksperta*, Helion, Gliwice, 1999.

OPTIONAL READING:

1. Hunt C.: *TCP/IP - Administracja sieci*, RM, 2003.
2. Kopertowska M., Łuszczyk E.: *PowerPoint 2003 wersja PL. Ćwiczenia*, Wydawnictwo Mikom, Warszawa, 2004.
3. Parker C. R.: *Skład komputerowy w minutę*, Intersoftland / Prentice Hall International, Warszawa, Polska / Hemel Hempstead, England, 1997.
4. Synarska A.: *Ćwiczenia z makropoleceń w Excelu*, Mikom, Warszawa, 2000.

REMARKS:

Student possessing European Computer Driving Licence are entitled to be excused from a class.

PROTECTION OF INTELLECTUAL PROPERTY

Course code: 6.9-WM-IB-S1-EP-005_13

Type of course: Additional

Language of instruction: Polish

Director of studies: dr inż. Jacek Rusiński

Name of lecturer: dr inż. Jacek Rusiński

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					2
Lecture	15	1	VII	Grade	

COURSE AIMS:

To acquaint students with the issues of intellectual property and to teach the use of the patent literature.

PREREQUISITES:

The student has to know his thesis topic.

COURSE CONTENTS:

Lecture content. The concept of intellectual property. The issue of intellectual property at law.

Paris Convention for the Protection of Industrial Property. The concept of industrial property. Patent. Right of protection. Right of registration.

Legislation on the protection of industrial property in Poland. The requirements to obtain a patent on the invention. Solutions devoid of patentability. Protection of utility models, industrial designs, topographies of integrated circuits. Protection of trademarks and service marks.

Procedure before the Polish Patent Office. Application documentation requirements for invention, utility model, industrial design, trade mark. Contentious procedure. Appeals against decisions of the Polish Patent Office. Licenses in trade of industrial property rights.

License: full, limited, exclusive, non-exclusive, open, implied, cross-license, compulsory. Patent information. Patent Classification. INID codes. Internet database of patent information. Patent research. State of the art study. Study of the patentability.

Obtain protection abroad. WIPO. PCT - Patent Cooperation Treaty. The European Patent Convention. OHIM. Madrid Agreement. TRIPS. Other international agreements for the protection of industrial property

Protection against unfair competition. Acts of unfair competition. Competition and consumer protection.

Copyright law. Bern Convention. Geneva Convention. Other international agreements on copyright. Copyright property. Personal copyright. Related Rights. Allowed for personal use. Allowed for public use. Criminal penalties for copyright infringement. Protection of computer programs. Protected subject matter. An entity of copyright to a computer program. Duplication of the program. Ending the use of computer program. Restrictions on property rights related to computer software. Access to the ideas and principles contained in the computer program.

Rules of using of the Internet. Netiquette. Violations of distinctive signs on the Internet. The use of email for commercial purposes. Other dishonest behavior in cyberspace. Agreement on cybercrime.

TEACHING METHODS:

Lectures with audiovisual aids.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W14 K_W19	The student has an ordered knowledge of the protection of intellectual property and patent law, knows and understands the basic concepts and principles of the protection of industrial property and copyright, can use the resources of patent information.
K_K02	The student is aware of and understands the importance and impact of non-technical aspects of engineering, including its impact on the environment, and the responsibility for decisions consequently related with these aspects

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W14 K_W19	A passing grade of the lecture depends on result of the written colloquium.
K_K02	The attitude creating during the classes.

Passing grade of the lecture depends on positive ratings of oral or written colloquiums carried out at least once a semester and study reports in the patent literature search for solutions related to the topic of the thesis student.

STUDENT WORKLOAD:

The student workload of 50 hours (2 ECTS), including consultations 20 hours, preparing for colloquium 20 hours, learning literature sources: 10 hours.

RECOMMENDED LITERATURE:

1. Szewc A., Jyż G: Prawo własności przemysłowej, Wyd. C.H.Beck, 2011
2. Gronowski S.: Prawo własności przemysłowej. Zagadnienia ogólne i proceduralne. Wyd. PIRP, Warszawa 2002
3. red. Promińska U.: Prawo własności przemysłowej, Wyd. Difin, Warszawa 2005
4. Barta J. Czajkowska-Dąbrowska M., Ćwiąkalski Z., Markiewicz R., Traple E.: Prawa autorskie i prawa pokrewne. Komentarz, Wyd. LEX a Wolters Kluwer business, Warszawa 2011

OPTIONAL LITERATURE:

1. Załucki M.: Prawo własności intelektualnej. Repetytorium, Difin, 2010
2. Sieńczyło-Chlabicz J.: Prawo własności intelektualnej, LexisNexis, 2009
3. Kostański P., Marek D.: Prawo własności intelektualnej. Test dla studentów, Oficyna a Wolters Kluwer business, 2008

BIOLOGY

Course code: 6.9-WM-IB-S1-EP-007_13

Type of course: Compulsory

Language of instruction: Polish

Director of studies: Dr Krystyna Walińska

Name of lecturer: Dr Krystyna Walińska
Dr Renata Grochowalska

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Studia stacjonarne					4
Lecture	30	2	I	Exam	
Laboratory	30	2		Grade	

COURSE AIMS:

The aim of the course is to acquire by the student the theoretical and practical knowledge in the range of using of biology in biomedical engineering.

PREREQUISITES:

Knowledge of basic biology at the secondary school level.

COURSE CONTENTS:

Lecture: The levels of organization of life. Properties of living matter. The chemical structure of livingorganisms, elemental composition of organisms and the general characteristics of chemical compounds of biological importance. Cell as a unit of life - the structure and function of cell organelles. Cell division - amitosis, mitosis and meiosis. Basics of metabolism of living organisms(respiration, photosynthesis). Transport of compounds across biological membranes. The structure and function of tissues. Reproduction of organisms and the transformation of generations. The basic mechanisms of heredity. Family tree of the world of the living. Basics of taxonomy. The division of living organisms and characteristics of the various kingdoms based on selected taxonomic groups.

Laboratory: Basics of microscopy (the optical microscope design, technology of microscopy). The chemical structure of living organisms (proteins, lipids and carbohydrates), the structure of the eukaryotic cell (subcellular structure, characteristics of selected structures intracellular). The life cycle of cells (cell division, chromosome structure, karyotypes), the plant histology basic (structure and function of plant tissues: dermal, ground and vascular tissue). Animal tissues (structure and function of epithelium, muscle, connective and neural tissue), model of living organisms and base of their function (the movement system of animals).

TEACHING METHODS:

Lecture: oral presentation (in the form of the ppt presentation)

Laboratory: practical (lab classes with the use of microscopes and binocular, the set of preparations and collected biological materials).

LEARNING OUTCOMES:

Learning outcomes		Field specific learning outcomes
Symbols of discipline specific learning outcomes	Engineering competence	
T1A_W01 T1P_W01		The student understands the basic concepts of biology, including the basis of cytology, histology, organology and systematics of living organisms.
T1A_U01		Uses literature sources and other sources (e-learning), is able to interpret and combine into a coherent whole the obtained information.
T1A_U02 T1A_U08	InzA_U01 InzA_U07	Plans and performs an experiment, can be used known research techniques (preparation of biological material, analysis using a microscope), interprets and draws conclusions. Uses skills in a professional environment and other environments.
T1A_U05 T1A_K01		Applies the method of self-education and recognizes the necessary to learn and improve their skills.
T1A_K02	InzA_U03 InzA_K01	Understands the non-technical aspects of engineering activity, including its relationship with the natural environment and the functioning of the living human

		being.
T1A_K03		Organizes the work of a team and works effectively in a group.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The lectures - the student is allowed to take the final written examination test after getting the pass mark credit of the classes. The 60 minute examination test contains 70 closed questions. 42 points (60%) out of 70 points are required to get the pass mark credit. The laboratory classes – the requirements of the assessment criteria refer to the pass mark credits of all laboratory classes. Tests (closed and open) as well as the dendrological herbarium made oneself, daily laboratory and practical skills test be assessed. The final mark consists of the average sum of all of the pass partial marks.

STUDENT WORKLOAD:

The contact hours:- the lectures (30 hours), the laboratory classes (30 hours),

The unassisted student work: - the preparations for the laboratory classes and the oneself preparation of dendrological herbarium (15 hours), the examination preparations and the presence of the exam (23 + 2 hours). The total amount of 100 hours refer to 4 ECTS points.

The determined student workload include: the workload of the direct assistance of the academic teacher: 30+30 2 h = 62 hours which refer to 2 ECTS points, - the practical classes workload : 15+23+2 h = 40 hours which refer to 2 ECTS points.

RECOMMENDED READING:

1. Podstawy biologii komórki - red. B. Alberts, PWN Warszawa 1999.

2. Biologia - Solomon, Berg, Villee, Multico Warszawa 1996.

3. Biologia – Berg, Martin, Multico W-wa 2007.

OPTIONAL READING:

1. Podstawy cytofizjologii - red. J. Kawiak, PWN Warszawa 1997

2. Cytologia i histologia - W. Lewiński, Wydawnictwo Operon Warszawa 2001

3. Fizjologia człowieka w zarysie - W. Traczyk, PZWL Warszawa 2007

4. Botanika, tom I – A. Szweykowska, J. Szweykowski, PWN Warszawa 2007

5. Cytologia, embriologia i histologia człowieka – P. Hoser, WSiP Warszawa 1996

REMARKS:

ELEMENTS OF LINEAR ALGEBRA WITH MATHEMATICAL ANALYSIS

Course code: 6.9-WM-IB-S1-EP-008_13

Type of course: compulsory

Language of instruction: Polish

Director of studies: dr Krystyna Białek

Name of lecturer: dr Krystyna Białek

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					
Lecture	30	2	I	Grade	4
Class	15	1		Grade	

COURSE AIMS:

The aim of the subject is to acquaint students with basic notions and methods of linear algebra, analytic geometry, mathematical analysis and as well as the students' equipment in basic mathematical indispensable tools to formulating and solving typical, the straight lines of engineering tasks with range of studied directions of studies.

PREREQUISITES:

Basic knowledge of mathematics in the field of secondary school.

COURSE CONTENTS:

1. Elements of mathematics logic and elements of sets theory. Bill of sentences. Quantifiers. Real numbers. The cartesian product of sets. Real numbers - 2 h.
2. Complex numbers: complex conjugate, modulus and argument of a complex number, polar representation, de Moivre's theorem - 2 h.
3. Matrices - part 1.: notation of a matrix and operations with matrices, determinant - definition and properties - 2 h.
4. Matrices - part 2.: inverse matrix, rank of a matrix, calculating the rank of a matrix - 2 h.
5. Matrices - part 3: systems of linear equations - methods for solving, eigenvalues and eigenvectors - 2 h.
6. Analytic geometry - part 1: vectors, inner product, vector product - examples of applying - 2 h.

7. Analytic geometry - part 2: equation of a straight line and a plane in R3, distance from point to a straight line and a plane, distance between two straight lines - 2 h.
8. Functions:definition, inverse functions, bijection, cyclometric functions (as an example), composite functions - 2 h.
9. Differential calculus of real-valued functions - part 1: neighbourhood and contiguity of a point, cluster point, limit of a sequence and its properties- 3 h.
10. Differential calculus of real-valued functions - part 2: limit of function and its properties, one-sided limits, improper limits - 3 h.
11. Differential calculus of real-valued functions - part 3: derivative, differential, one-sided derivatives, derivatives and differentials of higher order - 2 h.
12. Differential calculus of real-valued functions - part 4: mean-value theory, Taylor's formula and its application- 2h.
13. Differential calculus of real-valued functions - part 5: applications of derivatives: extremes, convexity, inflexion point, tangent lines, asymptotes, indeterminate forms, de l' Hospital's rule 4 h.

COURSE CONTENTS:

Class

1. Algebraic Structures : Groups. Definitions and examples (groups of numbers, the integers modulo n, symmetric groups). Rings and fields. Definitions and examples. Rings polynomials. Linears spaces. Definitions and examples - 1h.
2. Complex numbers: complex conjugate, modulus and argument of a complex number, polar representation, de Moivre's theorem. Polynomials. Horner’s Method - 2h.
3. Matrices - Algebraic operations. Determinants - Definition and properties. The Laplace theorem.. Evaluation of the rank of a matrix with determinants.- 2h.
4. Systems of Linear Cramer´s rule and their use. Kronecker-Capelli Theorem. Solving systems of linear equations. Gaussian elimination -2h.
5. Analytic geometry - vectors, inner product, vector product - examples of applying, equation of a straight line and a plane in R3, distance from point to a straight line and a plane, distance between two straight lines - 2 h.
6. Interim control written test -1h.
7. Numerical sequences. Limit of a sequence and its properties, definition of e. Limit of a function of one variable. Functions and their properties. Boundaries and limits at infinity inappropriate. Continuity of functions of one variable -1h.
8. Differential calculus of real-valued functions: definition, geometrical interpretation and physical derivative, differential, one-sided derivatives, derivatives and differentials of higher order) Computation of derivatives. Roll’s and Lagrange’s theorems, first derivative and differential,higher derivatives and differentials, monotonicity and local extremes -3h.
9. Written test -1h.

TEACHING METHODS:

Lecture: conventional, problematic, introduction.

Practice: the classic problematic method, work in groups, the demonstration from explanation, the discussion, storm of brains.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W01	The student has a basic knowledge of mathematics, including linear algebra, mathematical analysis I and analytical geometry, necessary to perform calculations in the design of processes; plan experiments and solve simple problems relevant to Biomedical Engineering.
K_U01	The student can obtain information from literature, databases and other sources, able to integrate the information, make their interpretation.
K_K01	The student understands the need for lifelong learning; is able to inspire and organize the learning process of others.
K_U07, K_K04	The student has self-education abilities to raise his qualifications and professional competence using library and electronic resources and data bases. The student understands the need for lifelong learning; is able to inspire and organize the learning process of others'.
K_U07, K_K01	The student has self-education abilities to raise his qualifications and professional competence using library and electronic resources. The student understands the need for lifelong learning; is able to inspire and organize the learning process of others.
K_K03	The student can interact and work in a group, adopting different roles.
K_W01	The student has a basic knowledge of mathematics, including linear algebra, analytical geometry and mathematical analysis I ,to perform calculations in the design of processes; plan experiments and solve simple problems relevant to Biomedical Engineering.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below:

The reference to the learning outcomes of the field of	The method of the learning outcomes assessment

study	
K_W01	Written exam. The pass of the lecture is to provide a positive assessment of written responses to questions regarding the theoretical aspects of the object.
K_U01,K_U07, K_K01,K_K03, K_K04	Grading exercise The prerequisite is to exercise a positive evaluation of the test.

1. Checking the degree of preparedness of students and their activities during the exercise.
2. Tests and test the tasks of varying difficulty, allowing to assess whether students have achieved learning outcomes to a minimum.

Form of the course - completion of the evaluation.

Final evaluation of the course: the average credit rating of training and a written test.

The prerequisite is to exercise positive ratings of the two written tests and exercises activity.

The pass exam is to get fixed (for the test) the minimum number of points (50%).

The prerequisite is to obtain a positive assessment of the multiple-choice test (Figure lecture examples) obtaining a test set for the minimum number of points (50%).

The pass test (Figure lecture examples) to obtain a test set for the minimum number of points (50%)

STUDENT WORKLOAD:

The student workload is 105 hours (4 ECTS), including contact hours: 45 hours, consultations: 20 hours, preparing for classes: 20 hours, preparing for the exam: 20 hours.

RECOMMENDED READING:

1. Gewert M., Skoczylas Z., *Analiza matematyczna* 1, Ofic. Wyd., GiS, Wrocław 2004
2. Jurlewicz J., Z. Skoczylas Z., *Algebra liniowa 1 i 2*, Ofic. Wyd., GiS, Wrocław 2004
3. Trajdos T., Matematyka. Część 3, WNT, Warszawa, 2005

OPTIONAL READING:

1. Białynicki-Birula A., *Algebra liniowa z geometrią*, PWN, Biblioteka Matematyczna t.48, W-wa 1979
2. Fichtenholz G.M.: *Rachunek różniczkowy i całkowy*, tom I, II i III. PWN, Warszawa 1978
3. Gancarzewicz J., *Algebra liniowa z elementami geometrii*, Wyd. Naukowe UJ, Kraków 2001.
4. Kajetanowicz P., Wierzejewski J., *Algebra z geometrią analityczną,* PWN 2008.

5. Klukowski J., Nabiałek I, *Algebra dla studentów*, WNT Warszawa 2004
6. Krysicki W., Włodarski L.: *Analiza matematyczna w zadaniach*, część I, PWN, W-wa 1998
7. Rudnicki W.: *Wykłady z analizy matematycznej*, PWN, Warszawa 2001.

REMARKS:

ELEMENTS OF LINEAR ALGEBRA WITH MATHEMATICAL ANALYSIS

Course code: 6.9-WM-IB-S1-EP-009_13

Type of course: compulsory

Language of instruction: Polish

Director of studies: dr Krystyna Białek

Name of lecturer: dr Krystyna Białek

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					
Lecture	30	2	II	Exam	5
Class	15	1		Grade	

COURSE AIMS:

Introduction to basic concepts, methods, linear algebra and calculus II and equip students with the basic mathematical tools needed to formulate and solve common, simple tasks in the field of engineering degree program being studied.

PREREQUISITES:

Knowledge in the field of material elements of linear algebra and mathematical analysis.

COURSE CONTENTS:

1. Indefinite integral - part 1: definition, indefinite integral of elementary functions, integration by parts and by substitution, examples - 2 h.
2. Indefinite integral - part 2: integration of rational, trygonometrical, irrational functions, recurrence formulas for integrals – 2h.
3. Definite integral - part 1: definition, properties, connection with an indefinite integral, integral as a function of its upper limit, change of variables- 2h.
4. Definite integral - part 2: application in geometry, improper integrals and their application - 2 h.
5. Regions and curves in R2: region, curve, classification of curves, length of curve, area of region, volumes of solids of revolution - 2h.
6. Differential calculus of functions f:Rn-->R - part 1: metric, limit and continuity of a function of n variables - 2 h.

7. Differential calculus of functions f:Rn-->R - part 2: partial and directional derivatives, elements of field theory, higher order partial and directional derivatives) - 4 h.
8. Taylor's formula: Taylor's formula and its application, relative extrema) - 3 h.
9. Multiple integral: double integral over a general region DcR2, normal regions, double integral over a normal region, calculating the volume of solid) - 3 h.
10. Line integrals - part 1: curve orientation, definition of a line integral of vector fields - 1 h.
11. Line integrals: properties of line integral of vector fields, calculating line integrals of vector fields - 2 h
12. Ordinary differential equations - part 1: definition of solutions, initial and boundary conditions, examples - 2 h.
13. Ordinary differential equations - part 2: separable differential equations, linear differential equations of order 1- 1 h.
14. Ordinary differential equations - part 3: linear differential equations of order 2 with constant coefficients) - 1 h.

COURSE CONTENTS:

1. Class Indefinite integral. Basic methods of determining integrals unmarked - 2h.
2. Definite integral and its applications: arc length, the field area, volume and surface area of the solid of revolution. Integral inappropriate. Improper integral convergence criteria-2h.
3. Functions of several variables. Limits and continuity of functions of several variables. The derivative of a function of several variables. Directional derivative. Partial derivatives. Gradient function. Higher order partial derivatives. Differential function and its application-2h.
4. Extremes of functions of several variables and their applications. Conditional extremes. The largest and smallest value of the function - the extremes of global-2h.
5. Multiple integrals. Double and triple integrals. Iterated integrals. Conversion of multiple integrals to iterated integrals. Change of variables. The use of multiple integrals-2h.
6. Ordinary differential equations and their applications. Equations with separated variables. First order linear equations (homogeneous and heterogeneous)-2h.
7. Second order linear equations with constant coefficients and methods of solving them. Elements of partial differential equations-2h.
8. Test - 1h.

TEACHING METHODS:

Lecture: conventional, problem, presentation.

Exercise: the classic method problematic, group work, presentation of explanation, discussion, brainstorming.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence

K_U07, K_W01	The student has a basic knowledge of mathematics, including linear algebra, mathematical analysis II necessary to perform calculations in the design of processes; plan experiments and solve simple problems relevant to Biomedical Engineering. The student has self-education abilities to raise his qualifications and professional competence using library and electronic resources.
K_U01	The student can obtain information from literature, databases and other sources, able to integrate the information, make their interpretation, as well as draw conclusions and formulate and opinions.
K_K01	The student understands the need for lifelong learning; is able to inspire and organize the learning process of others
K_U07, K_K04	The student has self-education abilities to raise his qualifications and professional competence using library and electronic resources and data bases. The student can properly determine priorities for implementation of tasks specified by themselves or others
K_U07, K_K01	The student has self-education abilities to raise his qualifications and professional competence using library and electronic resources and data bases. The student understands the need for lifelong learning; is able to inspire and organize the learning process of others.
K_K03	Potrafi współdziałać i pracować w grupie przyjmując w niej różne role społeczne. The student can interact and work in a group, adopting different roles
K_W01	The student has a basic knowledge of mathematics, including linear algebra, mathematical analysis II necessary to perform calculations in the design of processes; plan experiments and solve simple problems relevant to Biomedical Engineering.
K_W01	The student has a basic knowledge of mathematics, including linear algebra, mathematical analysis II necessary to perform calculations in the design of processes; plan experiments and solve simple problems relevant to Biomedical Engineering.
K_U07	He has knowledge of the integrals of functions of one variable and can be used to solve simple problems to calculate the arc length, the field area, volume and

K_W01	surface area of the solid of revolution. The student has self-education abilities to raise his qualifications and professional competence using library and electronic resources.
K_U07, K_W01, K_U07	He has knowledge of the calculus of functions of several variables and can be used to solve simple engineering tasks related to the issues being studied in the field of optimization direction. The student has self-education abilities to raise his qualifications and professional competence using library and electronic resources.
K_U07, K_W01	He has knowledge of the calculus of functions of several variables and can be used to solve simple engineering tasks for the calculation of (volume and weight area, static moments, coordinates the center of mass, moments of inertia, the force of gravitational attraction, electric field, potential and kinetic energy) and interpretation of the results. The student has self-education abilities to raise his qualifications and professional competence using library and electronic resources
K_U07, K_W01	He has knowledge of the elements of vector analysis, and can be used to calculate integrals curved surface and to solve simple problems being studied engineering in the field of Direktion. The student has self-education abilities to raise his qualifications and professional competence using library and electronic resources nd solve simple problems relevant to Biomedical Engineering
K_U07, K_W01	It has a basic knowledge of differential equations of first and second order and can be used to solve simple problems relevant to Biomedical Engineering. The student has self-education abilities to raise his qualifications and professional competence using library and electronic resources and data bases.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W01	Written exam The pass of the lecture is to provide a positive assessment of written responses to questions regarding the theoretical aspects of the object.

K_U01, K_U02, K_U07, K_K01, K_K03, K_K04	Grading exercise The prerequisite is to exercise a positive evaluation of the test.

1. Checking the degree of preparedness of students and their activities during the exercise.
2. Tests with the tasks of varying difficulty, allowing to assess whether students have achieved learning outcomes to a minimum.
3. Written exam.

Form of the course - exam.

Final evaluation of the course: the average credit rating of exercises and written exam.

The prerequisite is to exercise positive ratings of the two written tests and exercises activity.

The pass exam is to get fixed (for the test) the minimum number of points (50%).

The pass mark for the exam is to get a positive assessment of the multiple-choice test (Figure lecture examples) obtaining a test set for the minimum number of points (50%).

STUDENT WORKLOAD:

The student workload is 127 hours (5 ECTS), including contact hours: 45 hours, consultations: 30 hours, exam: 2 hours, preparing for classes: 30 hours, preparing for the exam: 20 hours.

RECOMMENDED READING:

1. Fichtenholz G. M., *Rachunek różniczkowy i całkowy*, tom I, II i III, PWN, Warszawa 1978
2. Gewert M., Skoczylas Z., *Analiza matematyczna 1 i 2,* Ofic. Wyd., GiS, Wrocław 2004
3. Gewert M., Skoczylas Z., *Elementy analizy wektorowej,* Ofic. Wyd., GiS, Wrocław 2004
4. Gewert M., Skoczylas Z., *Równania różniczkowe zwyczajne,* Ofic. Wyd., GiS, Wrocław 2004

OPTIONAL READING:

1. Fichtenholz G. M., *Rachunek różniczkowy i całkowy*, tom I, II i III, PWN, Warszawa 1978
2. Gewert M., Skoczylas Z., *Analiza matematyczna 1 i 2,* Ofic. Wyd., GiS, Wrocław 2004
3. Gewert M., Skoczylas Z., *Elementy analizy wektorowej,* Ofic. Wyd., GiS, Wrocław 2004
4. Gewert M., Skoczylas Z., *Równania różniczkowe zwyczajne,* Ofic. Wyd., GiS, Wrocław 2004

REMARKS:

PHYSICS

Course code: 6.9-WM-IB-S1-EP-010_13

Type of course: compulsory

Language of instruction: polish

Director of studies: dr Krzysztof Maciesiak

Name of lecturer: dr Krzysztof Maciesiak, dr Lidia Najder-Kozdrowska, dr Stefan Jerzyniak

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

COURSE AIMS:

The aim of the course is to familiarize students with the basic physical phenomena and processes occuring in the biomedical engineering; lerning of the measurement methods, basic phisical units; physical phenomena analysis and solving technical probelms based on physical laws

PREREQUISITES:

Basic knowledge of mathematics, physics, chemistry at the high school level.

