IT SYSTEMS IN MEDICINE

Course code: 6.9-WM-IB-S2-EP-001_13
6.9-WM-IB-N2-EP-001_13

Type of course: Compulsory

Language of instruction: Polish

Director of studies: dr inż. Marek Kowal

Name of lecturer: dr inż. Marek Kowal,
dr inż. Piotr Mróz

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	II	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	3	II	Grade	
Laboratory	18	3		Grade	

COURSE AIMS:

- development of skills in the creation and management of medical databases

- familiarize students with the architecture of IT systems supporting the work of the hospital, developing the ability to design and implement the IT system in healthcare.

- familiarize students with advanced computer systems that support diagnosis and treatment, development of skills in the implementation and maintenance of diagnostic and therapeutic equipment.

PREREQUISITES:

medical imaging techniques, digital signal processing, automated medical diagnosis systems

COURSE CONTENTS:

Databases in medicine. Modeling data structures using entity relationship diagrams. Database management systems. Basics of SQL language. Creating and editing data

structures in databases. The electronic patient records. Security challenges of electronic medical records.

IT systems to support the work of healthcare. Integrated hospital information system. Picture archiving and communication system. The standards and protocols used for the transmission and storage of medical data. Integration of medical systems. Implementation of IT systems in healthcare.

Diagnostic and therapeutic computer systems. Electrodiagnostics and medical imaging systems. Therapeutic programmable devices. The standardization of diagnosis and therapy. Automation and support of diagnostic and therapeutic processes. Methods of implementation of electronic diagnostic and therapeutic systems.

TEACHING METHODS:

Lectures - conventional lecture, discussion

Laboratory - laboratory exercises, case studies

LEARNING OUTCOMES:

Field specific learning outcomes	Knowledge, skills, competence
K_W01, K_W04	The student can design and create a database and he knows and can apply security and safety procedures
K_W04	He can use the SQL query language
K_W14	The student can name and characterize elements of IT systems used to support the work of healthcare units
K_W14	The student can explain and describe DICOM i HL7 standards
K_U14	The student can develop the plan to implement IT system in healthcare
K_U17	The student can name and characterize selected electrodiagnostics and medical imaging systems
K_U21	The student is aware of the threats to computer systems for diagnosis and therapy
K_U23	The student knows procedures used for implementation of electronic medical systems

LEARNING OUTCOMES:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W01, K_W04, K_W14	The main condition to get a pass are positive grades in written tests conducted two times per semester
K_U14, K_U17, K_U21, K_U23	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 75 hours (3 ECTS), including contact hours 60 hours, preparing for classes 5 hours, reading literature 10 hours

Part-time studies

The student workload of 75 hours (3 ECTS), including contact hours 36 hours, preparing for classes 19 hours, reading literature 20 hours

RECOMMENDED READING:

1. Huang H. K.: *PACS and Imaging Informatics, John Willey & Sons*, New Jersey, 2010.
2. Pianykh O. S.: *Digital Imagine and Comunication in Medicine (DICOM)*, Springer, 2008.
3. Piętka E.: *Zintegrowany system informacyjny w pracy szpitala*, PWN 2004
4. Kącki E., Kulikowski J.L., Nowakowski A., Waniewski E. (red.): *Systemy komputerowe i teleinformatyczne w służbie zdrowia Tom 7*, Exit, 2003
5. Tadeusiewicz, R., Wajs ,W. (red): *Informatyka Medyczna*, Wydawnictwo AGH, Kraków, 1999
6. Rudowski R. (red): *Informatyka medyczna*, PWN, 2003
7. Roterman-Konieczna I.: *Elementy informatyki medycznej 1. Ścieżki kliniczne, wirtualny pacjent, telekonsultacje*, Wydawnictwo Uniwersytetu Jagiellońskiego, 2011.
8. Cieciura M., Olchowik W.: *Metody i narzędzia projektowania komputerowych systemów medycznych*, VIZJA PRESS&IT, 2009.
9. Cieciura M., Olchowik W.: *Modelowanie i zastosowanie komputerowych systemów medycznych,* VIZJA PRESS&IT, 2009.

OPTIONAL READING:

1. Drever K., Hirschorn D., Thrall J.H., Mehta A. (red): PACS: *A Guide to the Digital Revolution*, Springer, 2006.
2. Branstetter B. F. (red.): Practical *Imaging Informatics: Foundations and Applications for PACS Professionals*, Springer, 2009.

3. Cytowski J., Gielecki J., Gola A.: Cyfrowe *przetwarzanie obrazów medycznych. Algorytmy. Technologie. Zastosowania*, Exit, 2008.
4. Nałęcz, M. (red.): *Problemy biocybernetyki i inżynierii biomedycznej. Tom 6: Informatyka medyczna.* WKiŁ, Warszawa 1991.

REMARKS:

MEDICAL TELEMATICS

Course code:	6.9-WM-IB-S2-EP-002_13 6.9-WM-IB-N2-EP-002_13
Type of course:	eligible
Language of instruction:	Polish
Director of studies:	Doc. dr inż. Emil Michta
Name of lecturer:	Doc.dr inż. E.Michta; mgr inż. Dariusz Eljasz

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

COURSE AIMS:

- to familiarize students with the basics of ICT systems,
- to familiarize students with the standards and methods of the medical data exchange,
- formation of basic skills among students in the use of ICT systems in medical applications.

PREREQUISITES:

- has an elementary knowledge of the basics of information technology,
- knows and understands the basic mechanisms of the functioning of the exchange and storage of information in health care,
- 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:

ICT networks - wired and wireless. The technical basis of the Internet. Technologies and network protocols - basic definitions and terms. Characteristics of medical data. Data

exchange methods in medicine - the specification requirements and restrictions. Characteristics of preparation methods for exchange of medical data (conversion methods, compression and presentation of the text, signals, pictures, audio and video). Text data exchange standards (HL7) and imaging data exchange standards (DICOM). The integration of systems and networks in medicine. Ensuring the quality and security of data and services. Technical aspects of telediagnostics. Videoconferencing. Searching multimedia data based on their content. Remote Data Acquisition Systems and methods for automated medical diagnosis (eg tele-ECG, navigation for the blind).

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_W04	The student has extensive and in-depth knowledge of informatics, operational studies, numerical methods and computer networks useful to formulate and solve complex problems in the field of Biomedical Engineering	T2A_W01 T2A_W02
K_W07	The student has theoretically based and detailed knowledge of digital techniques, tele-consultations and medical teleconferences, medical images elaboration, and the knowledge about development trends and the latest achievements in the field of Telemedicine	T2A_W04 