COURSE CONTENTS:

Lecture content.

Physical quntites and their units. Basic phisical laws. Classical and relativistic mechanics. Kinematics. Newton's laws of motion. Work and energy, conservation of energy. Special theory of relativity. Momentum and the law of conservation of momentum. The conservation laws in physics. Gravitation. Deformation and stress in an extended elastic

medium. Hooke's law. Oscilations and waves in an elastic medium. Acoustics elements. Acoustic wave. Doppler effect. Statistic and dynamics of fluids. Elements of thermodynamics and statistical physics. Kinetic theory of gases.Electricity and magnetism. Electromagnetic waves. Light. Classical and quantum optics. Elements of the quantum mechanics. Atomic structure and atomic nucleus. Nuclear physics and particle physics. Elements of plasma physics. Solid-state physics.

Laboratory content.

Verification of the circular rotation of a rigid body equation. Evaluation of a density of the solid bodies using pycnometer. Study of Lissajous curve, Evaluation of the gravitational acceleration using reversible pendulum. Study of damping harmonic oscillators. Resonance phenomen in driven oscillations. Evaluation of the modulus of rigidity using dynamic method. Study of a hysteresis of a ferromagnetic. Study of the power in alternating current (AC) circuit. Evaluation of the charge and capacitance of a capacitor. Study of a transformer. Ohm's and Kirchoff's laws.

TEACHING METHODS:

Lectures with audiovisual aids. Calculus exercises. Working with a book. Group work in laboratory classes.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W03	The student has a general knowledge in field of physics, particularly in classical, relativistic and quantum mechanics. Basic knowledge of general physical laws, units and fundamental interaction. Organised knowledge on material point and rigid body mechanics as well as electromagnetism.
K_W04	The student has a knowledge on conducting experiments and elaborating results of physical measurements, types of uncertainties and ways of their calculations
K_U01	The student can obtain information from literature, databases and other sources, able to integrate the information, make their interpretation, as well as draw conclusions and formulate and opinions
K_U02	The student can plan experiments and engineerig acitvities, elaborate in written form issues of those researches and engineering science, draw conclusions and formulate opinions.

K_U04	The student can obtain information from literature, databases and other carefully selected sources, in English or any other foreign language considered as a language of international communication in the field of Biomedical Engineering; can integrate the information, make its interpretation and critical evaluation, draw conclusions and formulate opinions

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W03, K_W04	Exam: A condition to obtain satisfactory grade is to answer correctly on theoretical questions and solve problems.
K_U01, K_U02, K_U04	Laboratory: A grade is determined on basis of: preparation for the classes, experiments realization and reports for all provided and conducted experiments.

Lecture: Exam
Laboratory: Grade

STUDENT WORKLOAD:

The student workload of 152 hours (6 ECTS), including work in the auditorium 60 hours, consultations 15 hours, exam 2 hours, preparing for grade 15 hours, preparing of control work and reports 30 hours, preparing for classes 30 hours.

RECOMMENDED READING:

1. Robert Resnick, David Halliday, Fizyka, Tom 1, Wydawnictwo Naukowe PWN, Warszawa.
2. David Halliday, Robert Resnick, Fizyka, Tom 2, Wydawnictwo Naukowe PWN,Warszawa.
3. David Halliday, Robert Resnick, Jearl Walker, Podstawy fizyki, Tomy 1-5,Wydawnictwo Naukowe PWN, Warszawa.
4. Szydłowski, Pracowania fizyczna, PWN, 1979 and later
5. H. Szydłowski, Niepewności w pomiarach – międzynarodowe standardy w praktyce, Wydawnictwo Naukowe UAM, 2001.
6. 6. T. Dryński, Ćwiczenia laboratoryjne z fizyki, PWN, 1967 and later

CHEMISTRY

Course code: 6.9-WM-IB-S1-EP-011_13

Type of course: optional

Language of instruction: Polish

Director of studies: Dr hab. Inż. Elżbieta Krasicka-Cydzik

Name of lecturer: Dr hab. Inż. Elżbieta Krasicka-Cydzik
Dr inż. Izabela Głazowska
Mgr inz. Agnieszka Kaczmarek
Mgr inż. Katarzyna Arkusz

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

COURSE AIM:

The aim of this course to acquire the skills and competencies by students in solving the technical problems of biomedical engineering based on the fundamental rights of inorganic, organic and selected areas of physical chemistry as well as perform calculations and conducting the experiments in the areas covered by the course subject.

PREREQUISITES:

Basic and advanced level of high school Chemistry course.

COURSE CONTENTS:

Lecture content: Atomic structure. Schrödinger equation. The atomic nucleus ambient electron structure. Pauli principle and Hund rule. The periodic table of elements. Bond theory. An ionic bond. A covalent bond. Polarization binding. Hybridization. Multiple bonds, donor-acceptor bonds. Complex connections of d-block elements. Metallic and ionic bonding. Metallic elements. Hydrogen bond. Chemical rights, Stoichiometry. Electrolytes theory. Dissociation. Hydrolysis. Buffer solutions. The phase construction of matter - gases, liquids and solids. Phase equilibria. Thermodynamics and thermochemistry. Parameters, thermodynamic functions and principles of thermodynamics. Reversible and irreversible

reactions, equilibrium of chemical reactions. The pace of chemical reactions. Simple, parallel, follow-up and chain reaction kinetics. Pace reaction dependence on temperature. Catalysis. Basics of electrochemistry. Redox reaction stoichiometry. Galvanic series. Galvanic cells, potential- determining reactions. Nernst equation. Red-ox reactions with use of oxygen and hydrogen. Pourboix diagrams. Electrolysis theory. Fundamentals of electrochemical corrosion of metals and alloys. Surface phenomena. Fundamentals of organic chemistry. Types of isomerism. Alkanes and cycloalkanes. Alkenes - synthesis and applications, detecting the presence of multiple bonds, Markovnikov's rule. Alkynes. Alcohols, their physical and chemical properties, Grignard reactions. Aromatic hydrocarbons, the physicochemical properties of aromatic systems. Ethers, aldehydes, ketones, acids - synthesis, chemical reactivity, the primary type of reaction, the identification reactions. Cannizzaro reaction and aldol condensation reaction. Construction of the carboxyl group. The pKa term as a quantity describing the acid strength. Amides and esters.

Laboratory content. Buffer solutions; pH metry; The Broensted hydrochloric effect; Complexometry; hydrolysis; Micelle - surface-active substances, solar cell - TiO2-based photovoltaics, electrochemical corrosion, potentiometric titration, Electrolysis; Colorimetry; Redox titration; Cations qualitative analysis; Colloids research; Organic compounds analysis.

TEACHING METHODS:

Lecture: Regular lecture

Laboratory: Laboratory classes.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence.
K_W04	has a basic knowledge of chemistry and biochemistry needed to understand and solve simple problems in Biomedical Engineering
K_U02	The student can plan experiments and engineering activities, elaborate the results of testing and engineering tasks, draw conclusions, formulate and justify opinions in technical issues
K_U23	The student can plan, carry out experiments, interpret results and Draw conclusions in the field of biomedical measurements, can run basic medical equipment in hospital, perform measurement of elementary biosignals: ie. EMG, EEG, EKG
K_K02	The student is aware of and understands the importance and impact of non-technical aspects of engineering,

	including its impact on the environment, and the responsibility for decisions consequently related with these aspects
K_K04	The student can properly determine priorities for implementation of tasks specified by themselves or others

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

In the field of technical sciences	The learning outcome assessment method.
K_W01	Exam in the form of the written test. A passing grade in the lecture part of the course is determined by positive grade for five written answers about the theoretical aspects of the subject.
K_U11 K_U16 K_U02 K_U23	Grade based on laboratory classes. A passing grade in the laboratory part is based on student preparation to each laboratory class, attendance, written reports and activity during the laboratory classes.

STUDENT WORKLOAD:

The student workload consists of 150 hours (6 ECTS).

Lectures attendance: 30 hours, Laboratory classes attendance: 30 hours, Consults attendance: 10 hours, Exam 5 hours, Preparing for classes 15 hours, Preparing for exam 20 hours, Preparing for test 20 hours, Preparing of control work and reports 20 hours.

RECOMMENDED READING:

1. L. Pajdowski, Chemia ogólna, PWN, Warszawa 1997.
2. A. Bielański, Podstawy chemii nieorganicznej, PWN, Warszawa 1997.
3. A. F. Wells, Strukturalna chemia nieorganiczna, WNT, Warszawa 1993.
4. P.W. Atkins., Chemia Fizyczna, PWN, Warszawa 2003.
5. Chemia fizyczna, Praca zbiorowa, PWN Warszawa, 1980.
6. K. Pigoń, Z Ruziewicz, Chemia fizyczna, PWN, Warszawa 1993.
7. G.M. Barrow, Chemia fizyczna, PWN, Warszawa 1978.

OPTIONAL READING:

1. L. Smoczyński, S. Kalinowski, J. Wasilewski, Karczyński F., Podstawy chemii fizycznej z ćwiczeniami, Wyd. UWM, Olsztyn 2000.
2. K. Pigoń, Z. Ruziewicz, Chemia fizyczna, PWN, Warszawa 1993.

3. G.M. Barrow, Chemia fizyczna, PWN, Warszawa 1978.
4. Eksperymentalna chemia fizyczna, Praca zbiorowa, SGGW, Warszawa 1995.
A. Wasik, P. Konieczka , Wybrane metody elektroanalityczne, Materiały do ćwiczeń, Politechnika Gdańska 2002

METHODS OF STATISTICAL DATA ANALYSIS

Course code: 6.9-WM-IB-S1-EP-012_13

Type of course: fundamental

Language of instruction: polish

Director of studies: prof. dr hab. inż. Dariusz Uciński

Name of lecturer: prof. dr hab. inż. Dariusz Uciński
dr inż. Maciej Patan

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

COURSE AIMS:

- introduction to the elementary methods of uncertainty description
- development of essential skills in the field of statistical inference

PREREQUISITES:

Basic knowledge in the field of probability calculus, combinatorics and mathematical analysis.

COURSE CONTENTS:

Measurement uncertainty. Uncertainty transfer. Random and systematic errors. Distributive series. Histogram. Measures of location, variability, asymmetry and concentration. Rejecting data.

Probability. Sample space. Probability definitions: classical, frequency-based and modern. Elementary properties. Conditional probability. Independence. Total probability. Bayes formula.

Discrete and continuous random variables. Discrete random variables. Distributions: binomial, Poisson and geometric. Functions of random variables. Notions of expected value

and variance. Joint distributions for many random variables. Independence of random variables. Continuous random variables. Uniform and exponential distributions. Cumulative distribution function. Normal distribution.

Basics of statistical inference. Sample generation schemes. Distributions: chi-square, t-Student and Fisher-Snedecora. Point and interval estimation. Unbiasedness, consistency, effectiveness and sufficiency. Parametric and non-parametric estimation. Confidence intervals for expected value. Limit theorems. Confidence intervals for expected value in population with unknown distribution, variance, standard deviation and probability.

Statistical hypotheses testing. Parametric significance tests for expected value and variance of population structure indicator. Non-parametric significance tests.

Linear and polynomial regression. Analysis of phenomena correlation. Correlation and regression. Least squares method. Inference in correlation and regression analysis. Linear correlation coefficient.

TEACHING METHODS:

Classic lecture and exercises in the computer laboratory.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W01	Student has knowledge in the field of probability theory, mathematical statistics and experimental design theory required for proper formulation and solution of basic problems related to biomedical engineering.
K_U19, K_U15, K_U13	Student is able to use various uncertainty descriptions.
K_U15, K_U19	Student can calculate elementary parameters of descriptive statistics.
K_U19, K_U15	Student performs basic statistical inference.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W01	Lecture grade is based on the final test.
K_U13, K_U15, K_U19	Laboratory grade is based on the evaluation of partial tests (at least 2 during the course), reports on laboratory classes, attendance and initiative on the part of the student.

STUDENT WORKLOAD:

The student workload of 100 hours (4 ECTS), including work in the auditorium 30 hours, consultations 30 hours, preparing for tests 10 hours, preparing of control work and reports 10 hours, preparing for classes 10 hours, homeworks and reading 10 hours

RECOMMENDED READING:

1. Kukuła K.: *Elementy statystyki w zadaniach*, PWN, Warszawa, 1998.
2. D Ostasiewicz S., Rusnak Z., Siedlecka U.: *Statystyka: elementy teorii i zadania*, Akademia Ekonomiczna, Wrocław,1999.
3. Krysicki W. i in.: Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach, PWN, Warszawa, 2000.

OPTIONAL READING:

1. Liengme B.V.: *Microsoft Excel w nauce i technice*, Read Me, Warszawa, 2002.
2. Sobczyk M.: *Statystyka*, PWN, Warszawa, 2000.

MATERIALS SCIENCE

Course code: 6.9-WM-IB-S1-EP-014_13

Type of course: Compulsory

Language of instruction: Polish

Director of studies: Ferdynand Romankiewicz, Prof.

Name of lecturer: Mariusz Michalski, PhD
Izabela Głazowska, PhD
Remigiusz Romankiewicz, PhD
Paweł Schlafka, MSc

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

COURSE AIM:

The aim of the course is to familiarize the student with the basic groups of engineering materials and with the correlation between the atomic and structural structure and physico-chemical, mechanical and technological properties of materials for the selection and application for biomedical engineering.

PREREQUISITES:

Basic level of high school chemistry and physics course.

COURSE CONTENTS:

Lecture content: Elements of crystallography, single crystals, polycrystals. Amorphous materials, glass, ceramics, polymers. The actual structure of metals and alloys. Nano-and microstructure of materials. Phase equilibrium systems. System: iron - carbon. The relationship between the structure and properties of materials. Classification and properties of ferrous and non-ferrous metals. Properties of materials: mechanical, thermal, electrical, magnetic, optical. Composites, fibers, layers. Biological properties of materials used in the biomedical engineering medicine. Shaping the structure and properties of materials by technology methods.

Laboratory content.

1. Macroscopic metallographic research.
2. Optical and electron microscopy.
3. Quantitative metallography.
4. Deformation and recrystallization.
5. The analysis of binary alloys.
6. Pig iron and cast iron structure.
7. Carbon steel structure.
8. The work off class.
9. Structure after the heat and thermo-chemical steel treatment.
10. Special steel structure.
11. Structure of titanium and cobalt alloys.
12. The structures of aluminum alloys and copper alloys.
13. Ceramics and composites
14. Technological methods of production.
15. Extra class. TEST

TEACHING METHODS:

Lectures with use of audiovisual aids. Reading the subject literature. Group and individual work in laboratory classes.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence.
K_W11	The student has knowledge of engineering materials, their investigation and shaping technologies in medical applications, knows computer technologies in materials selection and surface engineering, has knowledge of computer-aided methods of materials selection
K_U05, K_U13	The student can use experimental methods for the researches of materials used in the Biomedical Engineering.
K_U19	Student is able to select appropriate materials for the Biomedical Engineering.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

In the field of technical sciences	The learning outcome assessment method.
K_W11	Exam in the form of the written test. A passing grade in the lecture part of the course is determined by positive grade to questions about the

	theoretical aspects of the subject.
K_U05, K_U13, K_U19	Grade based on laboratory classes. A passing grade in the laboratory part is based on student preparation to each laboratory class, attendance and activity during the laboratory classes.

Final evaluation of the course is based on the arithmetic average of the grades exam and tests.

STUDENT WORKLOAD:

The student workload of 150 hours (6 ECTS), including work in the auditorium 60 hours, consultations attendance 12 hours, exam 2 hours, preparing for classes 20 hours, preparing for exam 20 hours, preparing of control work and reports 20 hours, reading the subject literature 16 hours.

RECOMMENDED READING:

1. Jegerman Z., Ślusarczyk A .: Gęsta i porowata bioceramika korundowa w zastosowaniach medycznych. Wyd. Nauk. Dyd. AGH, Kraków 2007.
2. Pampuch R. : Współczesne materiały ceramiczne. Wyd. Nauk. Dyd. AGH, Kraków 2005.
3. Dąbrowski J.R. : Spiekane biomateriały na bazie stopu Co-Cr-Mo. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2004.
4. Będziński R, : Biomechanika inżynierska. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1997.
5. Marciniak J. : Biomateriały w chirurgii kostnej. Wydawnictwo Politechniki Śląskiej, Gliwice 1999.

OPTIONAL READING:

3. Callister W. D. Jr, Materials science and engineering, John Wiley & Sons, New York, 1990.
4. Dobrzański L. A., Materiały inżynierskie i projektowanie materiałowe, WNT, Gliwice-Warszawa, 2006.
5. Ciszewski A., Radomski T., Szummer A, Materiałoznawstwo, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 1998.
6. Blicharski M., Inżynieria materiałowa – stal, WNT, Warszawa, 2004.
7. Staub I., F. i inni. „Metaloznawstwo". Wyd. Śląsk, Katowice, 1979.
8. Domke W. „Vademecum materiałoznawstwa" WNT Warszawa, 1989.
9. Wyatt O., H., Hughes D. "Wprowadzenie do inżynierii materiałowej". WNT Warszawa,1978.

MECHANICS AND STRENGTH OF MATERIALS

Course code: 6.9-WM-IB-S1-EP-015_13

Type of course: compulsory

Language of instruction: Polish

Director of studies: Prof. zw. dr hab. inż. Romuald Będziński

Name of lecturer: Prof. zw. dr hab. inż. Romuald Będziński
Dr inż. Krzysztof Białas-Heltowski
Dr inż. Paweł Jurczak

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	30	2	II	Exam	
Class	15	1		Grade	
Laboratory	15	1		Grade	

COURSE AIM:

The aim of the course is to familiarize students with problem-solving methodology based on the laws of mechanics and analysis of the strength found in mechanical engineering.

PREREQUISITES:

General knowledge of differential calculus, integral calculus, operations on the vectors.

COURSE CONTENTS:

Lecture

The basic notions and the principles of statics. Plane and spatial arrangement of convergent forces. Equilibrium plane and spatial arrangement of convergent forces. The basis of reduction of arrangement forces. The plane arrangements of strengths without friction (reduction of plane arrangement of forces, equilibrium of any plane arrangement of forces equilibrium of an arrangement consisting of rigid bodies). Friction and friction laws. Arbitrary spatial arrangement of forces. Reduction of spatial arrangement of forces. Basic

notions of strength of materials. Objectives and tasks of the strength of materials.The types of loads. Types of deformations. Internal forces, de Saint Venant principle. Tension and compression of materials. Hooke's law, Young's modulus, Poisson's ratio. Principle of superposition, allowable stress, the safety factor. Statically determinate and statically indeterminate systems tension or compression of rods systems. Analysis of stress and strain at the point, one-, two- and three-direction stresses and strains states. General components and main components of the stresses. Mohr's circle. Generalized Hooke's law for two- and three- direction stresses. Shear, strain and shear stress. Hooke's law in shear. Static moments. Moments of inertia of plane areas. Steiner formulae. Principal axes and principal moments of inertia, Mohr's circle for the moments of inertia. Torsion of circular shafts. Analysis of stresses and strains in torsion. Calculation of springs. Internal forces in rods and beams. Bending of straight rods.

Class

Solving classes based on lectures and source materials, in two parts: mechanics (vectors, constraints, reactions, coplanar forces: concurrent force systems, arbitrary force systems, determination of resultant moment, couples of forces, calculation of values of reactions in bearings of beams, calculation of internal forces in truss members of plane trusses) and strength of materials (tension, compression, shearing, bending, torsion).

Laboratory

Main topics: methods of measurement of hardness (Brinell, Rockwell and Vickers), static tensile metals, impact bending tests, determination of the static coefficient of friction, determination of the characteristics and stiffness of springs, dynamic balancing of machine parts with balancer.

TEACHING METHODS:

Lectures with audiovisual aids. Solving classes. Working with the book. Group work in laboratory classes.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W08	The student has an elementary knowledge of engineering graphics, mechanics, the principles of workpiece design and mechanical equipment constructions, design of devices and production systems, as an engineering discipline relevant to the field of Biomedical Engineering

K_U02	The student can plan experiments and engineering activities, elaborate the results of testing and engineering tasks, draw conclusions, formulate and justify opinions in technical issues
K_U01	The student can obtain information from literature, databases and other sources, able to integrate the information, make their interpretation, as well as draw conclusions and formulate and opinions
K_K02	The student is aware of and understands the importance and impact of non-technical aspects of engineering, including its impact on the environment, and the responsibility for decisions consequently related with these aspects
K_K06	The student can think and act in a creative and enterprising way

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	**The method of the learning outcomes assessment**
K_W08; K_K02	Written exam. A passing grade in the lecture part of the course is determined by five written responses to questions about the theoretical aspects of the subject.
K_U01, K_K06	A passing grade in laboratory part comprises positive evaluation of reports based on each laboratory class, attendance and initiative on the part of the student.
K_U02	Positive evaluation of the test.

Lecture

Exam

Class

Grade

Laboratory

Grade (received positive ratings of reports carried out laboratory)

Evaluation of the course is getting positive ratings from all forms: Lecture, Class, Laboratory

The final grade received by the student is the arithmetic mean of the above grades.

STUDENT WORKLOAD:

The student workload is 127 hours (5 ECTS), including work in the auditorium: 60 hours, exam: 2 hours, consultations: 15 hours, preparing for classes: 25 hours, revising for exam 10 hours, revising for tests: 10 hours, preparing study reports 5 hours.

RECOMMENDED READING:

1) Niezgodziński M. E., Niezgodziński T., Wytrzymałość materiałów, 1979 PWN wyd. XI.
2) Misiak J., Mechanika ogólna – Statyka i kinematyka, 1993 WNT wydanie IV.
3) Misiak J., Zadania z mechaniki ogólnej. Statyka, 1994 WNT wydanie V.
4) Walicki E., Smak T., Falicki J., Mechanika. Wprowadzenie teoretyczne do laboratorium. 2005, Oficyna Wydawnicza Uniwersytetu Zielonogórskiego.
5) Walicki E., Smak T., Falicki J., Mechanika. Materiały pomocnicze do ćwiczeń laboratoryjnych. 2005, Oficyna Wydawnicza Uniwersytetu Zielonogórskiego.
6) Walicka A, Walicki E, Michalski D, Jurczak P, Falicki J., Wytrzymałość materiałów / T. 1: Podręcznik akademicki. Teoria, wzory i tablice do ćwiczeń laboratoryjnych. – Zielona Góra: Oficyna Wydawnicza Uniwersytetu Zielonogórskiego, 2008.
7) Walicka A, Walicki E, Michalski D, Jurczak P, Falicki J., Wytrzymałość materiałów T. 2: Ćwiczenia laboratoryjne – Materiały pomocnicze. - Zielona Góra: Oficyna Wydawnicza Uniwersytetu Zielonogórskiego, 2008.

OPTIONAL READING:

1. Rżysko J., Statyka i wytrzymałość materiałów , 1979 PWN.
2. Jakubowicz A., Orłoś Z., Wytrzymałość materiałów, 1984 WNT.
3. Gubrynowiczowa J., Wytrzymałość materiałów, 1968 PWN.
4. Leyko J., Mechanika ogólna. t. I, 1980 PWN wydanie VII.
5. Leyko J., Zbiór zadań z mechaniki ogólnej. t. I, 1978 PWN wydanie IV.
6. Banasiak M., Grossman K., Trombski M., Zbiór zadań z wytrzymałości materiałów, 1998, PWN.

REMARKS:

COMPUTER AIDED DESIGN I

Course code: 6.9-WM-IB-S1-EP-016_13

Type of course: compulsory

Language of instruction: Polish

Director of studies: Dr inż. Krzysztof Białas-Heltowski

Name of lecturer: Dr inż. Krzysztof Białas-Heltowski

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

COURSE AIMS:

Design is a process of making a decision. It consists of calculation as well as technical drawings. The last part can be suppoorted using dedicated software. However, to use electronic tools in a reasonable way it is necessary to know the principles defining the ways of showing three-dimensional objects on two-dimensional plane.

The course has two main aims: (i) introduction of students into principles of technical drawing as well as the practical using of acquired knowledge and (ii) introduction of students into 2D/3D design software which enables them idependent development of their skills in the future. Therefore, during every meeting students make drawings manually and with electronic software.

PREREQUISITES:

COURSE CONTENTS:

The course is devided into three parts.

Part 1 – introduction into chosen design software – working on two-dimensional plane

1. Introduction to the subject → main principles according the course, literature, the basic ideas about design/technical drawing.

2. AutoCAD 2D (1) → general principles, introduction into AutoCAD design software, drawing tools, tools of modification, tool of precise drawing.

3. AutoCAD 2D (2) → zooming, layers, blocks, tools of measurement, printing, views.

4. AutoCAD 2D (3) → text, fractions, adaptation of the software to own needs, features, sections, styles of measurement, text, miltiline, point.

5. AutoCAD 2D (4) → creating of drawing template, opening of drawings partly, design center, export of data to another applications, systems of co-ordinates.

Part 2 – building of theoretical fundation

1. Axonometric projection → description, types of views, drawing of circles, application.
2. Orthogonal projection → description, three methods.
3. Sections → types, marking, lining, special types.
4. Measurement → lines, numbers, types, principles, examples.
5. Tolerances, roughness, coatings, thermal processing → kinds of tolerances (of dimensions, shape, position), fitting, marks of roughness, marking of thermal processing and coats.

Part 3 – introduction into chosen design software – working on three-dimensional plane and preparing to presentation of results of working

1. AutoCAD 3D (1) → global and local system of co-ordinates, isometrical views, creating of simple solid figures, their edition, extruders.
2. AutoCAD 3D (2) → rotatory solids, phaze and the curve, imprints, coats, modification of sides.
3. AutoCAD 3D (3) → meshed objects, surfaces, 3D operations, modification with the use of handles, materials, background.
4. Disjoint and inseparable connections (student presentations) → screwed, pole, cardial, welded, sealed, sticked, sewed and othres.
5. Simplifications (presentations of students) → definition, degrees of simplification, simplification of connections, gears, springs, bearings and Schemes → definition, types, used symbols, description. Summary and grade of the subject.

TEACHING METHODS:

The method depends on the subject of meeting. In the case of meeting number 1, 2, 3, 4, 5, 11, 12 i 13 – it is typical training with aim of introduction into the subject and bacis ideas of using design software. In the case of meeting number 6, 7, 8, 9 i 10 – the method is composed of two parts – part one is theoretical introduction into the subject of a meeting in the form of talk; second part is typical laboratory excersise, during which students work individually solving tasks defined by the leader. First, students solve the task manually, and then solve them using design software. In the case of meetings number 14 i 15 – it is kind of seminary, during which students present individually prepared presentations relating defined questions. Each presentation ends with short discussion.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W08	The student is able to define basic terms of design (related to egineering graphics/drawings) – what is making drawing, and describe its elements. Also is able to define the types of technical connections relevant to the

	field of Biomedical Engineering.
K_U11, K_U20	The student can apply in the basic range design tools like AutoCAD or ProgeCAD, which supprt 2D/3D design. Can present manually and in electronic form simple 3D object on 2D plane the field od Biomedical Engineering. Student knows and uses suitable norms concerning the drawing issues.
K_U06	The student can prepare and present an oral presentation concerning specific issues of the field of Biomedical Engineering.
K_U03	The student can work on his/her own and as a team member, select team members and determine requirements they should fulfil, manage the small team himself.
K_K01	The student understands the need for lifelong learning the range of design; is able to inspire and organize the learning process of others.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W08 K_K01	The laboratory ends with the grade. The final grade (FG) is composed of: - arithmetic average of grades of partial tasks (PT) – each partial task must be graded positively (50% of final grade), - activity/kowledge (A; 40% of final grade), - frequency of presence (F; 10% of final grade). FG = 0,5PT+0,4A+0,1F
K_U03 K_U06 K_U11 K_U20	The mark of prepared technical documentation, skill of using/applaying the knowledge in the range of design.

STUDENT WORKLOAD:

The amount of student's work is 75 hours (3 ECTS): 30 hours – contact hours, 10 hours – part in consultation, 10 hours – preparing to regular meetings, 25 hours – working out of projects.

RECOMMENDED READING:

1. Dobrzański T., Rysunek techniczny maszynowy, WNT, Warszawa, 2004
2. Bober A., Dudziak M., Zapis konstrukcji, PWN, Warszawa, 1999
3. Winkler T., Komputerowy zapis konstrukcji, WNT, Warszawa, 1997

4. Mazur J., Kosiński K., Polakowski K., Grafika inżynierska z wykorzystaniem metod CAD, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2004

OPTIONAL READING:

1. Rydzanicz I., Rysunek techniczny jako zapis konstrukcji: zadania, WNT< Warszawa, 2004
2. Lewandowski T., Zbiór zadań z rysunku technicznego dla mechaników, WSiP, Warszawa, 1995
3. Knosala R., Laboratorium z CAD-CAM, Politechnika Opolska, Opole, 2001
4. Pikoń A., AutoCAD 2005, Helion, Gliwice, 2005
5. Jaskulski A., AutoCAD 2006/LT 2006+: wersja polska I angielska: kurs projektowania, PWN, Warszawa, 2006

REMARKS:

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COMPUTER AIDED DESIGN II

Course code: 6.9-WM-IB-S1-EP-017_13

Type of course: compulsory

Language of instruction: Polish

Director of studies: Dr inż. Krzysztof Białas-Heltowski

Name of lecturer: Dr inż. Krzysztof Białas-Heltowski

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

COURSE AIMS:

The aim of the course is introduction of students into the principles of creating assembly drawings and to designing of relatively simple biomechanical elements/rehabilitation systems (like plates to bones or external stabilisers) in a group as well as individually.

PREREQUISITES:

The course of computer aided design I.

COURSE CONTENTS:

1. Summary of knowledge gained in first semester and introduction to the assembly drawings. Presentation of examples of such drawings.

2. Creating and grading of simple assembly drawing.

Level of working in groups (2-3 persons):

3. Project task I: PT I (1) – selection of the design task and conception.

4. PT I (2) – assembly drawing and specyfing of the design task.

5. PT I (3) – making drawings.

6. PT I (4) – 3D drawings.

7. PT I (5) – grading of full drawing documentation (project) and presentation of results in the electronic form by students.

Level of individual working/designing:

8. Project task II: PT II (cz. 1) – selection of the design task, defining of the task, preparing of individual plan of work.

9. PTII (2) – assembly drawing (1).

10. PT II (3) – assembly darwing (2).

11. PT II (4) – making drawings (1).

12. PT II (5) – making drawings (2).

13. PT II (5) – 3D drawings.

14. PT II (6) – grading of full drawing documentation concerning PT II and presentations of results in electronic form.

15. Summary and grade of the subject..

TEACHING METHODS:

The method depends of the subject of a meeting. In the case of meeting number 1-2 – it is kind of talk, multimedia lecture and demonstration (#1 – itroduction of issues concerning a assembly drawing) and consultations (#2). In the case of meetings number 3-7 – it is working in groups, consultations and seminary (#7). In the case of meeting number 8-14 – it is individual work, consultations, and seminary (#14). In the case of meeting number 15 – it is kind of talk.

LEARNING OUTCOMES:

Symbols of field specific learning outcomes	Field specific learning outcomes
K_U01, K_U07	The student can obtain information from literature, databases and other sources, able to integrate the information, make their interpretation, as well as draw conclusions and formulate and opinions. The student has self-education abilities to raise his qualifications and professional competence using library and electronic resources and data bases.
K_U08	The student can define requirements and constraints concerning given simple design task as well as design simple device or objects. Knows methods enabling design (concerns drawing part of design). The student can individually use various techniques supporting design (e.g. AutoCAD, ProgeCAD) in the professional community as well as in other communities.
K_U15	The student can record experimental results, elaborate studies protocol and present results in the clear report. Can work individually and use proper norms.
K_K03	The student can interact and work in a group, adopting different roles.
K_U06	The student can prepare the results of design and present an oral presentation concerning specific issues of the field of Biomedical Engineering. Also can manage specific knowledge and express it orally and in written form (the form of drawing documentation).

K_U05, K_U20	The student can design a simple device isung CAD methods and prepare technical documentation concerning the device in the field of Biomedical Engineering (rehabilitation equipment, implants, external stabiliser).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_U01 K_U06 K_U07 K_U08	The laboratory ends with the grade. The final grade (FG) is composed of: - arithmetic average of grades of partial tasks (PT) – each partial task must be graded positively (50% of final grade), - activity/kowledge (A; 40% of final grade), - frequency of presence (F; 10% of final grade). FG = 0,5PT+0,4A+0,1F
K_U20 K_U05	The mark of prepared technical documentation, skill of using/applaying the knowledge in the range of design.

STUDENT WORKLOAD:

The amount of student's work is 75 hours (3 ECTS): 30 hours – contact hours, 10 hours – part in consultation, 10 hours – preparing to regular meetings, 25 hours – working out of projects.

RECOMMENDED READING:

1. Dobrzański T., Rysunek techniczny maszynowy, WNT, Warszawa, 2004
2. Bober A., Dudziak M., Zapis konstrukcji, PWN, Warszawa, 1999
3. Winkler T., Komputerowy zapis konstrukcji, WNT, Warszawa, 1997
4. Mazur J., Kosiński K., Polakowski K., Grafika inżynierska z wykorzystaniem metod CAD, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2004

OPTIONAL READING:

1. Rydzanicz I., Rysunek techniczny jako zapis konstrukcji: zadania, WNT< Warszawa, 2004
2. Lewandowski T., Zbiór zadań z rysunku technicznego dla mechaników, WSiP, Warszawa, 1995
3. Knosala R., Laboratorium z CAD-CAM, Politechnika Opolska, Opole, 2001
4. Pikoń A., AutoCAD 2005, Helion, Gliwice, 2005
5. Jaskulski A., AutoCAD 2006/LT 2006+: wersja polska I angielska: kurs projketowania, PWN, Warszawa, 2006

REMARKS:

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METROLOGIA I

Course code: 6.9-WM-IB-S1-EP-018_13

Type of course: Directional

Language of instruction: Polish

Director of studies: Dr inż. Mariusz Krajewski

Name of lecturers: Dr inż. Mariusz Krajewski

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					4
Lecture	30	2	III	Exam	
Laboratory	30	2		Grade	

COURSE AIMS:

To ***acquire*** of theoretical and practical knowledge of various physical quantities measured by direct and indirect methods. Determination of uncertainty of measurement tools and methods.

PREREQUISITES:

General knowledge of the basics of electrical engineering and electronics

COURSE CONTENTS:

Lecture content.

Lecture: Basic concepts (definition of measurement, measurand and value of measurement, units of measurement, measurement scales, selected electrical and mechanical patterns). Measurement methods. A method of direct and indirect comparisons. Differential and zero method. Compensation and deviation method. A method of substitution and shift pattern. Determination of measurement uncertainty. Error sources. Systematic, random and excessive errors. Errors of a measurement method. Basic and additional errors of measurement instrument. Maximum error of direct and indirect measurement. Uncertainty of the direct and indirect measurement. The standard and expanded uncertainty. The principle of operation and properties of measurement tools. analog and digital instruments, transducers of value and measurand. A/C transducers. Oscilloscopes. Measurements of selected the electrical parameters: voltage, current DC and

AC, power, frequency, resistance and impedance. Measurement of non-electrical electric methods - selected examples.

Laboratory: Direct and indirect measurements of basic electrical quantities. Electronic oscilloscope. Analysis of the accuracy of the measurement result. Modeling phenomena and objects. The study of static properties of transducers. The study of dynamic characteristics of temperature sensors. The measurement rotation speed. Resistance and impedance measurements. Measurement of frequency and time. Digital DC voltmeter.

TEACHING METHODS:

Lecture: Auditorium form. Laboratory exercises are done in the form of exercise in special positions with didactic instructions.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W06	The student has an ordered and theoretically based knowledge of the basic methods, techniques and measurement tools used in the measurement of electrical and non-electrical applications of biomedical engineering
K_U02	The student can plan and carry out experiments, including measurements, and interpret the results and draw conclusions

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W19	Written exam. To pass the lecture, student has to get a positive assessment of written responses to questions regarding the theoretical aspects of the object.
K_U02	Examination of the laboratory. Assessment of the laboratory is based on student examine of preparing for classes and their realization and reports resulting from the execution of all implemented exercise.

The lecture is passed on the basis of a written and oral exam after the completion of the lab. Laboratory evaluation is included. To get passing grade is to perform all the exercises provided in the program and getting positive ratings from all reports.

STUDENT WORKLOAD:

The student workload of 102 hours (4 ECTS), including contact hours: 60 hours, participation in consultations: 10 hours, the exam: 2 hours, preparation for classes: 10 hours, prepare audit work, reports, reports, etc.: 10 hours, learning literature sources: 10 hours

RECOMMENDED LITERATURE:

1. Chwaleba A., Poniński M., Siedlecki A.: Metrologia elektryczna. Wydawnictwa Naukowo-Techniczne, Warszawa, 1998.
2. Piotrowski J.: Podstawy miernictwa. Wydawnictwa Naukowo-Techniczne, Warszawa, 2002.
3. Skubis T.: Podstawy metrologicznej interpretacji wyników pomiarów. Wydawnictwo Politechniki Śląskiej, Gliwice, 2004.
4. Tumański S.: Technika pomiarowa. Wydawnictwa Naukowo-Techniczne, Warszawa, 2007.
5. Jakubiec W., Malinowski J.: Metrologia wielkości geometrycznych. Wydawnictwa Naukowo-Techniczne, Warszawa, 2004.
6. Szklarski J.: Metrologia długości i kąta, część III i IV. Zielona Góra, 1997.
7. Arendarski J.: Niepewność pomiarów. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2003.
8. Laboratorium metrologii elektrycznej. Praca zbiorowa pod red. J. Lal-Jadziak. Wydawnictwo Politechniki Zielonogórskiej, Zielona Góra, 1999.
9. Międzynarodowy słownik podstawowych i ogólnych terminów metrologii. Główny Urząd Miar, Warszawa, 1996.

OPTIONAL LITERATURE:

1. Stabrowski M.: Cyfrowe przyrządy pomiarowe. PWN, Warszawa, 2002.

METROLOGY II

Course code: 6.9-WM-IB-S1-EP-019_13

Type of course: directional

Language of instruction: Polish

Director of studies: Agnieszka Kierzkowska

Name of lecturer: Agnieszka Kierzkowska

Classes type	Number of hours per semester	Number of hours per week	Semester	Form of the credit	ECTS points
Full-time study					3
Laboratory	30	2	IV	Grade	

COURSE AIMS:

The purpose of the course is to familiarize students with the basic methods of measuring length and angle, and the construction and service of measuring devices/apparatus and methods of evaluation and interpretation of the results.

PREREQUISITES:

Knowledge of the computer aided engineering design, basic metrology and statistical methods of data analysis. It is useful to know the basics of machine construction.

COURSE CONTENTS:

Scope of the laboratory course - to familiarize with the basic methods of measuring length and angle, and the construction and service of measuring devices. It especially includes:

- measurements using slide calipers and micrometric devices;
- measurements of external and internal angles,
- measurements of cones,
- measurements using sensory devices,
- measurements of diameters and spacing of hole's axes
- interferential measurements
- measurements of threads

- checking of universal measuring instruments,
- measurements of cylindrical gears,
- measurements of cams,
- measurements of non-linearity using methods based on angle measurements
- measurements of surface roughness.

TEACHING METHODS:

Laboratory classes - teamwork in 2 to 3 person groups. Each group, on particular classes, performs a separate topic from the list of laboratory topics, given at the first meeting. Classes are held on the measuring apparatuses, mainly Zeiss.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
T1P_U02	student potrafi porozumiewać się przy użyciu różnych technik, w tym informatycznych w środowisku zawodowym
T1P_U05	ma umiejętność samokształcenia się poprzez przenoszenie i łączenie wiedzy teoretycznej z praktyczną
T1P_U11	ma umiejętności niezbędne do pracy w środowisku przemysłowym oraz zna i stosuje zasady bezpieczeństwa związane z tą pracą
T1P_U14	potrafi dokonać identyfikacji i sformułować specyfikację prostych zadań inżynierskich o charakterze praktycznym, charakterystycznych dla kierunku studiów
T1P_U18	ma doświadczenie związane z rozwiązywaniem praktycznych zadań inżynierskich, zdobyte w środowisku zajmującym się zawodowo działalnością inżynierską
T1P_K02	ma świadomość ważności i rozumie pozatechniczne aspekty i skutki działalności inżynierskiej i związanej z tym odpowiedzialności za podejmowane decyzje
T1P_K03	potrafi współdziałać i pracować w grupie, przyjmując w niej różne role
T1P_K05	prawidłowo identyfikuje i rozstrzyga dylematy związane z

	wykonywaniem zawodu

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Laboratory classes - to pass the classes, student needs to get a positive grade (including the grade from the response in the oral or written form, and the grade from the report constituting a summary of research methodology and the gained results with their analysis) from all the exercises, which are specified in the program at the beginning of the semester.

STUDENT WORKLOAD:

Student workload comprises a total of 75 hours, including: participation in the lab - 30 hours, literature review, preparing for classes and oral/written tests - 30 hours, development of reports – 13 hours and consultations - 2 hours.

RECOMMENDED READING:

1. W. Jakubiec, J. Malinowski, Metrologia wielkości geometrycznych, WNT, W-wa 2004.
2. J. Szklarski, Metrologia długości i kąta, Cz.II, III i IV, Zielona Góra 1997.
3. W. Jakubiec, Metody matematyczne w organizacji i zarządzaniu przedsiębiorstwem przemysłu maszynowego, Łódź 1991.
4. Międzynarodowy słownik podstawowych i ogólnych terminów metrologii, Główny Urząd Miar, W-wa 1996.
5. S. Białas, Metrologia techniczna z podstawami tolerowania wielkości geometrycznych dla mechaników, Pol. Warsz. 1997.
6. J. Malinowski, Pomiary długości i kąta w budowie maszyn, WSiP, W-wa 1998.
7. H. Szydłowski, Pracownia fizyczna. PWN, Warszawa 1999.

OPTIONAL READING:

1. Czasopisma branżowe, normy ISO-PN

REMARKS:

MEDICAL PROPAEDEUTICS

Course code: 6.9-WM-IB1S-020-PKI

Type of course: Field specific

Language of instruction: Polish

Director of studies: Lek med. Diana Zaorska

Lecturer: Lek med. Diana Zaorska

Form of instruction	Number of hours per semester	Number of hours per week	Semester	Form of receiving a credit for a course	ECTS credits
Full-time studies					3
Lecture	30	2	I	Grade	

COURSE OBJECTIVES:

The aim of this course is to help students acquire skills and competences needed to make use of medical knowledge in biomedical engineering.

ENTRY REQUIREMENTS:

COURSE CONTENTS:

Lecture: health care organization, objectives of medicine, definition of health and disease, causes of diseases, division of medicine according to clinical criteria, medical specialties, the role of medical engineer in the patient treatment process, predicted directions of the evolution of health organization in Poland, significance of choosing this subject area of studies, employment opportunities after graduation, theory of medical team, improvement of medical services quality by means of technical development and increasingly growing team of specialists, diagnostics - laboratory, imaging, microbiological, surgical – invasive, pharmacotherapy – drugs – types, routes of administration, supply methods, new technologies, surgery – types of procedures according to medical specialty: open – endoscopic – etc., artificial implants, transplantology, human “cyborgization” - replacement of human organs functions, kidneys, liver, poisoning treatment, artificial sense organs (eye, ear), lungs, blood, artificial heart, ICD, pacemakers, local and general anaesthesia, intensive care unit - resuscitation with the use of defibrillator, respirator, pacemaker, iatrogenic disorders.

TEACHING METHODS:

Conventional lecture with the use of multimedia.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W02	The student has knowledge in the field of medicine structure and organization, diagnostic and treatment methods, the basic anatomy, transplantation and implant techniques, needed to formulate and solve simple engineering tasks in Biomedical Engineering

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W02	Lecture credit granted on the basis of grade. The main condition of gaining a lecture credit is obtaining a positive grade on colloquium.

Lecture: credit granted on the basis of grade on colloquium.

STUDENT WORKLOAD:

Student work input is 75 hours (3 ECTS) including office hours: 30 hours, consultations: 15 hours, preparation for instructions: 15 hours, preparation for colloquium: 15 hours.

RECOMMENDED READING:

1. Guzek J. W., Patofizjologia człowieka w zarysie, Wydawnictwo Lekarskie PZWL, 2005.
2. Michajlik A., Ramotowski W., Anatomia i fizjologia człowieka, Wydawnictwo Lekarskie PZWL, 2003.
3. Tatoń J., Czech A., Diagnostyka internistyczna, Wydawnictwo Lekarskie PZWL, 2002.

OUTLINE OF ANATOMY AND PHYSIOLOGY

Course code: 6.9-WM-IB-S1-EP-021_13

Type of course: Field specific

Language of instruction: Polish

Director of studies: Lek med Adam Haliński

Lecturer: Lek med Adam Haliński

Form of instruction	Number of hours per semester	Number of hours per week	Semester	Form of receiving a credit for a course	ECTS credits
Full-time studies					3
Lecture	30	2	II	Grade	

COURSE AIMS:

The aim of the course is to provide students with a knowledge in the field of using elements of anatomy and physiology in biomedical engineering.

PREREQUISITES:

COURSE CONTENTS:

Lecture: An introduction to the study of anatomy. Basic anatomical terms. Skeletotopy of organs and great vessels. Cycles of individual life. Skeletal system. Joints of skeletal system. Muscular system. Digestive system. Respiratory System. Renal System. Reproductive systems. Cardiovascular system. Nervous System.

TEACHING METHODS:

Conventional lecture with the use of multimedia.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W02	The student has knowledge in the field of medicine structure and organization, diagnostic and treatment methods, the basic anatomy, transplantation and implant techniques, needed to formulate and solve simple engineering tasks in

	Biomedical Engineering

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W02	Lecture credit granted on the basis of grade. The main condition of gaining a lecture credit is obtaining a positive grade on colloquium.

Lecture: credit granted on the basis of grade on colloquium.

STUDENT WORKLOAD:

Student work input is 75 hours (3 ECTS), including office hours: 30 hours, consultations: 15 hours, preparation for instructions: 15 hours, preparation for colloquium: 15 hours.

RECOMMENDED READING:

1. Bochenek A., Reicher M., Anatomia człowieka, Pzwl, 2007.
2. Gołąb B., Traczyk W. Z., Anatomia i fizjologia człowieka. Podręcznik dla studentów, Ośrodek Doradztwa i szkolenia TUR s.c.
3. Michajlik A., Ramotowski W., Anatomia i fizjologia człowieka, PZWL, 2007.
4. Netter F. H., Atlas anatomii człowieka Nettera, Urban & Partner.
5. Sokołowska-Pituchowa J. (red.), Anatomia człowieka, Pzwl, 2001.
6. Suder E., Brużewicz Sz., Anatomia człowieka. Podręcznik i atlas, Wydawnictwo Medyczne Górnicki.

BIOCHEMISTRY

Course code: 6.9-WM-IB-S1-EP-022_13

Type of course: Compulsory

Language of instruction: Polish

Director of studies: prof. dr hab. Aleksander Sikorski

Name of lecturer: prof. dr hab. Aleksander Sikorski, dr Beata Machnicka

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Intramural studies					3
Lecture	30	2	II	Grade	
Laboratory	30	2		Grade	

COURSE AIMS:

Learning and understanding the chemical basis of the structure and function of the body.

PREREQUISITES:

Biology

COURSE CONTENTS:

Biochemistry - explantation of the concept and content. Amino acids and proteins. Peptide bond. Proteins - structure, classification, and the complexity of the structural and functional diversity. The parameters characterizing the properties of the proteins. Enzymes - basic functions. Enzyme inhibitors. Nucleic acids - structure, diversity, function, biosynthesis. The genetic code. Protein biosynthesis. Sugars - structure and function in the body. Lipids - complexity, classification, biosynthesis and catabolism of certain lipids. Vitamins - the characteristics and distribution of vitamins.Basic concepts of methabolism. Anabolic and catabolic processes. Coupled reactions. Glycolysis. Krebs cycle. Photosynthesis. Oxidative phosphorylation. Inputs of nitrogen to the biosphere. Solutions - calculations. Conversion concentrations. Centrifugation, salting out and dialysis. Chromatographic techniques. Electrophoresis. Basics of spectrophotometry.

TEACHING METHODS:

LECTURE - Giving method: lecture in the form of a multimedia presentation, examples of problem solving LABORATORY - Giving method: discussion about applied analytical methods, analysis of experimental results. -Practical method: lab exercises with the use of selected biochemical methods

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K1A_W03	student explains the molecular basis of the functioning of a living organism,
K1A_U03 K1A_U04 K1A_U05	student solves simple problems in the field of biochemistry and molecular biology, prepares reports from performed laboratory experiments, uses basic laboratory equipment (pipettes, electrophoresis equipment and chromatography, spectrophotometers, pH meters, etc.), conduct experiments according to the procedures.
K1A_K02	student working in a group and organize the work in a particular experiment, listens to comments of the teacher and apply its recommendations
K1A_K01	student applies the method of self-study and understand that they possess the knowledge and experience gained in this field is essential for the reliable implementation of the biological experiments

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

LECTURE: condition of obtaining credit points is to get positive results from the written examination test. LABORATORY: provided credit is class attendance and getting positive results of the 7 written tests (in the form of 3-5 open questions, a positive mark above 50% of scored points), and credit of all written reports from performed laboratory experiments and credit of one practical skills test. The final mark consists of the average sum of all of the pass partial marks. LECTURE: provided credit is to get positive results from the 60 minute written examination test(in the form of 3 open questions, from a pool of about 200 questions previously availabled to students). Least 50% of scored points are required to get the pass mark credit.

STUDENT WORKLOAD:

THE FULL-TIME STUDIES. The student workload of 75 hours (3 ECTS), including work in the auditorium 60 hours, , preparing of control work and reports 5 hours, preparing for classes 10 hours.

RECOMMENDED READING:

- Berg, J.M, Tymoczko, J.L. , Stryer, L., Biochemia, Wydawnictwo Naukowe PWN, Warszawa, 2005, wydanie IV zmienione
- Berg, J.M, Tymoczko, J.L. , Stryer, L., Biochemia, Wydawnictwo Naukowe PWN, Warszawa, 2009, wydanie VI zmienione
- Kłyszejko-Stefanowicz L. Ćwiczenia z biochemii, PWN, Warszawa, 1999.

BIOPHYSICS

Course code: 6.9-WM-IB-S1-EP-023_13

Type of course: Compulsory

Language of instruction: Polish, Russian

Director of studies: Dr hab. Jarosław Piskorski, prof. UZ

Name of lecturer: Dr hab. Jarosław Piskorski, prof. UZ

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					3
Lecture	30	2	III	Grade	
Laboratory	15	1		Grade	

COURSE AIMS:

The aim of the course is to teach the foundations of biophysics to the extent which is both necessary and useful in biomedical engineering.

PREREQUISITES:

Basic Physics Course

COURSE CONTENTS:

1) Static forces: equilibrium considerations for the human body, skeletal muscles, levers, the elbow, the hip,

2) Friction: standing and moving on an incline, friction at joints,

3) Translational motion: jump – maximum standing and running jump and vault poling, energy considerations,

4) Angular motion: running: running on a curved track, pendulum and walking, speed of running, model of walking and running,

5) Elasticity and strength of materials: longitudinal stretch and compression, spring, bone fracture: energy and impulse force considerations, injuries in car accidents, osteoarthritis and exercise,

6) Fluids: force and pressure in fluids, Pascal's principle, hydrostatic skeleton, Archimedes' principle, power required for floating, surface tension,

7) Motion of fluids: Bernouli's equation, viscosity and Poiseuille law, turbulent flow, circulation of the blood, blood pressure, control of blood flow, turbulence in the blood, arteriosclerosis and blood flow, power produced by the heart, blood pressure measurement,

8) Heat and Kinetic Energy: Heat and hotness, kinetic theory of matter, basic definitions, transfer of heat, transfer of molecules by diffusion, diffusion through membranes, the respiratory system, surfactants and breathing, diffusion and contact lenses,

9) Thermodynamics: first and second laws of thermodynamics, thermodynamics of living systems, information and the second law,

10) Heat and life: energy requirements of people, energy from food, regulation of body temperature, control of skin temperature, evaporation, resistance to cold,

11) Electricity: nervous system, electrical potential in the axon, action potential, synaptic transmission, electricity in plants, electricity in the bones, electric fish, heart as an electric device,

12) Optics: vision, nature of light, structure of the eye, accommodation, lens system of the eye, resolving power of the eye, corrective lenses,

13) Atomic physics: the atom, spectroscopy, quantum mechanics, electron microscope, X-rays, Computed Tomography, lasers,

14) Nuclear physics: the nucleus, magnetic resonance imaging, radiation therapy, food preservation by radiation, isotopic tracers, laws of physics and life.

TEACHING METHODS:

Lecture, biophysics laboratory

LEARNING OUTCOMES:

The student is able to describe the physical bases of the functioning of living organisms (K_W03, K_W08, K_W10), is able to explain the functioning of the basic systems of the human body in terms of physics (K_W03, K_W08, K_W10, K_W16),. The student is aware of the limitations of the human and animal bodies following from the laws of physics (K_W03, K_W08). He or she is able to perform basic experiments of the biophysics laboratory (K_U02, K_U06).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Final test, the preparation of 4 laboratory reports

STUDENT WORKLOAD:

- Participation in the lectures – 30h
- Preparation for the lectures – 15h
- Participation in the laboratory – 15h
- Preparation for the laboratory – 15h

RECOMMENDED READING:

1. F. Jaroszyk, Biofizyka, Wydawnictwo Lekarskie PZWL, Poznań, 2008

OPTIONAL READING:

1. P. Davidovits, Physics in Biology and Medicine, Academic Press, New York, 2008

REMARKS:

BIOMATERIALS

Course code: 6.9-WM-IB-S1-EP-024_13

Type of course: Compulsory

Language of instruction: Polish

Director of studies: Izabela Głazowska, PhD

Name of lecturer: Izabela Głazowska, PhD

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					
Lecture	30	2	III	Exam	5
Laboratory	30	2	IV	Grade	

COURSE AIM:

The aim of the course is to familiarize students in terms of the classification, characteristic and application of biomaterials in the medical devices.

PREREQUISITES:

Passed following basic and optional courses in the studies plan: Chemistry, Biochemistry, Physics, Biology, Material Science, Anatomy and Physiology.

COURSE CONTENTS:

Lecture content: Basic concepts: biomaterial, medical product, concepts associated with the functioning of biomaterials within a biological environment: biodegradability, biocompatibility, bioactivity. The legal standards relating to biomaterials, classification of biomaterials: according to material groups, clinical applications, their impact on the biological environment. Tissue fusion materials, materials for dressings, materials used in bone surgery, soft-tissue surgery, orthopedics, cardiac surgery, dentistry and prosthodontics, the surgical instruments, the rehabilitation equipment, orthotics. Metallic materials, polymer materials, bioceramic materials, carbon materials, composite materials, bioglass. Biomaterial research methods, technological requirements for surface condition, methods of production, disinfection and sterilization issues. Testing and implementation of biomaterials accordingly to European law, legislative issues concerning biomaterials and medical devices.

Laboratory content. Characteristic properties of biomaterials using the Grant's software - CES Selector. Identification of the polymer materials, viscosity measurement in cross-linking flexible polymer systems, examination of the structure and properties of biomaterials used in dentistry – metal alloys, cements, adhesives, resins (SEM), examination of the mechanical properties, chemical and physical performance of materials used in soft tissue surgery and dermatology, and their water extracts, the examination of the bioceramics structure and bioceramics properties (SEM). Photocatalytic oxidation coatings obtaining and testing their properties. Biomaterials porosity measurement. The surgical and dental instruments disinfection and sterilization. Accessories and disposable and reusable medical supplies (syringes, bandages, plasters, tapes).

TEACHING METHODS:

Lectures with use of audiovisual aids. Group work in laboratory classes.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence.
K_W11	The student has knowledge of engineering materials, their investigation and shaping technologies in medical applications, knows computer technologies in materials selection and surface engineering, has knowledge of computer-aided methods of materials selection
K_W12	The student has basic knowledge in the field of biomaterials, knows basic methods and algorithms of biomaterials testing, technologies and applications of biomimetic, dental, smart and gradient materials
K_U22	The student can classify engineering materials, use methods of shaping their structures and characterise chemical, physical, mechanical properties of materials
K_U10	The student can use terminology relevant to the field of Biomedical Engineering.
K_U04	The student can obtain information from literature, databases and other carefully selected sources, in English or any other foreign language.
K_U19	The student can plan and carry out experiments, including measurements and computer simulations, to interpret the results and draw conclusions.
K_K03	The student can interact and work in a group.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W11 K_W12	Exam in the form of the written test. A passing grade in the lecture part of the course is determined by positive grade to questions about the theoretical aspects of the subject.
K_U22 K_U10 K_U04 K_U19 K_K03	Grade based on laboratory classes. A passing grade in the laboratory part is based on student preparation to each laboratory class, attendance and activity during the laboratory classes.

Exam in the form of the written test

Laboratory – To pass student needs to get positive grades from all the laboratory exercises within the laboratory program

STUDENT WORKLOAD:

The student workload of 125 hours (5 ECTS), including work in the auditorium 60 hours, consultations 15 hours, exam 2 hours, preparing for classes 15 hours, preparing of control work and reports 18 hours, reading the subject literature 15 hours.

RECOMMENDED READING:

1. Biomateriały / red. Stanisław Błażewicz [et al.], Warszawa : Akademicka Oficyna Wydawnicza EXIT,
   2003, Biocybernetyka i inżynieria biomedyczna 2000 ; t. 4
2. Marciniak W., Szulc A.: Wiktora Degi: Ortopedia i rehabilitacja, PZWL, Warszawa 2003
3. J.Marciniak : Biomateriały w chirurgii kostnej 1992, Wydawnictwo Politechnika Śląska
4. Ćwiczenia laboratoryjne z biomateriałów pod red. J.Marciniaka , Wydawnictwo Politechnika Śląska
   1999
5. Tylman D., Dziak A., Traumatologia narządu ruchu, 1985, PZWL, W-wa tom 1

OPTIONAL READING:

1. ISO standards, DIN standards and ASTM standards.
2. European Pharmacopoeia

BIOMECHANICS ENGINEERING

Course code: 6.9-WM-IB-S1-EP-025_13

Type of course: directional

Language of instruction: Polish

Director of studies: Agnieszka Kierzkowska

Name of lecturer: Agnieszka Kierzkowska

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time study					4
Lecture	30	2	IV	Exam	
Laboratory	30	2		Grade	

COURSE AIMS:

The aim of the course is to familiarize students with the basic issues concerning the biomechanics of movement and methods of testing and support of the human musculoskeletal system, as well as the acquisition of skills in determining the biomechanical properties of tissues and defining means of support dysfunction of the motor system.

PREREQUISITES:

Basic knowledge of the mechanics and strength of materials and methods of statistical data analysis. Basic knowledge of human anatomy and physiology.

COURSE CONTENTS:

Lecture:

Human musculoskeletal system. Kinematics of the musculoskeletal system. The basic parameters of strength, mechanical and physical properties of selected tissue structures. Joint as bio-bearing. Biotribology, friction, types of friction in bio-bearing.

Knee joint: design, kinematics and biomechanics, basic axes of limbs, load models, dysfunctions and their treatment, knee joint alloplasty.

The hip joint: anatomy of the hip joint, its components, kinematics and biomechanics, load models, dysfunction, hip alloplasty.

Spine: basic functions, anatomical elements of the spine and basic geometric parameters of the posture, models of the spine, kinematics and biomechanics, overloads and instability/stability, the main dysfunctions and treatment of the spine, spine implantology.

Long bones: anatomy, external fixation, external stabilizers design characteristics, external fixation in the treatment of fractures and limb lengthening.

Biomechanical overview of the other joints: anatomy of hand joints, shoulder joint and elbow join, alloplasty and characteristics of prosthesis/supporting implants design.

Laboratory:

Friction and bio-bearing – knowledge of the basic issues of friction, types of friction, experimental determination of the dependence of friction torque as a function of friction distance and the load. Physiological and functional properties of the human. Kinematics of selected joints.

Examination and evaluation of mechanical/strength properties of the tissue/implant components in static tests: tension, compression and bending. Testing and assessment of biomechanical properties of the implant-bone interface. Statistical analysis of gained results. Identification of selected implants and surgical tools – evaluation of the function, a description of the construction, installation methods analysis; assembling of the biostabilizer on the phantom/animal specimen.

TEACHING METHODS:

Transmission of the contents of lectures using multimedia presentations, use of multimedia information materials of medical companies in the range of the latest knowledge concerning biomedical engineering.

During the laboratory classes - teamwork* (mainly 2 to 4 persons) using the research-measuring devices and specimens/models/phantoms/stabilizers.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
T1P_U02	student potrafi porozumiewać się przy użyciu różnych technik, w tym informatycznych w środowisku zawodowym

T1P_U05	ma umiejętność samokształcenia się poprzez przenoszenie i łączenie wiedzy teoretycznej z praktyczną
T1P_U11	ma umiejętności niezbędne do pracy w środowisku przemysłowym oraz zna i stosuje zasady bezpieczeństwa związane z tą pracą
T1P_U14	potrafi dokonać identyfikacji i sformułować specyfikację prostych zadań inżynierskich o charakterze praktycznym, charakterystycznych dla kierunku studiów
T1P_U18	ma doświadczenie związane z rozwiązywaniem praktycznych zadań inżynierskich, zdobyte w środowisku zajmującym się zawodowo działalnością inżynierską
T1P_K02	ma świadomość ważności i rozumie pozatechniczne aspekty i skutki działalności inżynierskiej i związanej z tym odpowiedzialności za podejmowane decyzje
T1P_K03	potrafi współdziałać i pracować w grupie, przyjmując w niej różne role
T1P_K05	prawidłowo identyfikuje i rozstrzyga dylematy związane z wykonywaniem zawodu

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture - to credit the lecture, the student needs to get a positive grade from the test conducted in writing (in special cases and/or oral) form, comprising 5 to 10 exam questions.

Laboratory - to pass the classes, student needs to get a positive grade (including the grade from the response in the oral or written form, and the grade from the report constituting a summary of research methodology and the gained results with their analysis) from all the exercises, which are specified in the program at the beginning of the semester.

STUDENT WORKLOAD:

Student workload comprises a total of 100 hours, including: participation in the lecture/lab - 60 hours, stand-alone work – 10 hours, literature review, preparing for classes and oral/written tests - 5hours, development of reports – 10 hours, preparation to the exam – 5 hours, exam – 2 hours and consultations - 8 hours.

RECOMMENDED READING:

1. Ross Ethier, Craig A. Simmons: Introductory Biomechanics, Cambridge University Press, 2008.
2. M. Gzik: Biomechanika kręgosłupa człowieka, Politechnika Śląska, Gliwice 2007.
3. J. W. Błaszczyk: Biomechanika kliniczna, PWWL, Warszawa, 2004.

4. R. Będziński: Biomechanika Inżynierska, Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 1997.
5. Praca zbiorowa pod red. M. Nałęcza: Biomechanika i Inżyniera Rehabilitacyjna, EXIT, Warszawa 2004.
6. P. McGinnis: Biomechanics of sport and exercise, Champaign: Human Kinetics, 1999.
7. J. Kubacki: Alloplastyka stawów w aspekcie zagadnień ortopedycznych i rehabilitacyjnych, AWF, Katowice 2004.
8. M. Gierzyńska-Dolna: Biotribologia, Wyd. Politechniki Częstochowskiej, 2002.
9. J. Mrozowski, Jan Awrejcewicz: Podstawy biomechaniki, Wydawnictwo Politechniki Łódzkiej, 2004.

OPTIONAL READING:

1. Czasopisma branżowe, np. Acta of Bioengineering and Biomechanics, Engineering of Biomaterials.

REMARKS:

*Number of people in the team during the laboratory depends on the number of students in the group and the economic-aperture possibilities of the laboratory.

IMPLANTS AND ARTIFICIAL ORGANS

Course code: 6.9-WM-IB-S1-EP-026_13

Course type: optional

Language of instruction: Polish

Director of studies: Dr hab. Andrzej Rabenda

Name of lecturer: Dr hab. Andrzej Rabenda

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					3
Lectures	30	2	VI	Grade	

COURSE AIMS:

Chalegnes and oportinities in replacing of failure organs by implants or artificial organs. Issue of organs and tissues transplantation. Significance of surgery techniques for saving patients health and life. Problems in implantology.

PREREQUISITES:

Basics: anatomy, physiology, immunology, pathophysiology, toxicology and chemistry.

COURSE CONTENTS:

Implant clasification. Biomaterials/tissue interactions. Cellular responce for implantation: inflammation, tissue repair process, biocompatibility with blood, carcinogenicity. Transplantology. Artifical organs. Biological efectors. Skeletar muscles control and stimulation. Active implants of motion organs. Stimulation and control the internal organs activities. External and implanted stimulators. Technical substitutes of organs. Biochemical efectors. Artificial tissues. Hematological and immunological problems in artificial organs. Heart stimulators. Heart-lung machine. Equipment for hemodialysis. Artificial pancreas (infusion pump+glucose sensor). Artificial liver. Artificial blood. Artificial skin.

TEACHING METHODS:

Audiovisual lectures, literature analysis, students presentations, metting/lecture with surgeon.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W02, K_W12	The student has knowledge in the field of medicine structure and organization, diagnostic and treatment methods, the basic anatomy, transplantation and implant techniques, needed to formulate and solve simple engineering tasks in Biomedical Engineering
K_U10	The student can use terminology relevant to the field of Biomedical Engineering
K_U06	The student can prepare and present an oral presentation concerning specific issues of the field of Biomedical Engineering

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W02, K_W12	Graduate – written verification of theoretical knowledge.
K_U06, K_U10	Verify of knowledge in students oral presentation concerning specific issues

STUDENT WORKLOAD:

The student workload of 75 hours (3 ECTS), including work in the auditorium 30 hours, preparing for grade 30 hours, literature analysis: 25 hours

RECOMENDED LITERATURE:

1. J Łaskawiec, R. Michalik Zagadnienia teoretyczne i aplikacyjne w implantach wyd. Polit. Śląska, Gliwice 2002
2. R. Tadeusiewicz Inżynieria biomedyczna wyd. AGH Kraków 2008
3. Sztuczne narządy Tom3 red. M Dąbrowski , T. Orłowski

4. Biomechanika Tom 5 Problemy Biocybernetyki i Inżynierii Biomedycznej
5. H. Morawiec Z. Lekston Implanty medyczne z pamięcią kształtu. Wyd. Polit. Śląska Gliwice 2010

SENSORS ANDMEASUREMENTS OFNON-ELECTRICAL QUANTITIES

Course code: 6.9-WM-IB-S1-EP-027_13

Course type: Kierunkowy

Language: Język polski

Main lecturer: dr hab.inż. Elżbieta Krasicka-Cydzik,prof. UZ

Second lecturer: dr.hab inż. Wiesław Miczulski, prof. UZ
dr hab.inż. Elżbieta Krasicka-Cydzik,prof. UZ
dr.inż. Mariusz Krajewski
mgr inż. Agnieszka Kaczmarek

Lecture form	All lectures time	Lecture time in one week	semester	Form of graduation	ECTS points
Stationary studies					3
Lecture	30	2	IV	Grade	
Laboratory	30	2		Grade	

CEL PRZEDMIOTU:

The aim of the course is acquisition knowledge and competences in practical use and exploitation of sensors and to measure non-electrical quantities in biomedical engineering.

REQUIRED BASE:

Basics: electrotechnics, electronics, physics, biology, biochemistry, metrology.

COURSE CONTENTS:

Course includes:

Lectures: Introduction to measurements of non-electric quantities. Examples of non-electrical sensors in medicine. Energy transfer in sensors. Static and dynamic properties of sensors. Inteligent sensors. Sensor networks. Temperature measurements. Measurements of selected mechanical values. Tensometric sensors of strength and pressure in medicine. Flow and vibration measurements and their examples in medicine. Megnetic field in medicine. Sound sensors. Microphone and their examples in medicine. Photo electric sensors. Semiuconductor light sources. Semiuconductor light sensors. Photo electric sensors in oximetry. Measurements of selected physical values. Humidity measurements. Density measurements. Viscosity measurements. Measurements of hydrogen ions concentration (pH). Absorption spectrometry, mass spectrometry, surface absorption. Liquid and gas chromatography. Basics of polarography and woltametry. Characteristics of selected polarography techniques. Introduction to biosensors. Medical and non-medical

applications. Transmitter systems. Immunosensors. Biopotentials, microelectrodes, electrical phenomena of electrode-tissue interaction. Biomolecules and analites, proteins, antibodies and nucleic acids, biomolecules immobilization, receptors and cells biosensors. Materials and preparation techniques. Electrochemical biosensors. Redox enzymes and mediators forst, second and third generation. Cyclic voltametry, amperometry, potentiometry. Lab-on-a-chip, dry biotests, bioreactors, non-medical biosensors applications (in environmental protection, food industry). Developments in biosensors (implanted, miniaturized)

Laboratory: Extensometers and linear shift sensors. Temperarute sensors. Megnetic field sensors. Presure and humidity sensors. Analog- to- digital trasnducers. Viscosity measurements. Electrochemical measurements- volt amperometry. Ions concentration measurements due to different ions selected electrodes. Conductivity measurements. Spectrophotometry measurements.

TEACHING METHODS:

Wykład : Audiovisual lectures, literature analysis

Laboratorium: practical exercises (individual or in student group)

LEARNING OUTCOMES:

Learning outcome	Specification
K_W06	The student has an ordered and theoretically based knowledge of sensors, biosensors and other actuators of electrical and non-electrical quantities - applied in medicine, has basic knowledge of scientific results elaboration, knows the basic diagnostic methods and tools as an engineering discipline relevant to the field of Biomedical Engineering
K_W17	The student has an ordered knowledge of signals theory, in particular methods of signal filtration and digital signal processing
K_U04, K_U13	The student can use known analitical, simulation and experimental methods to undertake decisions in the field of Biomedical Engineering
K_U06, K_U19	The student can plan and carry out experiments, including measurements and computer simulations, to interpret the results and draw conclusions
K_K02	The student is aware of and understands the importance and impact of non-technical aspects of engineering, including its impact on the environment, and the responsibility for decisions consequently related with these aspects

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Learning outcome	Verify technique
K_W06, K_W17	Written exam – verification of theoretical knowledge
K_U04, K_U06, K_U13, K_U19, K_K02	Practical verification of knowledge and skills in sensors and measurements of non-electrical quantities. Written report from every exercise with data presentation and conclusions.

Lectures: Grade

Seminar: Grade

STUDENT WORKLOAD:

The student workload of 75 hours (3 ECTS), including work in the auditorium 60 hours, preparing for grade 5 hours, preparing of control work and reports 5 hours, preparing for classes 5 hours.

RECOMENDED LITERATURE:

1. Miłek M.: Metrologia elektryczna wielkości nieelektrycznych. Wydawnictwo Uniwersytetu Zielonogórskiego, Zielona Góra 2006.
2. Piotrowski J. (red.): Pomiary czujniki i metody pomiarowe wybranych wielkości fizycznych i składu chemicznego. WNT, Warszawa 2009
3. Szczepaniak W.: Metody instrumentalne w analizie chemicznej. PWN, Warszawa 2008.
4. Torbicz W. i inni: Biopomiary, t.2 serii Biocybernetyka i inżynieria biomedyczna pod red. Macieja Nałęcza. Akademicka Oficyna Wydawnicza EXIT, 2001.
5. Bharat Bhushan (ed.), Springer handbook of nanotechnology, Springer - Verlag, 2004.
6. Brzózka Z. (red.), Miniaturyzacja w analityce, OWPW, W-wa, 2005.
7. Brzózka Z., Sensory chemiczne, OWPW, W-wa, 1999.
8. Brzózka Z. (red.), Mikrobioanalityka, OWPW, W-wa, 2009.
9. Chmiel A. Biotechnologia, PWN, W-wa, 1994.
10. Chwojnowski A., Sucha chemia, W-wa, Exit, 2003.
11. E. Hall, Biosensors, Open University Press, Biotechnology Series, Milton Keynes, 1991.
12. C. Kumar, Nanomateials for Biosensors, Viley-VCH, 2007.
13. Sensors in medicine and health care / ed. by P. Ake Oberg, T. Togawa, F. A. Spelman.
14. MEMS/NEMS : handbook techniques and applications. Vol. 5, Medical applications and MOEMS / edited by Cornelius T. Leondes.

15. Nanoscale technology in biological systems / ed. by Ralph. S. Greco, Fritz B. Prinz, R. Lane Smith.

16. Kulka Z., Libura A., Nadachowski M.: Przetworniki analogowo-cyfrowe i cyfrowo-analogowe, WKiŁ Warszawa 1987.

COMPUTER GRAPHICS

Course code: 6.9-WM-IB-S1-EP-028_13

Type of course: obligatory

Language of instruction: Polish/English

Director of studies: dr hab. inż. Sławomir Nikiel, prof. UZ

Name of lecturer: dr hab. inż. Sławomir Nikiel, prof. UZ,
mgr inż. Chrystian Klonecki-Olech

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	30	2	3	Grade	
Laboratory	30	2		Grade	

COURSE AIMS:

To make students aware of contemporary computer graphics (CG) technology, including the CG applications and SDKs. Understanding of CG related terminology and basic functionalities of CG systems.

PREREQUISITES:

Introduction to computer science

COURSE CONTENTS:

Human factors. Visual perception. Creator and consumer of computer graphics content, CG models.

Introduction to computer graphics technologies. Input/Output devices. Color models. Digital images. Sample CG applications in education, entertainment, architecture, science and human care. Scientific visualization.

Raster graphics. Digital raster images. Preparation of raster images. Desk-Top Publishing and pre-press. Processing raster images.

Fractals in computer graphics, theory and applications.

Vector graphics. Computer graphics and vector models. Interpolation and interpolators. Hierarchical structure of graphics objects. Graphics rendering pipeline. 3D scene

construction algorithms. Computer Aided Design. Manipulation of 3D vector objects, 3D scene representation, shading and shadows.

Photo-realistic techniques. Ray Tracing and Radiosity, Environmental Mapping and Image-Based Rendering. Stereoscopic rendering.

Review of available software tools for computer graphics.

METHODS OF EDUCATION:

Laboratory tasks are meant to be solved in a given time. All tasks cover design, creative use of digital media within the CG environments including CG applications and SDKs. Lecture is generally based on the given references, but it includes the most recent information form conferences and events related to CG.

LEARNING OUTCOMES:

Learning outcomes		Field specific learning outcomes
Technical	Engineering	
Image processing	Raster imaging	Knowledge of image processing algorithms, raster imaging and pre-press skills of image manipulation and enhancement. DTP skills.
Vector graphics	CAD design	Knowledge of 2D and 3D image models, creative skills. CAD skills.
Scientific visualization	Infographics and media design	Knowledge of infomation design and infographics . Visualisation skills.

Student has the following knowlege and competences	Type of activity	Form of education	output	Symbols of discipline specific learning outcomes
The student has an elementary knowledge of computer design and operations, has an ordered knowledge of operational systems, technologies, protocols and services in computer networks.	Lecture Lab+ consulting	Discussion Examples	Project	T1A_W04 T1A_K02 T1A_W07
The student can select and use	Lab	Example	Project	T1A_W0

the specialistic informatic tools to solve engineering problems in numerical way, analyse results and present them graphically, also prepare documents and digital media		s		7 T1A_U07
The student can communicate using various techniques in the professional community as well as in other communities	Lecture+ consulting	Discussion Examples	Project	T1A_U02
The student can select and apply the appropriate computer applications to make calculations, simulation, design and verification of engineering solutions in the field of Biomedical Engineering	Lecture Lab	Examples	Project	T1A_U07

VERIFICATION OF LEARNING OUTCOMES AND CONDITIONS OF CLASSIFICATION:

Lecture – classification based upon positive mark obtained during colloqium or exam in form suggested by the teacher.

Lab - classification based upon positive marks obtained during the course. Final mark is a weighted sum of all marks obtained for the given lab tasks.

STUDENT WORKLOAD:

15 two-hour labs, where students receive tasks to be done during the course, 15 two-hour lectures.

Consultations	*30 hrs lect, 30 hrs lab =*	*60h*
Preparation		*10 h*
Literature research		*10h*
Preparation of report		*10h*
Tasks received during the labs that require additional time (writing code, rendering animation, etc.)		*25h*
Preparation for colloqium or exam		*10h*

Total 125h = 5 ECTS

RECOMMENDED READING:

7. Hearn. D, Baker D.: *Computer Graphics- C version*, Prentice Hall, 1997
8. Jankowski M.: *Elementy grafiki komputerowej*, WNT, 2006 (in Polish)

OPTIONAL READING:

1. Tomaszewska-Adamerek A., Zimek R.: *ABC grafiki komputerowej i obróbki zdjęć*, Helion, 2007 (in Polish)
2. Preparata P., Shamos N.: *Geometria obliczeniowa. Wprowadzenie*, Helion, 2003 (in Polish)
3. Flemming B., Dobbs D.: *Animacja cyfrowych twarzy*, Helion, 2002 (in Polish)

REMARKS:

Students use at labs supplementary materials obtained from the teacher and from the inernet resources .

DIGITAL SIGNAL PROCESSING

Course code: 6.9-WM-IB-S1-EP-029_13

Type of course: compulsory

Language of instruction: Polish

Director of studies: dr hab. inż. Ryszard Rybski, prof. UZ

Name of lecturer: dr hab. inż. Ryszard Rybski, prof. UZ
dr inż. Mirosław Kozioł

Form of instruction	teaching hours	teaching hours	Semester	Form of receiving a credit for a course	Number of ECTS credit allocated
Full-time studies					4
Lecture	30	2	V	Exam	
Laboratory	30	2		Grade	

COURSE AIMS:

- to acquaint students with the fundamental properties of signals and the fundamentals of digital signal processing;
- raising the awareness of a need to use digital signal processing in modern engineering, including in medical engineering;
- formation of basic skills in the field of spectral analysis by digital signal processing and digital filter design.

PREREQUISITIES:

Student:

- has fundamental knowledge in the field of mathematical analysis, electrical engineering, electronics and programming languages,
- is able to develop a simple documentation concerns the engineering task and prepare a text containing a discussion of the task results.

COURSE CONTENTS:

Introduction. Applications of digital signal processing (DSP). DSP advantages and disadvantages. Examples of digital processing of biomedical signals. Methods of medical signal acquisition.

Fundamentals of signal theory. Notion of signal. Classifications of signals: analog, discrete and digital signals, deterministic and random signals. Mathematical models of selected signals.

Frequency-domain analysis of analog signals. Fourier series with examples. Synthesis of continuous-time signals on the basis of the Fourier series coefficients. Gibbs phenomenon. Conditions of the Fourier series representation of signals (Dirichlet conditions). Properties of Fourier series. Fourier transform. Dirichlet conditions for Fourier transform. Properties of Fourier transform. An influence of a signal observation in finite-time interval on its spectrum.

Analog-to-digital and digital-to-analog conversion. Typical analog-to-digital and digital-to-analog signal processing chain. Sampling, quantization and coding and examples of their practical implementation: sample-and-hold circuit, analog-to-digital converter. Digital-to-analog conversion.

Sampling theorem. Conditions of proper sampling. Sampling frequency and Nyquist frequency. Spectrum of sampled signal. Aliasing phenomenon.

Discrete Fourier transform (DFT). Derivation of Fourier transform for discrete-time signals. Properties of DFT. Derivation of amplitude and phase spectrum. Spectral leakage. Parametric and non-parametric spectral windows. Improvement of spectrum resolution by zero padding. Examples of spectral analysis of discrete-time signals and their interpretation.

Fast Fourier transform (FFT). Outline of the radix-2 FFT algorithm and a discussion of the butterfly computation. Computational profit. Different aspects of practical implementation of radix-2 FFT. Computation of inverse DFT using FFT. Real-valued FFT.

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

Z-transform. Definition of Z-transform. Region of convergence. Inverse z-transform and methods of its evaluation. Properties of Z-transform. The transfer function. Poles and zeros of transfer function. Pole locus and stability of system.

Digital filters. Finite and infinite impulse response systems. Processing discrete-time signals by digital filters. Basic structures of filters. Determination and interpretation of the frequency response of digital filters. An influence of zeroes and poles locus on the system frequency response. Filters with linear phase response. Group delay.

IIR digital filter design. Bilinear transformation method.

FIR digital filter design. Method based on windowed Fourier series.

TEACHING METHODS:

- lecture,
- laboratory classes.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence

K_W17	The student has an ordered knowledge of signals theory, in particular methods of signal filtration and digital signal processing
K_U16	The student can perform of signal spectral analysis and interpret obtained spectra characteristics
K_U13	The student can use known analitical, simulation and experimental methods to undertake decisions in the field of Biomedical Engineering
K_K02	The student is aware of and understands the importance and impact of non-technical aspects of engineering, including its impact on the environment, and the responsibility for decisions consequently related with these aspects

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W17	Written exam To pass the lecture a positive grade of written exam has to be get.
K_U13, K_U16, K_K02	Grade The laboratory grade results from testing how student was prepared for classes, execution of laboratory exercises, and written reports resulting from the execution of all exercises planed in the framework of laboratory.

- the exam is conducted in written form,
- pass of all laboratory exercises.

Method of assessment: the student has to obtain a positive grade from the exam and laboratory exercises planned for implementation within the framework of laboratory classes.

Final grade = 0.5 of the exam grade + 0.5 of the laboratory grade.

STUDENT WORKLOAD:

The student workload is 122 teaching hours (4 credits), including contact hours: 60 teaching hours, exam: 2 teaching hours, preparation for classes: 20 teaching hours, preparation for exam: 20 teaching hours, preparation of control work, reports, etc.: 20 hours.

RECOMENDED READING:

4. Lyons R.G., „Wprowadzenie do cyfrowego przetwarzania sygnałów”, WKŁ, Warszawa 1999.
5. Moczko J.A., Kramer L., „Cyfrowe metody przetwarzania sygnałów biomedycznych”, Wydawnictwo Naukowe UAM, Poznań, 2001.
6. Zieliński T.P., „Cyfrowe przetwarzanie sygnałów. Od teorii do zastosowań”, WKŁ, Warszawa, 2005.

OPTIONAL READING:

1. Smith S.W., „Cyfrowe przetwarzanie sygnałów. Praktyczny poradnik dla inżynierów i naukowców.”, Wydawnictwo BTC, Warszawa, 2007.Szabatin J., „Podstawy teorii sygnałów”, WKŁ, Warszawa 2002.

REMARKS:

PROGRAMMING LANGUAGE

Course code: 6.9-WM-IB-S1-EP-030_13

Type of course: compulsory

Language of instruction: Polish

Director of studies: dr inż. Robert Dąbrowski

Name of lecturer: dr inż. Paweł Majdzik, mgr inż. Chrystian Klonecki-Olech, dr inż. Robert Dąbrowski

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					
Lecture	30	2		Grade	5
Laboratory	30	2		Grade	

COURSE AIM:

The aim is to acquire the skills and competencies of the structured programming in C language and the basics of programming in C + +

ENTRY REQUIREMENTS:

Basic knowledge of information technology.

COURSE CONTENTS:

Designing the program. Structured Programming. The algorithms and data structures and their representations in a programming language. Programming in C. The structure of the program, the command syntax. Fixed and variable data types. Operators, expressions. Type conversions. Arithmetic operators and their hierarchy. Instructions inputs and outputs. Conditional statements. Instructions iterative loops: for, while, for. Features: structure, arguments, result, prototype declaration calling. The formal parameters and actual functions. The concept and properties of the stack. Passing parameters by value and address. Returning values from functions. Recursive functions.

Indicators: declaration, initialization, and a reference to the address indicated value. Solid indicators and indices for fixed: properties and application range. Pointers to functions:

examples of applications. Formal parameters of the function which is a pointer to a function.

Boards. The declaration, applicable examples. String as an array of characters. Arrays vs pointers. Multi-dimensional arrays. Data structures. Properties. Arrays of structures. Fields. Lift.

Introduction to object-oriented programming. The concept of class as an abstract data type, storage methods, encapsulation. Basics of inheritance. Polymorphism as a mechanism to support object-oriented programming.

TEACHING METHODS:

Lecture: Feeding (lecture in the form of a multimedia presentation)

Laboratory: practical (laboratory exercises and calculations)

LEARNING OUTCOMES:

Directional effect of education	Description
K_W07	Has ordered knowledge of the methods and techniques of programming
K_U17	Able to formulating and solving tasks related to biomedical engineering, to see the system aspects, economic, legal and social with the use of computer technology.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the effects of field of study	The method of checking the effect of education
K_W07	Grading lecture The pass of the lecture is to provide a positive evaluation of the test.
K_U17	Grading of the laboratory Evaluation of the laboratory is based on checking student prepare for classes and their implementation, and reports / reports resulting from the

	implementation of all measures to be implemented exercise.

Lecture - provided credit is to get a positive evaluation of the test.

Laboratory - provided credit is to pass all the laboratory.

STUDENT WORKLOAD:

The student workload is 100 hours (4 credits), including contact hours: 60 hours, preparation for classes: 20 hours, preparing for test: 10 hours, sources familiar with the literature: 10 hours

RECOMMENDED READING:

1. Loudon K. Algorytmy w C. Helion 2003.
2. Kerighan, Ritchie. Programowanie w języku C. WNT 2000.
3. Kisilewicz J.. Język. w środowisku Borland C++. Wydanie IV. Oficyna Wydawnicza Politechniki Wrocławskiej. Wrocław 2003.
4. Bjarne Stroustrup, C++ Język programowania. WNT 2001.

OPTIONAL READING:

1. Lippman S. B. *Model w C++*, WNT, Warszawa, 1996.
2. Eckel B.: *Thinking in C++*, Hellion, Warszawa, 2002.

CONTROL ENGINEERING AND ROBOTICS

Course code: 6.9-WM-IB-S1-EP-031_13

Type of course: Compulsory

Language of instruction: Polish

Director of studies: Dr inż. Wojciech Paszke

Name of lecturer: Dr inż. Wojciech Paszke

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					4
Lecture	30	2	IV	Exam	

Laboratory	30	2		Grade	

COURSE AIMS:

The aim is to get the student's skills and competencies in the following areas: stability analysis of linear systems, determination of basic control performance indexes, design and tune of PID controllers and compensators, plotting and analyzing Nyquist diagrams, Bode plots and root locus, the use of MATLAB and SIMULINK environments in the analysis and synthesis of linear systems. Ability to analyze simple robot manipulators made from standard components.

PREREQUISITES:

Knowledge and skills in the field of programming languages, numerical methods and the basics of electrical engineering and electronics.

COURSE CONTENTS:

Laplace transform. Linear differential equations. Laplace transform and its basic properties. Application for solving of linear differential equations. The inverse la place trans form. The transfer function.

Introduction of basic concepts. Dynamics system, system input, system output, system state, regulation and control.

Basic system properties. Stability of dynamic systems. Stability definitions. Controllability and ***observability*** of linear dynamic systems. Conditions for controllability and ***observability***. Practical meaning of controllability in the context of control systems design.

Stability of dynamic systems. Stability criterions for linear systems: Routh-Hurwitz criterion, Nyquist criterion.

Frequency response techniques. Frequency response from the transfer function. Analytical expressions for frequency response. Frequency-domain plots: Bode plots, Nyquist Diagram. Time-domain plots: step and impulse responses. Relation between transient and frequency responses.

Description of basic dynamic elements. Proportional term, first and second order terms, integral term, differential and delay terms.

Automatic control: Feedback: control performance indexes, disturbance sensitivity and robustness, steady-state error, response of closed loop systems. PID controller: Basic properties, Ziegler- Nichols method of tuning PID controllers. System ***astatism*** and ***steady-state*** accuracy. Robustness of a closed-loop system to disturbances and uncertainties. Digital implementation of controllers.

Root locus techniques: Examples of root locus for some dynamic systems. Sketching the Root locus, controller design via root locus. Improving transient response via cascade compensation, tuning of lead-lag compesentors.

Introduction to robotics. Historical outline. Tasks performed by robots. Classification of robotic manipulators and robots. Basic units and systems of industrial robots. Robot as a

control system. Structure of robotic manipulators and robots. Description methods for position and orientation of rigid bodies. Degrees of freedom and gears. Gripper. 3-D transformations and descriptions.

Kinematics. Kinematics dependency. Forward kinematics of a robot arm. Determining Denavit-Hartenberg parameters. Inverse kinematics problem. Velocity kinematics and Jacobians.

Path and trajectory generation. Trajectory generation for joint-space motion. Cartesian motion. Geometric problems. Trajectory generation in real time. Trajectory planning based on dynamics models. Motion planning with obstacle avoidance.

Industrial robot drives. Pneumatic, hydraulic and electric drives

Sensors and detectors in robotic systems. Processing methods for sensor signals. Vision sensors and systems.

Examples of robot applications in industry. Welding and laser cutting. Palletization. Robotic workcells. Assembling. Painting stations.

TEACHING METHODS:

Classical lectures with audiovisual aids.

Laboratory: exercises and practical control problem solving

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W08, K_W09, K_W15	Student has a basic knowledge on developmental trends in robotics.
K_W09, K_U24	Student knows meaning of principal performance indexes for automatic control systems.
K_U24	Student can design and tune a controller using computer-aided software engineering (CASE).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment

K_W08, K_W09, K_W15	the main condition to get a pass is a sufficient mark during final exam (written form)
K_U24	the main condition to get a pass is scoring sufficient marks for all laboratory exercises.

Passing grade of the lecture depends on positive ratings of oral or written colloquiums carried out at least once a semester and study reports in the patent literature search for solutions related to the topic of the thesis student.

STUDENT WORKLOAD:

12. The student workload of 60 hours (2 ECTS), including consultations 20 hours, preparing for colloquium 20 hours, learning literature sources: 20 hours.

RECOMMENDED LITERATURE:

1. Kaczorek T., Dzielinski A., Dabrowski W., Łopatka R.: *Podstawy teorii sterowania*, WNT, Warszawa, 2005.
2. Amborski K.: Marusak A., *Teoria sterowania w ćwiczeniach*, PWN, Warszawa, 1978.
3. Spong M. W., Vidyasagar M..: *Dynamika i sterowanie robotów*, WNT, Warszawa, 1997.
4. Jezierski E.: *Dynamika robotów*, WNT, Warszawa, 2005.

OPTIONAL LITERATURE:

1. Brzózka J.: *Regulatory i układy automatyki*, Mikom, Warszawa, 2004..
2. Honczarenko J.: *Roboty przemysłowe. Budowa i zastosowanie*, WNT, Warszawa, 2004.

NUMERICAL METHODS

Course code: 6.9-WM-IB-S1-EP-032_13

Type of course: compulsory

Language of instruction: Polish

Director of studies: dr hab. inż. Andrzej Obuchowicz, prof. UZ

Name of lecturer: dr hab. inż. Andrzej Obuchowicz, prof. UZ

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					
Lecture				Credit with grade	4
Laboratory				Credit with grade	

COURSE AIM:

- familiarize students with the basic aspects of numerical mathematics to solve common problems,
- familiarize students with the basic algorithms to solve these tasks,
- education students' ability to use Matlab to issues of engineering calculations.

ENTRY REQUIREMENTS:

Mastery of knowledge and skills in the subject Elements of Algebra and Mathematical Analysis

COURSE CONTENTS:

Lecture: Computer Arithmetic (Fixed and floating point representation of numbers, calculation errors in floating-point arithmetic and accuracy of numerical algorithms, numerical conditioning task). Solving nonlinear equations (bisection method, regulatory falsi, secant and tangent method). Solving linear algebra (exact method for solving systems of linear equations: Gauss method, pivoting, triangular distribution method, Thomas-Banachiewicz Cholesky method, iterative methods: Jordan, Gauss-Seidel, setting benchmarks and matrix inverse spectral problem). Interpolation (definition and classification methods, polynomial interpolation: Lagrange interpolation formula, Newton's interpolation formula, spline interpolation, splines 3 degrees). Approximation (mean square approximation discrete and continuous, triangular families of orthogonal polynomials in approximation). Quadrature (pattern of rectangles and triangles, Newton-Cotes quadrature, Gauss quadrature, numerical integration of the limits of improper integrals and singular points within the interval of integration, integration of multidimensional functions). Ordinary differential equations (Euler's method, Runge-Kutta methods). Introduction to the methods of boundary and partial differential equations.

Laboratory: Environmental engineering calculations Matlab (system resources, environmental programming, graphical tools, and editing). Floating-point arithmetic (numerical experiments, errors of calculation procedures and the accumulation and transfer of numerical instability). Solving equations (equations of nonlinear systems of linear equations, systems of a van der Monde, testing algorithms, Newton and Newtona_Raphsona). Data Processing (interpolation method, method of approximation of mean method, spectral analysis, Fast Fourier Transform). Ordinary differential equations,

initial and boundary issues. Elementary finite element techniques and testing them on the basis of certain issues.

TEACHING METHODS:

Lecture: Lecture conventional

Laboratory: laboratory exercises and accounting

LEARNING OUTCOMES:

Directional effect of education	Description
K_W05	Student who has completed the subject understands the limitations of numerical algorithms related to floating-point arithmetic.
K_W19	Knows the basic numerical methods for solving nonlinear equations and systems of linear equations and differential, know the basic techniques of interpolation, approximation and numerical integration.
K_U25	Able to take advantage of the functionality of MATLAB environment to basic numerical, graphical representation of the results.
K_U25	Able to choose of these algorithms which is the most advantageous to solve a specific numerical problem.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the effects of field of study	The method of checking the effect of education
K_W05, K_W19	Grading lecture The pass of the lecture is to provide a positive evaluation of the test.
K_U25	Grading of the laboratory Evaluation of the laboratory is based on checking student prepare for classes and their implementation, and reports / reports resulting from the implementation of all measures to be implemented exercise.

Learning outcomes 1 and 2: the final test to evaluate the content of the lecture; Learning outcomes 3 and 4: Final test for assessment based on problem-solving tasks using computer and Matlab environment.

STUDENT WORKLOAD:

The student workload is 100 hours (4 credits), including contact hours: 45 hours, 15 hours consultation, preparation for classes: 15 hours, preparing to test: 5 hours, preparation of audit work, reports, reports, etc.: 20 hours, familiarization with literature sources 15 hours.

RECOMMENDED READING:

1. Stachurski M., Metody Numeryczne w programie MATLAB. Wydawnictwo MIKOM Warszawa 2003.
2. Zalewski A.. Cegieła R., MATLAB – obliczenia numeryczne i ich zastosowania. Wydawnictwo Nakom. Poznań 2001.
3. Fortuna Z., Macukow B., Wąsowski J., Metody numeryczne. Warszawa: Wydawnictwa Naukowo-Techniczne, 1995.
4. Demidowicz B. P., Maron I. A., Metody numeryczne. Tom 1. Analiza, algebra, metody Monte Carlo. Warszawa: Państwowe Wydawnictwo Naukowe, 1965.
5. Demidowicz B. P., Maron I. A., Szkwałowa E. Z., Metody numeryczne. Tom 2. Przybliżanie funkcji: równania różniczkowe i całkowe. Warszawa:PWN, 1965.

OPTIONAL READING:

Baron B., Metody numeryczne w Turbo Pascalu: 3000 równań i wzorów. Gliwice: Helion, 1995.

FOREIGN LANGUAGE – I, II, III, IV

Course code:	6.9-WM-IB-S1-EP-067_13 6.9-WM-IB-S1-EP-037_13 6.9-WM-IB-S1-EP-038_13 6.9-WM-IB-S1-EP-039_13
Type of course:	
Language of instruction:	Polish
Director of studies:	mgr Anna Przyjemska, mgr Agnieszka Florkowska
Name of lecturer:	mgr Anna Przyjemska, mgr Agnieszka Florkowska

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					III,IV=2 V,VI=3
Lecture			III,IV,V,VI		
Class					
Laboratory	30	2		Grade	
Seminar					
Workshop					
Project					
Part-time studies					
Lecture					
Class					
Laboratory					
Seminar					
Workshop					
Project					

COURSE AIM:

The main aim of the course is to extend and refine students' knowledge of English acquired prior to the course and finally attain the level corresponding to B2 level of the Common European Framework of Reference for Languages. In addition to general competences, the course aims to provide students with a sufficient level of technical terminology, which allows them to work with a variety of source materials, popular science and specialist literature, and finally pursue their future careers in the academic and/or professional spheres.

PREREQUISITES:

Language competence at least A1 level - according to the Common European Framework of Reference for Languages

COURSE CONTENT:

Developing the skills of listening and speaking ,as well as reading and writing in English. A broader application of language functions to enable the use of foreign language in everyday situations. The ability to apply the complex grammatical structures, used to express the present, the past and the future. Extending the aspect of culture and civilization, focusing on the lifestyle in the English speaking countries. Distinguishing between the literary and colloquial language. The ability to implement the general technical language and the specialist technical language in the field of biomedical engineering, including:
basic skills of interpersonal communication and psychology, the ability to describe the features of character and psychological profile, elements of biology and medicine (vocabulary, phenomenon): the construction of the human body and an animal, the names of animals and plants, the names of organs, bones, the cell structure, basic skills in mathematical operations, the names of the chemical elements and physical bodies, describing the properties of materials, physical phenomena and mechanisms, organization and safety at work, a description of the construction and process of equipment operations, specific engineering work (responsibilities, workplace).

TEACHING METHODS:

Grammar, vocabulary and language skills are taught by means of presentation, whole-class discussion, small-group, pair-work and individual exercises, as appropriate, using course books, and tutor-prepared texts, audiovisual and multimedia materials, as well as computer and internet resources. A wide range of authentic texts is used in the course. Methods used:

Feeding method: explanation and discussion of descriptive grammar, words and idiomatic expressions.

Practical method: language exercises with text, lexical exercises explaining specialist terminology, idioms, synonyms and antonyms, practicing grammar and vocabulary in communicative situations

LEARNING OUTCOMES:

<table>
<tr><td colspan="2">Learning outcomes</td><td rowspan="2">Knowledge, skills, competence</td></tr>
<tr><td>In the field of technical sciences</td><td>Engineering competence</td></tr>
</table>

T1A_U01		The student can obtain information from literature and other carefully selected sources, also in a foreign language considered to be the international language in the field being studied; can integrate the information, make its interpretation, as well as draw conclusions, formulate and justify opinions;
T1A_U02		can communicate using various techniques in a professional and other environments;
T1A_U03		can prepare, both in Polish and a foreign language, a well-documented study of a problem within the scope of the studied field
T1A_U04		can prepare and give, both in Polish and English, an oral presentation on specific issues concerning his/her field of study;
T1A_U05		has self-teaching abilities;
T1A_U06		has the language skills applicable to a his/her field of study , according to the requirements set out for level B2 of the European Framework of Reference for Languages;
T1K_01		understands the need for lifelong learning; is able to inspire and organize the learning process of others;
T1K_03		can interact and work in a group, adopting different roles;
T1K_04		can properly determine priorities for implementation of tasks specified by him/herself or others
T1K_07		is aware of the social role of technical school graduates, and particularly understands the need to formulate and communicate (especially through mass media) information and opinions on the technical progress and other aspects of engineering, makes efforts to communicate such information and opinions in a commonly understood way and is able to justify his/her points of view.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The prerequisites for the completion of semesters III-V: regular attendance, active participation in classes, satisfactory assignment completion, including home assignments and oral presentations on given topics, regular tests (at least two per semester). Final exam (semester VI) consists of two parts:

- a multimedia presentation with the use of specialist terminology
- a written test comprising: an essay of 250-300 words, a reading test, a language test (vocabulary and grammar)

STUDENT WORKLOAD:

The student workload of 45 hours comprises: 30 hours class participation, individual work (outside classroom) 15 hours.

RECOMMENDED READING:

- Oxenden,C.& Lathan-Koening, C. New English File, Oxford University Press.2000
- Harding, K. &Taylor, L., International Express, Oxford University Press.2009
- Vicky Hollet, John Sydes, *Tech Talk Intermediate,* Oxford University Press, 2005
- Ibbotson, M., Cambridge English for Engineering, Cambridge University Press 2006
- Pickering, W.R. Complete Biology. Oxford University Press. 2005.
- Penn, J. and E. Hanson. Anatomy and Physiology for English language learners. Person Logman.2006.
- Kelly, K. Science. Macmillan. 2007.
- Kelly, K. Geography. Macmillan.2007.
- Bains. W. Biotechnology from A to Z. Oxford University Press. 2007.

OPTIONAL READING:

- Vince, M. Macmillan English Grammar in Context. Macmillan. 2007.
- Murphy, R. English Grammar in Use. Intermediate. Cambridge University Press. 2008.
- Semeniuk, B. and G. Maludzińska. Polish-English Chemical Dictionary. Wydawnictwo Naukowo-Techniczne. Warszawa 2003.

http://www.onestopenglish.com/

http://www.insideout.net/

SUBJECT UNIVERSITY-WIDE

Course code: 6.9-WM-IB1S-040-PDO

Type of course: Optional

Language of instruction: Polish

Director of studies:

Name of lecturer:

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					2
Lecture	30	2	VI		

COURSE AIMS:

The subject is selected from the list of subjects university-wide

ELECTRONIC SYSTEMS

Course code: 6.9-WM-IB1S-41A-POB

Type of course: Elective

Language of instructor: Polish

Director of studies: dr inż. Robert Dąbrowski

Lecturer name: dr inż. Robert Dąbrowski

Form of instruction			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 AIMS:

The acquisition by the student's theoretical knowledge and practical skills in the use of electronic components and integrated circuits for the construction of analog or mixed (analog/digital) electronic circuits.

PREREQUISITES:

Fundamentals of electrical engineering and electronics, Metrology basics

COURSE CONTENTS:

Designing electronic circuits using general purpose and specific integrated circuits. The use of general-purpose operational amplifiers for biomedical signals processing. Strengthening weak signals under conditions of strong interference. The use of integrated circuits for the construction of continuous and pulsed power supplies, DC / DC and AC / DC. Ways to provide the required insulation in power supplies. Electronic technology used to ensure the safety of the patients connected to biomedical devices: optocouplers, isolation amplifiers. Specific Integrated Circuits: a reference voltage source, electronic keys, digital-to-analog and analog-to-digital converters. Examples of physical implementations

TEACHING METHODS:

Lecture supported by multimedia presentations.

Laboratory includes practical experiments and computer-aided design and simulations. The basis of the experiment is the knowledge acquired during the lecture and individual student preparation based on the given instructions of laboratory exercises. Preparation is verified during a written test. Student work is assessed during laboratory classes and implemented on the basis of his reports.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W16	The student has an ordered and theoretically based knowledge of circuits theory, operation of electronic elements and electronic systems
K_W23	The student has a specialistic knowledge in the field of the chosen studies specialization
K_U19	The student can plan and carry out experiments, including measurements and computer simulations, to interpret the results and draw conclusions

K_U27	The student can use a specialistic knowledge to organize the implementation of simple tasks relevant to the field of the chosen specialization

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W16, K_W23	Written examination and supplementary oral examination (applies to lecture)
K_U19	Grade (applies to laboratory) Assessment of the laboratory is mainly determined by checking the reports resulting from exercise.
K_U27	Grade (applies to laboratory) Significant impact on the assessment of student skills has partial evaluation obtained during testing the student preparation for the course and during the laboratory tasks.

The course ends on the basis of a written and oral exam after a positive assessment of the laboratory. The pass mark for the laboratory is performing all the exercises included in the program and getting good grades for all reports.

STUDENT WORKLOAD:

The student workload of 122 hours (4 ECTS), including contact: 60 hours, consultations: 15 hours, exam: 2 hours, learning and preparing for laboratory: 20 hours, preparing for exam 10 hours, preparing reports: 15 hours

RECOMMENDED LITERATURE:

7. Horowitz P., Hill W.: *Sztuka elektroniki*, Wydawnictwo Komunikacji i Łączności, Wydanie 7, Warszawa 2003.
8. Chwaleba A., Moeschke B., Płoszyński G.: *Elektronika*, Wydawnictwa Szkolne i Pedagogiczne, Wydanie 6, Warszawa 1998.
9. Nadachowski M., Kulka Z.: Analogowe układy scalone, WKŁ, 1979.

ADDITIONAL LITERATURE:

1. Articles and electronic documentation provided by the teacher.

BIOELECTROMAGNETISM

Course code: 6.9-WM-IB-S1-EiI-042_13

Type of course: Optional

Language of instruction: Polish

Director of studies: dr inż. Anna Pławiak-Mowna

Name of lecturer: dr inż. Anna Pławiak-Mowna

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					4
Lecture	30	2	V	Grade	
Project	15	1		Grade	

COURSE AIMS:

The objective of this course is to introduce students to the basic aspects of bioelectromagnetism.

PREREQUISITES:

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COURSE CONTENTS:

Introduction to Bioelectromagnetism. History of Bioelectromagnetism. The human exposure to electromagnetic field. The sources of electromagnetic fields. Electromagnetic fields and environment. The Ionizing and non-ionizing radiation. Medical and biological aspects of EMF. Electromagnetic stimulation. The effect of electromagnetic field in protection of labour and human environment. The exposure of biological objects on high, medium and low frequencies EMF. Exposure assessment. Health effects of exposure to electromagnetic fields and health prevention. Electromagnetic compatibility of medical implants.

TEACHING METHODS:

Conventional lectures, project method, discussion, bibliography research, case-study, teamwork

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W23	The student has a specialistic knowledge in the field of the chosen studies specialization
K_U01	The student can obtain information from literature, databases and other sources, able to integrate the information, make their interpretation, as well as draw conclusions and formulate and opinions
K_U04	The student can obtain information from literature, databases and other carefully selected sources, in English or any other foreign language considered as a language of international communication in the field of Biomedical Engineering; can integrate the information, make its interpretation and critical evaluation, draw conclusions and formulate opinions
K_K02	The student is aware of and understands the importance and impact of non-technical aspects of engineering, including its impact on the environment, and the responsibility for decisions consequently related with these aspects
K_K07	The student is aware of the social role of technical school graduates, and particularly understands the need to formulate and communicate (especially through mass media) information and opinions on the technical progress and other aspects of engineering, makes efforts to communicate such information and opinions in a commonly understood way and is able to justify different points of view.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W23	The main condition to get a pass are sufficient marks in written or oral tests conducted at least once per semester.

K_U01, K_U04, K_K02, K_K07	The main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

STUDENT WORKLOAD:

The student workload of 100 hours (4 ECTS):

1. contact hours – lecture 30 hours, project 15 hours,
2. preparation for classes - 20 hours,
3. preparation of reports - 10 hours,
4. bibliographical research - 25 hours.

RECOMMENDED READING:

1. Aniołczyk H. (red.): Pola elektromagnetyczne. Źrodła-oddziaływanie-ochrona, Wydawnictwo Instytutu Medycyny Pracy, im. Prof. J. Nofera, Łódź 2000.
2. Nałęcz M.(red.), Pawlicki G., Pałko T., Golnik N., Gwiazdowski B., Królicki L. (red. Tomu): Biocybernetyka i inżynieria biomedyczna 2000. Fizyka Medyczna, Akademicka Oficyna Wydawnicza Exit, Warszawa, 2002.
3. Keller J.: Elektronika medyczna, tom I i II, Wydawnictwo Lekarskie PZWL, Warszawa, 1984.
4. Marciniak J.: Zagrożenie naturalnego środowiska elektromagnetycznego, Wydawnictwo Politechniki Śląskiej, Gliwice, 2000.

OPTIONAL READING:

1. Krawczyk A., Zyss T. (red.): Bioelektromagnetyzm – teoria i praktyka, Polskie Towarzystwo Zastosowań Elektromagnetyzmu, Warszawa, 2006. Krawczyk A.,
2. Wyszkowska J. (red.): Pole elektromagnetyczne w biosferze, Polskie Towarzystwo Zastosowań Elektromagnetyzmu, Warszawa, 2005.
3. Krawczyk A., Pławiak-Mowna A. (red.): Kompatybilność elektromagnetyczna w biologii i medycynie, Instytut Naukowo-Badawczy ZTUREK, Warszawa, 2003.

REMARKS:

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MICROPROCESSOR ENGINEERING IN MEDICINE

Course code: 6.9-WM-IB-S1-EiI-044_13

Type of course: optional

Language of instruction: Polish

Director of studies: dr inż. Mirosław Kozioł

Name of lecturer: Employees of WEIiT IME

Form of instruction	teaching hours	teaching hours	Semester	Form of receiving a credit for a course	Number of ECTS credit allocated
Full-time studies					
Lecture	30	2	V	Grade	4
Laboratory	30	2		Grade	

COURSE AIMS:

The aim of the course is to familiarize students with the fundamentals of microprocessor engineering in the field of embedded systems and their use in the design of medical equipment.

PREREQUISITIES:

Fundamentals of electrical engineering and electronics, Digital signal processing, Programming languages

COURSE CONTENTS:

Microprocessor systems. Basic components of microprocessor system. Central processor unit. System buses. Tri-state buffers. Data memory. Program memory. Input-output ports. Peripheral systems. Microprocessor and microcontroller. Architectures of microprocessor systems: von Neumann architecture, Harvard architecture, and modified Harvard architecture. Basic registers. The most common flags in processor status word. Stack.

Instructions. Instruction. Instruction set. Machine code. Mnemonic opcodes. Instruction execution. Basic addressing modes. Basic groups of instructions.

Memories used in microprocessor systems. Basic memory types. Write and read operations. Basic memory parameters. Memories with serial interfaces.

Connection of peripherals. Uniform and separate addressing. Address decoder design on the basis of middle scale of integration chips and PLD devices.

Handling of peripheral devices. Polling. Interrupt system. Direct memory access.

Transmission of information transmission between microprocessor systems. Transmission of information with and without acknowledgement. Synchronous and asynchronous transmission. Parallel and serial transmission. Their advantages and disadvantages. Scope of application. The common standards of serial interfaces (RS-232C, RS-485).

Microcontrollers of family MCS-51. The most significant features of their architecture. Functional blocks. Interfacing of external program and data memory. Available addressing modes. Embedded peripheral systems i.e. timer-counters and serial interface. Interrupts. Parallel ports. Power-saving modes of operation. Examples of programming in assembler and C.

Basic user interface in microprocessor system. Keyboard. LED and LCD displays. Service of user interfaces by software.

Microprocessor circuits in medical equipment. Examples of microprocessor-based medical devices: digital thermometer, oximeter, ECG, defibrillator, digital stethoscope, dialysis, respirator, infusion pump. Monitoring of the patient's vital signs - both wired and wireless solutions

TEACHING METHODS:

Education on this course is carried out by providing students the theoretical knowledge during the lecture and its practical application during the laboratory classes through the implementation of software for microprocessor systems.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W15	The student has an ordered knowledge of paradigm and programming techniques, knows recent trends and the latest achievements in the field of informatic applications dedicated to the Biomedical Engineering problems
K_W19, K_W23	The student knows the basic methods, techniques and tools required to solve simple tasks in the field of Biomedical Engineering The student has a specialistic knowledge in the field of the chosen studies specialization

K_U01	The student can obtain information from literature, databases and other sources, able to integrate the information, make their interpretation, as well as draw conclusions and formulate and opinions
K_U05	The student can prepare, record and elaborate in written form issues of technical science and scientific disciplines specific to the field of Biomedical Engineering, in Polish and English
K_K03	The student can interact and work in a group, adopting different roles

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W15, K_W19, K_W23	Grade To pass the lecture a positive grade of written test has to be get.
K_U01, K_U05, K_K03	Grade The laboratory grade results from testing how student was prepared for classes, execution of exercises, and written reports resulting from the execution of all exercises planed in the framework of laboratory.

Lecture: Verification of learning outcomes is based on written tests carried out at least once a semester. To pass the lecture the student has to achieve positive grade of written tests.

Laboratory: Verification of learning outcomes is based on written reports delivered to the teacher at the end of each laboratory exercise. The pass the laboratory the student has to achieve positive grades of all laboratory exercises planed to implementation in the framework of laboratory.

STUDENT WORKLOAD:

The student workload is 100 teaching hours (4 credits), including contact hours: 60 teaching hours, preparation for classes: 20 teaching hours, preparation of audit work, reports, etc.: 20 hours.

RECOMENDED READING:

1. Hadam P., „Projektowanie systemów mikroprocesorowych”, BTC, Warszawa 2004.
2. Mielczarek W., „Szeregowe interfejsy cyfrowe”, Helion, Gliwice, 1993.

3. Pełka. R., „Mikrokontrolery: architektura, programowanie, zastosowania”, WKŁ, Warszawa, 2000.
4. Starecki T., „Mikrokontrolery 8051 w praktyce”, BTC, Warszawa 2002.

OPTIONAL READING:

1. Badźmirowski K., Pieńkos J., Myzik I., Piotrowski A., „Układy i systemy mikroprocesorowe, cz.1 i 2”, WNT, Warszawa, 1990.
2. Badźmirowski K., Pieńkos J., Piestrzyński W., „Systemy mikroprocesorowe, WNT, Warszawa 1981.
3. Bogusz J., „Programowanie mikrokontrolerów 8051 w języku C w praktyce”. BTC, Warszawa 2005.
5. Majewski J. „Programowanie mikrokontrolerów 8051 w języku C, pierwsze kroki”, BTC, Warszawa 2005.

REMARKS:

WIRELESS SENSOR NETWORKS

Course code: 6.9-WM-IB-S1-EiI-045_13

Course type: eligible

Language of instruction: Polish

Responsible lecturer: Doc. dr inż. Emil Michta

Taking classes: Doc. dr inż. Emil Michta; mgr inż.Piotr Powroźnik

Teaching methods	Hours per semester	Hours per week	Semester	Assessment methods	Credits ECTS
Full-time study					6
Lecture	30	2	VI	Exam	
Laboratory	30	2		Grade	

COURSE AIMS

- to familiarize students with the basics of the construction and operation of wireless sensor networks,
- to familiarize students with the communication architecture and selected communication protocols used in wireless sensor networks,
- formation among students basic skills in setting up and programming of wireless sensor network nodes.

PREREQUISITES:

- has an elementary knowledge of sensors, automation and programming basics,
- knows and understands functioning of the basic devices used in measuring non-electrical quantities and electronic medical equipment,
- is able to write a simple documentation for the worked out engineering task and prepare a text containing a discussion of the results of this task.

COURSE CONTENTS:

Introduction: Wireless data transmission. The evolution and classification of wireless networks to transmit data. Wireless networks in medical applications.

Introduction to sensor networks: The development of wireless WPAN class. IEEE Wireless Networks 802.15.x. Areas of sensor network applications.

Sensor networks: sensor network topologies. The physical layer and the data layer of wireless sensor networks – IEEE 802.15.4 standard. Network layer and application layer - ZigBee standard.

ZigBee: ZigBee protocol architecture. ZigBee network operation. Central management and routing. Domains, clusters and networks ZigBee profiles. Configuring the ZigBee network. Security at the MAC layer, network and applications. Addressing and bind variables. Areas of application and types of application profiles. Healthcare Application Profile.

Bluetooth: Bluetooth architecture. The functioning of the Bluetooth network. The measurement – control functions in Bluetooth environment.

WPAN nodes: Types and functions of the nodes in the ZigBee networks and Bluetooth networks.

Basics of sensor networks designing. Selection of the proposed network topology. Setting up coordinator and networks. Determination of communication parameters of the proposed network. Examples of sensor network applications in medicine. Network WBAN (Wireless Body Area Network).

LEARNING METHODS:

- conventional lecture,
- laboratory exercises.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence	Symbols of discipline specific learning outcomes
1	2	3
Knowledge (W)		
K_W23	The student has a specialistic knowledge in the field of the chosen studies specialization	T1A_W03-08, T1A_W11
Skills (U)		
K_U12	The student can select the proper modules and use the integrated information systems	T1A_U07
K_U19	The student can plan and carry out experiments, including	T1A_U08

	measurements and computer simulations, to interpret the results and draw conclusions	
K_U26	The student can run the laboratory equipment, select the proper method and tool to solve simple practical engineering problem	T1A_U16
Social Competences (K)		
K_K02	The student is aware of and understands the importance and impact of non-technical aspects of engineering, including its impact on the environment, and the responsibility for decisions consequently related with these aspects	T1A_K02

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

- written examination (multiple choice) and oral examination,
- pass all laboratory tasks.

Method of Assessment: obtaining positive rating exam and evaluations of laboratory examination, to be implemented in the laboratory classes.

Final rating = 0.5 assessment of the forms of assessment activities lecture + 0.5 credit assessment of the mold laboratory classes.

STUDENT WORKLOAD:

Contact hours	30 hours lec. + 30 hours lab = 60 hours
Preparing for classes	20 hours
Becoming familiar with indicated literature	20 hours
Preparation of reports	20 hours
Prepare for the test	30 hours
Total:	150 hours = 6 ECTS

RECOMMENDED READING:

1. Miller A.B., Bisdikian Ch.: Bluetooth. Helion. Gliwice, 2004.
2. Nawrocki W.: Komputerowe systemy pomiarowe. WKŁ, Warszawa, 2004.
3. Raghavendra C.S., Sivalingam K.M., Znati T.: Wireless Sensor Networks. Kluver Academic Publisher, 2005.
4. Zieliński B.: Bezprzewodowe sieci komputerowe. Helion, Gliwice, 2000.
5. Zhao F., Gibas L.: Wireless Sensor Networks. An Information Processing Approach. Elsevier, 2004.

OPTIONAL READING:

1. Gislason D.: ZigBee Wireless Networking. Elsevier Inc, 2008.
2. ZigBee Alliance. ZigBee Specification v.1.1 2007.

AUTOMATED MEDICAL DIAGNOSIS SYSTEMS

Course code: 6.9-WM-IB-S1-EiI-046_13

Type of course: Optional

Language of instruction: Polish

Director of studies: dr inż. Marek Kowal

Name of lecturer: dr inż. Marek Kowal

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	30	2	VI	Grade	
Laboratory	30	2		Grade	

COURSE AIMS:

- familiarize students with the methods of data collection used in medical diagnosis and the development of skills in the pre-processing of medical data

- familiarize students with the architecture of medical data warehouse and development of skills in the designing and application of analytical systems for medical data

- familiarize students with the methods used to build automated medical diagnosis systems and development of skills allowing the use of decision support and data mining algorithms

PREREQUISITES:

medical imaging techniques, digital signal processing, statistical methods of data analysis

COURSE CONTENTS:

Methods of data acquisition and processing for automated medical diagnosis.

Radiological imaging. Virtual microscopy. Application of image segmentation algorithms for the extraction of morphometric features. Feature selection methods. Discovering outliers. Completing the missing data.

Methods of storage and analysis of medical data. Medical data warehouse architecture. Analytical systems. Multidimensional data structures. Statistical analysis. Reporting

methods and services. Analytical systems review. Overview of public repositories of medical data.

Medical decision support systems. Expert systems. Methods of knowledge representation. Methods of knowledge discovery. Classification algorithms. Artificial intelligence methods. Medical decision support systems - case studies. Integration of decision support systems with picture archiving and communication systems.

TEACHING METHODS:

Lectures - conventional lecture, discussion

Laboratory - laboratory exercises, case studies

LEARNING OUTCOMES:

Field specific learning outcomes	Knowledge, skills, competence
K_W23	The student can name and explain image segmentation methods, he can apply these methods to extract objects from images and compute their morphometric parameters.
K_W23	The student knows and can explain methods of outlier detection and missing data handling.
K_U27	The student can name and define feature selection algorithms and he can apply these methods for medical data.
K_U27	The student can characterize components of a data warehouse
K_U27	The student can design and build multidimensional data structure using star schema.
K_U27	The student can explain how the expert system is built and he knows methods of knowledge representation.
K_U27	The student can interpret the results of data analysis and write the report.
K_U27	The student can name and define data mining techniques used for association and sequence discovering, clustering and classification.
K_U27	The student know how to apply learned data mining methods to explore medical data.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W23	The main condition to get a pass is positive grade in written test conducted once per semester.
K_U27	Grade based on laboratory classes. A passing grade in laboratory part comprises positive evaluation of reports based on each laboratory class, and preparation for classes.

final evaluation = 0.5 assessment of the lecture + 0.5 assessment of the laboratory.

STUDENT WORKLOAD:

Full-time studies

The student workload of 150 hours (6 ECTS), including contact hours 60 hours, consultations 15 hours, preparing for classes 30 hours, preparing for exam 15 hours, preparing of control work and reports 15 hours, reading literature 15 hours.

RECOMMENDED READING:

1. Grabski F., Jaźwiński J.: *Metody bayesowskie w niezawodności i diagnostyce*, WKŁ, 2001.
2. Piętka E.: *Zintegrowany system informacyjny w pracy szpitala*, PWN, 2004.
3. Rudowski R. (red.): *Informatyka medyczna*, PWN, 2003.
4. Cytowski J., Gielecki J., Gola A.,: *Cyfrowe przetwarzanie obrazów medycznych. Algorytmy technologie zastosowania.*, AOW EXIT,2008
5. Nieniewski M.: *Segmentacja obrazów cyfrowych. Metody segmentacji wododziałowej*. AOW EXIT, 2005.
6. Hand D., Mannila H., Smyth P.: *Eksploracja danych*. WNT, 2005.
7. Kisielnicki J., Pańkowska M., Sroka H.: *Zintegrowane systemy informatyczne. Dobre praktyki wdrożeń,* Warszawa, PWN, 2011.
8. Larose T. D.: *Odkrywanie wiedzy z danych*, Warszawa, PWN, 2006.
9. Larose D. T.: *Metody i modele eksploracji danych*, Warszawa, PWN, 2008.
10. Pelikant A.: *Hurtownie danych. Od przetwarzania analitycznego do raportowania*, Helion, 2011.

OPTIONAL READING:

1. Kącki E., Kulikowski J.L., Nowakowski A., Waniewski E. (red.): *Systemy komputerowe i teleinformatyczne w służbie zdrowia*. AOW EXIT, 2000.
2. Zajdel R., Kęcki E., Szczepaniak P., Kurzyński M.: *Kompendium informatyki medycznej*, Alfa-Medica Press, 2003.
3. Cierniak J.: *Tomografia komputerowa. Budowa urządzeń CT. Algorytmy rekonstrukcyjne.*
4. Klonecki W.: *Statystyka dla inżynierów*. PWN. 1999.
5. Cantor A.B.: *Survival Analysis Techniques for Medical Research*. SAS, 2007.

6. Suri J. S., Setarehdan K, Singh S. (red.): *Advanced Algorithmic Approaches to Medical Image Segmentation*. Springer, 2002.

REMARKS:

PATTERN RECOGNITION

Course code: 6.9-WM-IB-S1-EiI-047_13

Obligatority: optional

Language: polish, english

Course director: dr. Andrzej Marciniak, Ph.D.

Lecturer: dr. Andrzej Marciniak, Ph.D.

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	15	1	VI	Exam	
Laboratory	30	2		Grade	
Project	15	1		Grade	

COURSE AIMS:

Introduction to statistical pattern recognition. The students are provided with sufficient knowledge for designing and evaluating classifiers using proper methods for the problem at hand. Students will be able to implement a set of practical methods to solve real world problems in medical diagnosis, biometrics and image processing.

PREREQUISITES:

Probability and statistics, linear algebra, math skills.

COURSE CONTENTS:

Introduction. Real world examples of pattern recognition applications. Formulation of basic problems, notions and terms. Fundamentals of decision theory.

Reception and structure of feature space. Feature extraction and representation. Dimensionality reduction, prototyping. Feature selection and searching strategies: sequential and branch & bound approaches.

Estimation of prediction accuracy. Generalization and substitutions. Assessment and validation methods: bootstrapping, cross-validation.

Linear discriminant analysis. Fisher's discriminant, separability in feature space, regions and decision boundaries, scatter plot.

Bayes decision theory and Bayes classifier. Decision rules, the Bayes decision rule for minimum error, the Bayes decision rule for minimum cost, error probability in hypothesis testing, upper bounds on the Bayes error. Bayes linear classifier, naïve approach, design of: linear classifier, quadratic classifier, piecewise classifier.

Nonparametric classifiers. Nearest neighbor decision rules: editing, condensing and efficient nearest neighbor search. KNN Density Estimation, Parzen Density Estimation.

Cluster analysis. Decision-directed learning, graph-theoretic methods, agglomerative and divisive methods, ISODATA.

Syntactic and structural classification. String methods, Freeman chain coding, Shaw description language.

Applications. Biometrics: face detection and recognition. Image processing: segmentation and compression. Medical diagnosis: classification of breast cancer.

TEACHING METHODS:

Lectures with audiovisual aids. Group work in laboratory classes.

LEARNING OUTCOMES:

Learning outcomes		Knowledge, skills, competences
In the field of technical sciences	Engineer competency	
T1A_W01, T1P_W01		The student knows general principles and methods of decision theory, machine learning and data clustering.
T1A_W07		The student is able to characterize and implement separate stages of pattern recognition design cycle.
T1A_U15	InzA_U02	The student is able to select a set of relevant features for solving classification problem.
T1A_U08	InzA_U08	The student can design pattern classifier and set up parameters.
T1A_U13	InzA_U05	The student is able to verify a quality of classifier using

		statistical techniques of model validation.
T1A_U01		The student is able to interpret research results, draw conclusions and write short scientific report.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture - exam based on written test. Laboratory – final grade comprises positive evaluation of reports based on each laboratory class, attendance and initiative on the part of the student. Project – evaluation of final report.

STUDENT WORKLOAD:

Working with teacher:	15 h lecture + 30 h laboratory + 15 h project	=	60 h
Preparing for classes:			30 h
Reading:			30 h
Preparing laboratory reports:			10 h
Preparing for grade:			10 h
Preparing project final report:			10 h
		Total:	150 h

RECOMMENDED READING:

1. Bishop C.: *Neural Networks for Pattern Recognition*, Oxford University Press, 1995.
2. Duda P., Hart R. and Stork O.: *Pattern Classification*, 2nd edition, Wiley, 2000.
3. Fukunaga K.:, *Statistical Pattern Recognition*, 2nd edition, Morgan Kaufmann, 1990.

OPTIONAL READING:

1. Mitchell T.M.: *Machine Learning*, WCB/McGraw-Hill, 1997.
2. Vapnik V.N.: *The Nature of Statistical Learning Theory*, 2nd edition, Springer, 2000.

PRECISE DRIVES

Course code: 6.9-WM-IB-S1-EiI-048_13

Type of course: Compulsory

Language of instruction: Polish, English

Director of studies: Dr hab. inż. Robert Smoleński

Name of lecturer: Dr hab. inż. Robert Smoleński

Form of instruction	teaching hours per	teaching hours per	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 AIMS:

The aim of the course is to familiarize students with basic physical dependencies concerning electric drives and practical usage of the knowledge in order to properly select drive systems for specific load requirements.

PREREQUISITES:

Elementary knowledge in mathematics, physics and electrical engineering

COURSE CONTENTS:

Servomotors applied in robots and robot systems. Conventional and disc permanent magnet DC motors. Synchronous permanent magnet and reluctance motors. Step motors and asynchronous motors. Converter-fed servomotor drives.

Medical equipment drives (operating table, linear accelerator, Magnetic Resonance Imaging MRI, Computed Tomography CT).

Control methods of electric drives. Scalar control. Field oriented control. Direct torque control. Sensorless control.

Open and closed loop control of speed, torque and position. Realization of four-quadrant direct and alternating current drives. Follow-up and position servo drives, precise drives. Robot drives. Sensor systems of robots.

TEACHING METHODS:

Conventional lectures, brain storm, laboratory

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W23	Student can classify electric drives and select proper drive for specific load requirements
K_W23	Student is able to describe issues concerning electromechanical energy conversion, use basic characteristics of electric motors in drive development.
K_U17	On the basis of technical and economical analyses can select proper converter-fed drive.
K_U27	Is able to analyze exploitation properties of motors in both technical and economical context.
K_K02	Is conscious of the effects of drive influence on the electric grid. Is conscious of the drive importance for technical development.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	**The method of the learning outcomes assessment**
K_W23	grade based on written test
K_U17, K_U27, K_K02	grade based on laboratory classes

A passing grade in the lecture part of the course is determined by two written responses to questions about the theoretical aspects of the subject.
A passing grade in laboratory part comprises positive evaluation of reports based on each laboratory class, attendance and initiative on the part of the student.
To get a credit the student has to receive both passing grades.

STUDENT WORKLOAD:

The student workload is 100 hours (4 ECTS), including contact hours: 60 h, consultations: 10 h, class preparation: 10 h, colloquium preparation: 10 h, literature study: 10 h

RECOMMENDED READING:

1. Jerzy Honczarenko, Roboty przemysłowe. Budowa i zastosowanie, WNT 2004.
2. Boldea I., Nasar S.A, Electric Drives, CRC Press, 1999.
3. Orłowska-Kowalska T.: Bezczujnikowe układy napędowe z silnikami indukcyjnymi, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2003.
4. Tunia H., Kaźmierkowski M. P.: Automatyka napędu przekształtnikowego, PWN 1987.
5. Kaźmierkowski M. P., Blaabjerg F., Krishnan R.: Control in Power Electronics, Selected Problems, Elsevier 2002.

OPTIONAL READING:

1. Łastowiecki J., Duszczyk K., Przybylski J., Ruda A., Sidorowicz J., Szulc Z. Laboratorium podstaw napędu elektrycznego w robotyce WPW W-wa 2001.

REMARKS:

ADVANCED METHODS OF BIOMATERIALS TESTING

Course code: 6.9-WM-IB-S1-BiB-049_13

Type of course: Optional

Language of instruction: Polish

Director of studies: dr.hab.inż.Elżbieta Krasicka-Cydzik,prof.UZ

Name of lecturer: dr.hab.inż.Elżbieta Krasicka-Cydzik,prof.UZ
dr inż. Krzysztof Białas-Heltowski
mgr inż. Agnieszka Kaczmarek

Form of instruction	teaching hours per	teaching hours per	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 AIMS:

The aim of the course is to acquire skills and competencies in the practical use of chemical and electrochemical methods of surface layer formation and instrumental testing methods of their properties and degradation in tissue environment.

PREREQUISITES:

Knowledge of chemistry, electrochemistry and biomaterials.

COURSE CONTENT:

Lecture and Laboratory: Electrochemical testing methods, formation conditions and properties of surface layer and degradation of biomaterials (corrosion testing of implants, electropolishing, passivation, anodizing, formation of nanostructured layers). M*ethods of microstructural examinations (*optical, scanning electron SEM and transmission TEM microscopy, X-ray diffraction XRD*). Properties of biomaterial/tissue interface (*hydrophilic-hydrophobic properties, zeta potential, photoelectron spectroscopy: XPS, SIMS, atomic force microscopy – AFM, tunneling microscopy, infrared spectroscopy FTIR-ATR), testing of biomaterials in simulated biological environment, chemical investigation of extracts, degradation in vitro and in vivo tests. Procedures and standards of biomaterials engineering..

TEACHING METHODS:

Conventional lectures with audiovisual aids. Working with professional literature. Individual and team work on laboratory exercises.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W23	The student has an elementary knowledge of basic methods and algorithms for testing biomaterials using electrochemical methods
K_W11	The student knows the basic method for selecting a set of analytical techniques to the study of biomaterials
K_U13	The student knows how to use the software used for electrochemical studies
K_U19	The student can analyze signals and interpret polarization characteristics
K_U24	The student is able to suggest improvements to existing technologies, is able to able to assess the usefulness of routine methods and techniques related to the scope of Biomedical Engineering
K_K02	The student is aware of the benefits of advanced polarization techniques and materials research in the field of medicine

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W11, K_W23	The written exam A passing grade in the lecture part of the course is determined by written responses to questions about the theoretical aspects of the subject.
K_U13, K_U19,	Project: Grade Grade based on accuracy of selection techniques and methods the student uses and the quality of the project

K_U24, K_K02	

Lecture: Exam

Laboratory: Grade

STUDENT WORKLOAD:

The student workload of 102 hours (4 ECTS), including work in the consultations: 60 hours, exam: 2 hours, preparing for grade: 20 hours, preparing a project: 15 hours, familiarization with literature sources: 5 hours.

RECOMMENDED READING:

1. Zbigniew Galus „*Teoretyczne podstawy elektroanalizy chemicznej*" , PWN Warszawa 1977.
2. Jiri Koryta, Jiri Dvorak, Vlasta Bohackowa, „*Elektrochemia*", PWN, Warszawa 1980.
3. A.J.Bard and L.R. Faulkner, „*Electrochemical Methods*", Wiley, New York 1980 (or later editions).
4. **L. Dobrzański, A. Hajduczek,** *Mikroskopia optyczna i elektronowa,* WNT, 1987.
5. **A. Oleś,** *Metody doświadczalne fizyki ciała stałego,* WNT, 1993.
6. **J. Przedmojski,** *Rentgenowskie metody badawcze w inżynierii materiałowej,* WNT 1990.
7. **Z. Bojarski, E. Łągiewka,** *Rentgenowska analiza strukturalna,* PWN 1988, Wyd. Joseph Wang, „Analytical Electrochemistry" 1994 VCH Publisher, Inc, New York, Cambridge.

FUNDAMENTALS OF MECHATRONICS

Course code: 6.9-WM-IB-S1-BiB-050_13

Type of course: optional

Language of instruction: Polish

Director of studies: dr inż. Tomasz Klekiel

Name of lecturer: mgr inż. Chrystian Klonecki-Olech
dr inż. Tomasz Klekiel

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

COURSE AIM:

The aim of the course is to get the student's practical skills in the field of mechatronics and knowledge on the functioning of the basic elements of guidance and control systems for intelligent robotic structures. One of the learning outcomes of the course is skills to mechatronic design and practical skills in the process of prototyping and verification of design assumptions on the actual model.

ENTRY REQUIREMENTS:

Fundamentals of Electrical Engineering and Electronics, Physics, Mechanics and Strength of Materials

COURSE CONTENTS:

Lecture: Basic definitions of mechatronics. Mechatronics development and its goals. Structure of mechatronics devices.AS-I (actuator - sensor - interface). Consumer devices. The modular mechatronic devices. The concept of the mechatronic system, the concept of a technical system. Structure of mechatronic sensors. Structure of mechatronic actuators: pneumatic, hydraulic, electrical actuators. Technology in complex mechatronic systems. Functional description of mechatronic systems. Integration of mechatronic subsystems. Issues of Mechatronic design. Interdisciplinarity in the mechatronic designs. The integration of mechanical, electrical, electronic, software and control systems in the design of mechatronic. Steps in mechatronic designing. Technology in mechatronic projects. Virtual designing and rapid prototyping in mechatronic designing. Examples of mechatronic projects. The use of morphology arrays in the design of mechatronic. The CAD systems in the mechatronic design.

Project: The Project of the selected mechatronic system based on SSK-01 controller with a microprocessor ATMEGA8. The project carried out in accordance with a schedule of the design, preparation of documentation, the implementation of the model and running the system. Running the system requires programing of the control device.

TEACHING METHODS:

Conventional lecture and work with literature source. Group work at the realization of the project with broken down into individual tasks. The practical implementation of mechatronic system operating on the basis of the prepared project.

LEARNING OUTCOMES:

Directional effect of education	Description
K_W16	Acquire basic practical knowledge of electronics, mechanics and computer science
K_W23	Acquire basic knowledge about the construction of modern mechatronic systems
K_U01	Able to develop specifications for the selected mechatronic systems and analyze the functioning of the various components of the system
K_U11	Able to find information about sensors, actuators, control systems, based on the assumptions and specifications
K_U18	Meets general rules for safe operation of mechatronic devices
K_U27	Able to choose a design solution in terms of cost performance and is able to analyze the functionality of the proposed solution
K_U24	Has the ability to design simple mechatronic system, choose sensors, propose a solution design drive and define the requirements for control device
K_K03	Gaining skills and experience in teamwork
K_K07	Able to presents a proposal in the form of presentation

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the effects of field of study	The method of checking the effect of education

K_W16, K_W23	Grading lecture The pass of the lecture is to provide a positive evaluation of the test.
K_U01, K_U11, K_U18, K_U24, K_U27, K_K03, K_K07	Grading design classes Evaluation of the project is determined on the basis of the relevance of selection techniques and methods used and the quality of the implementation of the project.

Lecture - provided credit is to get a positive evaluation of the test carried out in the form of the test.

Project - provided credit is to implement the project on the basis of assumptions, starting position and performance reports.

STUDENT WORKLOAD:

The student workload is 100 hours (4 credits), including contact hours: 45 hours, office hours: 10 hours, the development of the project: 10 hours, execution and commissioning of the designing project.: 25 hours, work with literature: 10 hours.

RECOMMENDED READING:

1. Gawrysiak M.: Mechatronika i projektowanie mechatroniczne. Politechnika Białostocka. Rozprawy Naukowe nr 44. Białystok 1997
2. Hajduk Z.: Mikrokontrolery w systemach zdalnego sterowania. Wydawnictwo BTC. Warszawa 2005
3. Heimann B., Gerth W., Popp K.: Mechatronika. Komponenty, metody, przykłady. PWN. Warszawa 2001
4. Juran J.M., Gryna F.M.(Jr.): Quality Planning and Analysis. From Product Development through Use. Second Edition. McGraw-Hill, Inc. 1980 Konstrukcja przyrządów i urządzeń precyzyjnych. Praca zbiorowa pod red. W. Oleksiuka. WNT. Warszawa 1996
5. Oakland J.S.: Total Quality Management. Butterworth-Heinemann Ltd. Oxford 1992
6. Pełka R.: Mikrokontrolery. Architektura, programowanie, zastosowania. WKŁ. Warszawa 1999
7. Andrzeja Gajka, Zdzisława Judy , Czujniki. Mechatronika samochodowa

OPTIONAL READING:

1. Praca zbiorowa (red. Uhl T.): Wybrane problemy projektowania mechatronicznego. KRiDM AGH, Kraków, 1999.
2. Petko M.: Wybrane techniki projektowania mechatronicznego, UWND AGH, Kraków, 2005.

3. Rafał Baranowski, Mikrokontrolery AVR ATmega w praktyce, Wydawnictwo BTC,Warszawa 2005
4. Auslander K.L.: Mechatronics. Kluver Academic Press, New York, 1998.
5. Mrozek B., Mrozek Z.: Matlab uniwersalne środowisko do obliczeń naukowo-technicznych. CCATIE,Kraków 1995.
6. V. Giurgiutiu, S. E. Lyshevski, Micromechatronics, CRC Press, Boca Raton, FL, 2003.
7. C.W. de Silva, Mechatronics, An Integrated Approach, CRC Press, Boca Raton, FL, 2003.

HEAT ANF FLOW PROBLEMS IN BIOLOGICAL SYSTEMS

Course code: 6.9-WM-IB-S1-BiB-052_13

Type of course: compulsory

Language of instruction: polish

Director of studies: Dr inż. Roman Sobczak

Name of lecturer: Dr iż. Roman Sobczak

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					
Lecture	30	2	V	Grade	4
Laboratory	15	1		Grade	
Project	15	1		Grade	

COURSE AIMS:

Students are familiar to specific language of technical physic, methods of describing real processes, can create and use models of simple fluid flows and energy transformations. Students can solve simple technical problems in bio-engineering

PREREQUISITES:

Course of BasicTechnical Physic

COURSE CONTENTS:

Scientific Methods of describing processes by physical units and Laws of Physics. The SI Units System. Dimensional Analysis. Properties of a Substance; ideal Gas, Mixtures of Gases. Equilibrium State of Matter. Motion, Forces, Energy, Conservation Lows for Matter and for Energy (Thermodynamics Lows). Practical Use of Matter and Energy Conservation Laws - D. Bernoulli Low for Fluids. Types of Processes, Spontaneous Processes. The Law of Entropy Creation. Changing Phases of a Pure Substance. Rheology, Surface Tension, Viscosity, Inertia Forces in Fluids. Navier – Stokes Equilibrium. Laminar and Turbulent Flows. Energy Transfer by

Work, Heat, Radiation, Flow of Matter, Electrical Current. Mathematical Models of Energy transfer by Heat; Conduction, Convection, Radiation. Specific Properties of Biological Fluids; No-Newtonian Flows, Pulsar Flows. Special cases of Heat Transfer and Flows in Bioengineering. Psychrometrics Effect, Friction Losses in Fluid Ducts, Technical Devices for Energy Treatment; Combustion, Refrigeration, Power Cycles, Heat Exchanger.

Project exercisers:

1. Systems of Units
2. Conservation Laws in Fluid Flows
3. Properties of Gases – Clapeyron`s Law
4. Heat Transfer
5. Energy Balance for some Processes
6. Molier Psychrometric Chart for Air Humidification
7. Combustion

Labor exercises:

1. Measure of Temperature
2. Measure of Pressure
3. Enthalpy of Combustion – Heating Value
4. Laminar and Turbulent Flow – visualization
5. Rheological Properties of Fluids
6. Heat Exchanger

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W23	The student has a specialistic knowledge in the field of the chosen studies specialization
K_U14	The student can select and apply the proper calculation methods to solve simple research problems in the field of Biomedical Engineering
K_U27	The student can use a specialistic knowledge to organize the implentation of simple tasks relevant to the field of the chosen specialization

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W23	Credit based on written test. A passing grade in the lecture part of the course is determined by three written responses to questions about the theoretical aspects of the subject.
K_U14	Grade based on laboratory classes. A passing grade in laboratory part comprises positive evaluation of reports based on each laboratory class, attendance and initiative on the part of the student.
K_U27	Grade based on project. Grande on project is determined on the basis of accuracy of selection techniques and methods used and the quality of the project.

For grade course - lectures - Student must pass written quizze –enough 3 positive answers of 5 questions.

For Exercises – Student prepare correct written solution for given set of problems

For Laboratory – Grad by systematic Class participation

STUDENT WORKLOAD:

Student workload is about 100 hours (4 ECTS) including prepare to lessons - 60 hours, 20 hours preparing to exam and 20 hours participating lessons

RECOMMENDED READING:

1. Basic transport phenomena in biomedical engineering / Roland L. Fourier, 2 ed. New York, Francis Group, 2007
2. A Heat Transfer Textbook, 4th edition John H. Lienhard IV, Professor, University of Houston John H. Lienhard V, Professor, Massachusetts Institute of Technology
3. http://web.mit.edu/lienhard/www/ahtt.html

OPTIONAL READING:

17. http://ocw.mit.edu/resources/res-6-001-electromagnetic-fields-and-energy-spring-2008/
18. http://ocw.mit.edu/courses/biological-engineering/20-330j-fields-forces-and-flows-in-biological-systems-spring-2007/

REMARKS:

NANOTECHNOLOGY AND MATERIALS FUNCTIONAL BASIS

Course code: 6.9-WM-IB-S1-BiB-053_13

Type of course: Optional

Language of instruction: Polish, English

Director of studies: dr hab. inż. Elżbieta Krasicka-Cydzik, prof. UZ

Name of lecturer: Dr inż. Piotr Kuryło

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

COURSE AIMS:

The aim of the course is to familiarize students with the basic concepts of nanotechnology, nanomaterials science and engineering, and define the boundaries of nanotechnology related to changes in the properties of materials by reducing the scope of the material in size nano.

PREREQUISITES:

Basic knowledge of materials science and knowledge of the materials used in the engineering of biomaterials.

COURSE CONTENTS:

1. Introduction to the Study of nanometriałach - selected definitions of nanotechnology, the history of nanotechnology, nano and micro scale, examples (2 hrs.).
2. Engineering new materials - basic information (possible classifications of materials, structure and properties of engineering materials (metals, ceramics, polymers, composites), semiconductors and insulators; density of electron states in the metal, the materials on a scale "nano" The essence of the "new features" nanomaterials (basic phenomena in nanomaterials used, the impact of the scale of dimensional, mechanical properties), mesoscopic systems (4 hrs.).

3. Engineering Nanomaterials - Nanomaterials one-, two-and three-dimensional, Fullerenes, Nanotubes, nanodiamonds, nanowires, nanomaterials of single molecules (eg nanożele-nanoparticles, nanospheres, nanocapsules), Nano-materials macroscopic (nanostructure) Nanometale - synthesis and application, Dots and quantum wires, nanometric magnetic materi-als, polymers and composites, examples of use of nanomaterials entering (6 hrs.).
4. Nanotechnology - engineering nanomaterials: technologies "top-down" and "bottom-up"; Nanomanipulacje (2 hrs.).
5. Nanolayers surface - the method of preparation, the degree of coverage of the substrate, termalizacja and binding on the surface, the binding of the surface coverage, the diffusion of atoms at the surface. The metal oxide nanolayers shell PCD based nitrides (4 hrs.).
6. Characterization and modeling of nanomaterials - the method of imaging the structure of nanomaterials, a quantitative description of the structure, properties and modeling of processes in nanomaterials (2 hrs.).
7. Nanofibers - polymer nanofibers (methods of preparation, the solution electrospinning process, the production of nanofibers with different morphology), the properties of the nanofibers, the nanofibers used in medicine (4 hrs.).
8. Biocompatible nanomaterials - nanobiomaterials (2 hrs.).
9. Applications and prospects of nanotechnology in the production of hydrogen, energy, environmental protection, medicine, bionanotechnology perspectives, issues Nanotoxicology (4 hrs.).

Project content.

1. Turning of external rotating surfaces.
2. Turning of internal rotating surfaces.
3. Turning of complex shape rotating surfaces.
4. Milling of flat and shaped surfaces.
5. Milling of helical grooves.
6. Processing technologies for holes.
7. Slotting.
8. Cutting gear teeth by hobbling.
9. Cutting gear teeth by shaping
10. Grinding of external rotating surfaces.
11. Grinding of flat surfaces.
12. machining of medical products with CNC machine tools.
13. Cutting tool sharpening.

14. Correction laboratory and tests.

TEACHING METHODS:

Lectures with audiovisual aids. Working with the book and in Internet. Group work in laboratory classes.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W23	The student knows the methods and principles of medical devices production, he knows the rules and possibilities of conventional and CNC machine tools, characterizes conventional and modern technologies, describes the design and use of common tools and fixtures, peculiarity of assembly. He can choose the typical machines, tools and propose methods for machining of typical surfaces of medical devices
K_U11	can use information and communication technologies to produce laboratory results
K_U13	can interpret the results of laboratory exercises and draw conclusions.
K_U27	can analyze the performance characteristics of machines in the economic and technical context
K_K03	can interact with a group

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W23	Exam based on written test. A passing grade in the lecture part of the course is determined by three written responses to questions about the theoretical aspects of the subject.
K_U11, K_U13, K_U27	Grade based on laboratory classes. A passing grade in laboratory part comprises positive evaluation of reports based on each laboratory class, attendance and initiative on the part of the student.
K_K03	The course of the laboratory classes

In evaluating of the lecture part, the following guidelines will be used:

Grade 2	Grade 3	Grade 4	Grade 5
The student don't understand the questions, can not answer properly	Replies contain only basic information without supporting schemes, diagrams, etc	Replies include information presented in the classroom, but not fully complete or with minor errors	Replies contain complete information presented in the classroom and student's own perception of the problem

To get a credit the student has to receive both passing grades.

The final grade received by the student is the arithmetic mean of the above grades.

STUDENT WORKLOAD:

The student workload of 150 hours (6 ECTS), including work in the auditorium 60 hours, consultations 15 hours, exam 2 hours, preparing for grade 10 hours, preparing of control work and reports 15 hours, preparing for classes 20 hours.

RECOMMENDED READING:

1. Wybrane zagadnienia z inżynierii wytwarzania: obróbka ubytkowa/ red. A. Laber.- Zielona Góra Oficyna Wydaw. Uniwersytetu Zielonogórskiego, 2008;
2. Filipowski R., Marciniak M. Techniki, obróbki-mechanicznej i erozyjnej. Warszawa Oficyna Wydawnicza Politechniki Warszawskiej 2000;
3. Praca zbiorowa. Obróbka skrawaniem, ścierna i erozyjna. Pod red. L. Dąbrowskiego i in. Warszawa Oficyna Wydawnicza Politechniki Warszawskiej 1997.

OPTIONAL READING:

1. Praca zbiorowa. Encyklopedia technik wytwarzania stosowanych w przemyśle maszynowym. Pod red. J. Erbla. T. II. Obróbka skrawaniem. Montaż. Warszawa Oficyna Wydawnicza Politechniki Warszawskiej, 2001;
2. Laboratorium technik wytwarzania. Obróbka skrawaniem i obrabiarki/ red. Z. Wójcik. Warszawa Wydawnictwo Politechniki Warszawskiej 1980;
3. Czasopismo Annals of CIRP and others.

REMARKS:

SOME LABS CAN BE CONVERTED INTO TRIPS TO THE PLANTS PRODUCING MEDICAL DEVICES.

PRODUCTION TECHNIQUES FOR MEDICAL DEVICES

Course code: 6.9-WM-IB-S1-BiB-054_13

Type of course: Optional

Language of instruction: Polish, Russian

Director of studies: Prof. dr hab. inż. Eugene Feldshtein

Name of lecturer: Prof. dr hab. inż. E.Feldshtein, dr inż. A.Laber, dr inż. R.Maruda

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

COURSE AIMS:

The aim of the course is to familiarize students with the details of the production of medical devices, principles of operation of conventional machine tools, conventional and unconventional processing methods for medical devices, assembly methods and general issues for design technological processes to be used in their future careers.

PREREQUISITES:

Material Science, Biomaterials, Metrology.

COURSE CONTENTS:

Lecture content. Conditions for the production of medical devices. Basic issues of technology and organization of production. Types and basic concepts of the machining. Cutting wedge. Cutting parameters. Turning of rotating surfaces. Machining of holes with axial tools. Milling operation. Machining of complicated shapes surfaces. Abrasive machining technologies. Strengthening technologies. Modern methods of processing - electro, plasma, laser technologies, etc. Features of surface machined. Assembly technologies.

Laboratory content.

1. Turning of external rotating surfaces.
2. Turning of internal rotating surfaces.

3. Turning of complex shape rotating surfaces.
4. Milling of flat and shaped surfaces.
5. Milling of helical grooves.
6. Processing technologies for holes.
7. Slotting.
8. Cutting gear teeth by hobbing.
9. Cutting gear teeth by shaping
10. Grinding of external rotating surfaces.
11. Grinding of flat surfaces.
12. machining of medical products with CNC machine tools.
13. Cutting tool sharpening.
14. Correction laboratory and tests.

TEACHING METHODS:

Lectures with audiovisual aids. Working with the book and in Internet. Group work in laboratory classes.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W23	The student knows the methods and principles of medical devices production, he knows the rules and possibilities of conventional and CNC machine tools, characterizes conventional and modern technologies, describes the design and use of common tools and fixtures, peculiarity of assembly. He can choose the typical machines, tools and propose methods for machining of typical surfaces of medical devices
K_U11	can use information and communication technologies to produce laboratory results
K_U13	can interpret the results of laboratory exercises and draw conclusions.
K_U27	can analyze the performance characteristics of machines in the economic and technical context
K_K03	can interact with a group

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W23	Exam based on written test. A passing grade in the lecture part of the course is determined by three written responses to questions about the theoretical aspects of the subject.

K_U11, K_U13, K_U27	Grade based on laboratory classes. A passing grade in laboratory part comprises positive evaluation of reports based on each laboratory class, attendance and initiative on the part of the student.
K_K03	The course of the laboratory classes

In evaluating of the lecture part, the following guidelines will be used:

Grade 2	Grade 3	Grade 4	Grade 5
The student don't understand the questions, can not answer properly	Replies contain only basic information without supporting schemes, diagrams, etc	Replies include information presented in the classroom, but not fully complete or with minor errors	Replies contain complete information presented in the classroom and student's own perception of the problem

To get a credit the student has to receive both passing grades.
The final grade received by the student is the arithmetic mean of the above grades.

STUDENT WORKLOAD:

The student workload of 182 hours (6 ECTS), including work in the auditorium 60 hours, consultations 30 hours, exam 2 hours, preparing for grade 30 hours, preparing of control work and reports 30 hours, preparing for classes 30 hours.

RECOMMENDED READING:

1. Wybrane zagadnienia z inżynierii wytwarzania: obróbka ubytkowa/ red. A. Laber.- Zielona Góra Oficyna Wydaw. Uniwersytetu Zielonogórskiego, 2008;
2. Filipowski R., Marciniak M. Techniki, obróbki-mechanicznej i erozyjnej. Warszawa Oficyna Wydawnicza Politechniki Warszawskiej 2000;
3. Praca zbiorowa. Obróbka skrawaniem, ścierna i erozyjna. Pod red. L. Dąbrowskiego i in. Warszawa Oficyna Wydawnicza Politechniki Warszawskiej 1997.

OPTIONAL READING:

1. Praca zbiorowa. Encyklopedia technik wytwarzania stosowanych w przemyśle maszynowym. Pod red. J.Erbla. T. II. Obróbka skrawaniem. Montaż. Warszawa Oficyna Wydawnicza Politechniki Warszawskiej, 2001;
2. Laboratorium technik wytwarzania. Obróbka skrawaniem i obrabiarki/ red. Z. Wójcik. Warszawa Wydawnictwo Politechniki Warszawskiej 1980;
3. Czasopismo Annals of CIRP and others.

REMARKS:

Some labs can be converted into trips to the plants producing medical devices.

REHABILITATION ENGINEERING

Course code: 6.9-WM-IB-S1-BiB-055_13

Type of course: optional

Language of instruction: Polish

Director of studies: dr inż. Tomasz Klekiel

Name of lecturer: dr inż. Tomasz Klekiel

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					4
Lecture	30	2	VI	Exam	
Project	30	2		Grade	

COURSE AIM:

The aim of the course is presentation the basics of rehabilitation engineering in designing of medical equipment, rehabilitation devices and basic methods of rehabilitation.

ENTRY REQUIREMENTS:

Introduction to Medical Science, Physiology and Anatomy, Physics, Mechanics, Electronics and Electrical Engineering, Computer Aided Design, Biomechanics, Sensors and Measurement of Non-electrical Signals, Electronic Medical Equipment.

COURSE CONTENTS:

Lecture: Introduction to rehabilitation engineering, history of rehabilitation, basic definitions,, the phase of the rehabilitation process. The role of rehabilitation engineering, upper limb prosthesis, prosthetic hand, forearm prosthesis, prosthetic legs, gait kinematics, locomotion, prosthetic legs, prosthetic feet, prosthetic dynamic foot, lower leg prosthesis, prosthetic thigh, hip prostheses, legs orthotics, limbs orthotics. Functional stimulation of the lower limbs, functional electrical stimulation, supply orthotic upper limbs, upper limbs orthosis, spine orthotics equipment, aids, Sensor technology in the devices for rehabilitation, rehabilitation devices, measurements of muscle tension, non-electrical measurements in medical diagnostics, sensors in modern prosthetics and orthotics. Innovative solutions smart rehabilitation devices.

Project: An introduction to rehabilitation engineering, analysis methods and techniques for rehabilitation of the locomotion system selected, the principles of the planning process of rehabilitation, medical consultation, conceptual design of mechatronic devices supporting the rehabilitation process of a particular condition, the assessment of solutions in terms of the effectiveness of the rehabilitation process, the technical capabilities of the device, the

conditions and rules for the production of medical and rehabilitation equipment, machine control system design, selection of actuators and sensors, preparation of technical documentation, assembly drawing machine, drawings, control algorithms, evaluation of projects.

TEACHING METHODS:

Lecture conventional design method, discussion, work with the literature, group work.

LEARNING OUTCOMES:

Directional effect of education	Description
K_W23	Knows the basic equipment used in the process of rehabilitation, has a basic knowledge of the development of modern techniques of rehabilitation, has information in the field of rehabilitation equipment recycling, and has a basic knowledge of the problems of people with disabilities
K_U05	has the ability to organize work in a project team
K_U18	Apply principles of safety rehabilitation equipment and prosthetic devices
K_U20	Able to choose a design solution in terms of cost performance, formulate a conceptual design for the chosen design of rehabilitation equipment and in accordance with a preset specification, taking into account the non-technical aspects of the design a simple device for rehabilitation
K_U24	Able to identify the device by its purpose, on the basis of knowledge and analysis of the functioning and indicate a device which assists the rehabilitation of selected diseases
K_U27	Able to find and discuss the principle of rehabilitation equipment for the assumed purpose and also has experience in the analysis of the relationship between structural and functional solution rehabilitation equipment
K_K01, K_K02 K_K03	Has knowledge of the importance of technical measures in the lives of people with disabilities, acquire skills and experience in teamwork and is aware of the ongoing development of rehabilitation equipment and prosthetic devices

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the effects of	The method of checking the effect of education

field of study	
K_W23	Grading lecture - exam The pass of the lecture is to provide a positive assessment of written responses to questions regarding the theoretical issues of the subject.
K_U05, K_U18, K_U20 K_U27	Grading project classes Evaluation of the project is determined on the basis of the relevance of selection techniques and methods used and the quality of the implementation of the project.
K_K01, K_K02, K_K03	skills developed during the project and its various stages of consultation

Lecture: The prerequisite is to obtain a positive evaluation of the test carried out in writing form.

Project: credit with a grade (based on credit ratings received during the project's preparation for classes, and the final assessment for the project).

The final grade is the average of all ratings.

STUDENT WORKLOAD:

The student workload is 100 hours (4 ECTS), including contact hours: 60 hours exam: 2 hours, preparation for classes: 8 hours, the development of the project: 20 hours, to prepare for the exam: 10 hours.

RECOMMENDED READING:

1. Biomechanika i Inżynieria Rehabilitacji, Tom 5.
2. T. Bober, J. Zawadzki, Biomechanika układu ruchu człowieka.
3. Ross Ethier, Craig A. Simmons, Introductory Biomechanics.
4. Romuald Będziński, Biomechanika Inżynierska, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1997
5. Kolster, G. Ebelt-Paprotny Poradnik fizjoterapeuty, Osolineum, 1996
6. Borkowska M. (red): ABC rehabilitacji dzieci. Najczęstsze schorzenia narządu ruchu. Wyd. Pelikan, Warszawa 1989.
7. Bruhl W. : Zarys reumatologii. PZWL, Warszawa 1987.
8. Dega., Senger A.: Ortopedia i rehabilitacja. PZWL, Warszawa 1996

OPTIONAL READING:

1. Dega W., Milanowska K.: Rehabilitacja medyczna. PZWL, Warszawa 1993
2. Dziak A.: Ćwiczenia usprawniające w uszkodzeniach kości i stawów. PZWL, Warszawa 1990
3. Encyklopedyczny Słownik Rehabilitacji, 1986
4. Grochmal S., Zielińska- Chrzanowska S.: Rehabilitacja w chorobach układu nerwowego.
5. PZWL, Warszawa 1986
6. Hulek A. (red.): Człowiek niepełnosprawny w społeczeństwie. PZWL, Warszawa 1986
7. Kaliszewski J.: Rehabilitacja w klinice chorób wewnętrznych.PZWL, Warszawa 1974
8. KiwerskiJ., Kowalski M., Krasuski M.: Schorzenia i urazy kręgosłupa. PZWL, Warszawa 1997
9. Kuch J.: Rehabilitacja. PZWL, Warszawa 1989
10. Larkowa H.: Człowiek niepełnosprawny – problemy psychologiczne. PWN, Warszawa 1987
11. Larkowa H.: Postawy otoczenia wobec osób niepełnosprawnych. PZWL, Warszawa 1970

ENTERPRENEURSHIP & QUALITY MANAGEMENT

Course code: 6.9-WM-IB1S-48-POB

Type of course: compulsory

Language of instruction: polish

Director of studies: mgr inż. Agnieszka Kaczmarek

Name of lecturer: mgr inż. Agnieszka Kaczmarek

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					4
Lecture	30	2	V	Grade	
Project	30	2		Grade	

COURSE AIMS:

Course has specific goals:

1. To familiarize students with the issues and challenges facing entrepreneurs in emerging markets
2. To provide an understanding of the human and organizational contexts in which young entrepreneur will be working and the skills he will need to be productive and successful
3. To explore how to put the scientific, technical and organizational knowledge learned at University to work in today organizations.

PREREQUISITES:

None

COURSE CONTENTS:

Abraham Maslow and his model of human needs. Quality of Life, Strategic Thinking about Problem Solving, Marketing as a method of Quality of Life creating by Worth Exchange. Marketing and Entrepreneurship, Identifying Market Opportunities, Market Development, Entrepreneurial Communication Strategy, Entrepreneurial Pricing Strategy, Entrepreneurial Distribution Strategy, Building Customer Relationships.

Management as; planning, organizing, staffing, motivating, directing and controlling. Productivity, Lean management, Total Quality Management, Leadership and Team building. Project Management, Quality Function Deployment (QFD). Doman's Rules of Quality, Elements of Law for entrepreneurship, Tax policy in Poland, Financing, Emerging markets, Trends of Development in Technology, Society of Future. Multi- culture Relations and Communication. Creativity, methods of creative thinking. Business Plan, Cash Flow, Payback of Innovation. How to start business. Decision Theory, Risk Management.

TEACHING METHODS:

Lecture and class discussion. Homework with Business Plan preparing. Reading.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence	
K_W23	The student has a specialistic knowledge in the field of the chosen studies specialization	T1A_W03, T1A_W04, T1A_W05, T1A_W06, T1A_W07, T1A_W08, T1A_W11
K_W13	The student has a basic knowledge necessary to understand the social, economic, legal, environmental and other non-technical considerations of engineering activities, understands the application of his/her knowledge in engineering practice, knows the rules associated with safety and ergonomics	T1A_W02 T1A_W07
K_U27	The student can use a specialistic knowledge to organize the implementation of simple tasks relevant to the field of the chosen specialization	T1A_U12, T1A_U13, T1A_U14, T1A_U15, T1A_U16
K_K06	The student can think and act in a creative and enterprising way	T1A_K06

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to	The method of the learning outcomes assessment	

the learning outcomes of the field of study		
K_W13	The student has a basic knowledge necessary to understand the social, economic, legal, environmental and other non-technical considerations of engineering activities, understands the application of his/her knowledge in engineering practice, knows the rules associated with safety and ergonomics	T1A_W02 T1A_W07
K_W23	The student has a specialistic knowledge in the field of the chosen studies specialization	T1A_W03, T1A_W04, T1A_W05, T1A_W06, T1A_W07, T1A_W08, T1A_W11
K_U27	The student can use a specialistic knowledge to organize the implentation of simple tasks relevant to the field of the chosen specialization	T1A_U12, T1A_U13, T1A_U14, T1A_U15, T1A_U16
K_U06	The student can prepare and present an oral presentation concerning specific issues of the field of Biomedical Engineering	T1A_U04

End quiz for lecture and own made Project (Business plan) presentation evaluation

For note 3 - only basic, standard knowledge from lectures

For note 4 - knowledge from readings and own experience

For note 5 – own experience, readings, participation in class discussions, use of modern methods like QFD, Prince 2 etc.

STUDENT WORKLOAD:

Student workload is about 100 hours (4 ECTS) including prepare to lessons - 60 hours, 20 hours preparing to final presentation and 20 hours participating lessons

RECOMMENDED READING:

1. “The Essential Drucker” – Polish edition as „Myśli przewodnie Druckera”, wyd.MT Biznes sp z o.o, 2001

2. “The Post Capitalist Society” – Peter Drucker, 1993, Polish edition as “Społeczeństwo pokapitalistyczne” Wyd. Naukowe PWN, Warszawa 1999
3. “The Toyota Way – 14 management principles from the world’s greates manufacturer”, Jeffrey K. Liker, by McGraw- Hill, 2004, Polish edition as “Droga Toyoty…” wyd. MT Biznes, 2005
4. “Future Shock” – Alvin Toffler, 1970, Polish edition as “Szok przyszłości” Wyd Zysk I S-ka, wyd. II 1974
5. “Kotler on Marketing. How to create, Win, and Dominate Markets”, Philip Kotler, The Free Press, 1999, Polish edition as ”Kotler o marketing, jak kreować I opanować rynki” Wyd. Profesjonalnej Szkoły Biznesu, Kraków, 1999
6. “Influence, Science and Practice” Robert B. Cialdini, A Pearson Educational Company, 2008, Polish edition as “ Wywieranie wpływu na ludzi – teoria i praktyka” wyd. Gdańskie Wydawnictwo Psychologiczne, 2010

OPTIONAL READING:

1. „Biznes – po prostu” Leszek Czarnecki, Wyd. Studio EMKA, Warszawa, 2011
2. „Przedsiębiorczość dla ambitnych – jak uruchomić własny biznes” Jerzy Cieślik, Wyd. Akademickie i Profesjonalne, Warszawa 2006
3. „Happier: Learn the Secrets to Daily Joy and Lasting Fullfilment” – Tal Ben-Shahar, 2007, Polish edition “W stronę szcześcia”, Wyd. Dom Wydawniczy REBIS 2009

REMARKS:

none

SPECIALIST SEMINAR

Course code: 6.9-WM-IB-S1-BiB-057_13

Type of course: Optional

Language of instruction: Polish

Director of studies: Dr hab. inż. Elżbieta Krasicka-Cydzik, prof. UZ

Name of lecturer: Theses supervisors

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					3
Laboratory	60	4	III	Grade	

COURSE AIMS:

The student acquires knowledge about technical and editorial preparation of thesis.

PREREQUISITES:

COURSE CONTENTS:

The subject contains issues related to the implementation of the thesis, for example: work preparation techniques, *literature analysis methods,* methods of data collection and their analysis, presentation, verification of the results and tools for editing text. The students present the results and status of work.

TEACHING METHODS:

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_K01	The student understands the need for lifelong learning; is able to inspire and organize the learning process of others
K_K02	The student is aware of and understands the importance and impact of non-technical aspects of engineering, including its impact on the environment, and

	the responsibility for decisions consequently related with these aspects

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_K01, K_K02	The evaluation of the use of knowledge and skills acquired during their studies to realization engineering thesis

Seminar: Grade.

STUDENT WORKLOAD:

The student workload of 75 hours (3 ECTS), including consultations: 60 hours, preparing for classes 10 hours, work with literature: 5 hours

RECOMMENDED READING:

Literature specified by supervisors depending on topic of thesis.

BSc SEMINAR I

Course code: 6.9-WM-IB1S-050-POB

Type of course: Optional

Language of instruction: Polish

Director of studies: Dr hab. inż. Elżbieta Krasicka-Cydzik, prof. UZ

Name of lecturer: Theses supervisors

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					3
Laboratory	45	3	VI	Grade	

COURSE AIMS:

The students should to know how to present and discuss a selected topics related to biomedical engineering and his thesis.

PREREQUISITES:

COURSE CONTENTS:

The students should to write independent engineering thesis, that allow him partake final exam in the range of biomedical engineering. The subject contains issues related to the implementation of the thesis, for example: thesis preparation techniques, *literature analysis methods,* methods of data collection and their analysis, presentation, verification of the results and tools for editing text. The students present the results and status of work.

Thematic range is individually and include theses topics. The students show presentation of the final results in seminar group. Each presentation ends with a discussion between the rest of the seminar group and orator. It is acceptable to develop presentations in English. Evaluation the work.

TEACHING METHODS:

Regular *consultations with supervisor*

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_K01	The student understands the need for lifelong learning; is able to inspire and organize the learning process of others
K_K03	The student can interact and work in a group, adopting different roles
K_K04	The student can properly determine priorities for implementation of tasks specified by themselves or others

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_K01, K_K03, K_K04	The evaluation of the use of knowledge and skills acquired during their studies to realization engineering thesis

Grade based on final presentation of thesis and activities on the lessons.

STUDENT WORKLOAD:

The student workload of 75 hours (3 ECTS), including consultations: 45 hours, preparing for classes: 15 hours, work with literature: 15 hours

RECOMMENDED READING:

Literature specified by supervisors depending on topic of thesis.

BSC SEMINAR 02

Course code: 6.9-WM-IB-S1-BiB-059_13

Type of course: Optional

Language of instruction: Polish

Director of studies: Dr hab. inż. Elżbieta Krasicka-Cydzik, prof. UZ

Name of lecturer: Thesis supervisors

Form of instruction	teaching hours per	teaching hours per	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Seminar	90	6	VII	Grade	

COURSE AIMS:

The students should to know how to present and discuss a selected topic related to biomedical engineering and his thesis.

PREREQUISITES:

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COURSE CONTENTS:

The students should to write independent engineering thesis, that allow him partake final exam in the range of biomedical engineering. The subject contains issues related to the implementation of the thesis, for example: thesis preparation techniques, literature analysis methods, methods of data collection and their analysis, presentation, verification of the results and tools for editing text. The students present the results and status of thesis.

Thematic range is individually and include theses topics. The students show presentation of the final results in seminar group. Each presentation ends with a discussion between the rest of the seminar group and orator. It is acceptable to develop presentations in English. Evaluation the thesis.

TEACHING METHODS:

Regular seminar with supervisor

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_K01	The student understands the need for lifelong learning; is able to inspire and organize the learning process of others
K_K03	The student can interact and work in a group, adopting different roles
K_K04	The student can properly determine priorities for implementation of tasks specified by themselves or others

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_K01, K_K03, K_K04	The evaluation of the use of knowledge and skills acquired during their studies to realization BSc thesis

Grade based on the final presentation of thesis and activities on the lessons

STUDENT WORKLOAD:

The student workload of 150 hours (6 ECTS), consultations: 45 hours, preparing for classes: 50 hours, work with literature: 55 hour

RECOMMENDED LITERATURE:

Literature specified by supervisors depending on topic of thesis.

PROFFESIONAL PRACTICE

Course code:

Course type: directional

Language: polish

Responsible for the course: Agnieszka Kierzkowska

Leader: supervisor authorized by the head of the unit in which the practice takes place

Classes type	Number of hours per semester	Number of hours per week	Semester	Form of the credit	ECTS points
Full-time study					15
Project	0	0	VII	--	

THE AIM OF THE COURSE:

The purpose of student professional practice is to develop the ability to apply and test theoretical knowledge gained in the course of study in practice.

INITIAL REQUIREMENTS:

Graduation of the II year (IV semester) of the study.

THEMATIC SCOPE OF THE SUBJECT:

Thematic scope includes i.a.:

- Introduction to basic and valid regulations related to the labor discipline, labor requirements and conditions of health and safety at work;
- Introduction to the institution's structure and study methods of work organization, especially in technical departments;
- Introduction to conditions and characteristic actions of the company;
- Development of interests and abilities of work in a team;

- Confrontation and deepening of the knowledge obtained in the process of education by its application in professional practice;
- Improving knowledge through practical participation in the ongoing activities of the company;
- Acquisition of skills related to service the equipment;
- Learning the principles and needs resulting from exploitation, technical supervision, service and maintenance of medical, research and technological equipment, etc.;
- Learning the course of the technological process (in the case of a production unit), economic and sociological factors.

METHODS OF TRAINING:

Practical participation in company's activities. Training methods in detail are determined by the head of the unit in which the practice takes place.

LEARNING OUTCOMES:

Learning outcomes		Knowledge, Skills, Competences
T1P_U02		student potrafi porozumiewać się przy użyciu różnych technik, w tym informatycznych w środowisku zawodowym
T1P_U05		ma umiejętność samokształcenia się poprzez przenoszenie i łączenie wiedzy teoretycznej z praktyczną
T1P_U11		ma umiejętności niezbędne do pracy w środowisku przemysłowym oraz zna i stosuje zasady bezpieczeństwa związane z tą pracą
T1P_U14		potrafi dokonać identyfikacji i sformułować specyfikację prostych zadań inżynierskich o charakterze praktycznym, charakterystycznych dla kierunku studiów
T1P_U18		ma doświadczenie związane z rozwiązywaniem praktycznych zadań inżynierskich, zdobyte w środowisku zajmującym się zawodowo działalnością inżynierską
T1P_K02		ma świadomość ważności i rozumie pozatechniczne aspekty i skutki działalności inżynierskiej i związanej z tym odpowiedzialności za podejmowane decyzje

T1P_K03		potrafi współdziałać i pracować w grupie, przyjmując w niej różne role
T1P_K05		prawidłowo identyfikuje i rozstrzyga dylematy związane z wykonywaniem zawodu

VERIFICATION OF THE EFFECTS OF EDUCATION AND CONDITIONS OF THE CREDIT:

160 hours of practice certified by the supervisor of practice authorized by the head of the unit and to obtain credit in the supervisor of practice at University of Zielona Góra on the basis of the Practice Diary. In justified cases, after the consent of the Dean of the Faculty, the practice can be classified on the basis of the certification of student's professional work.

STUDENT'S WORKLOAD:

375 hours of practice undertaken in the months of July, August and September. In justified cases, after the consent of the Dean of the Faculty, the practice may take place in another month.

BASIC LITERATURE:

COMPLEMENTARY LITERATURE:

NOTICES: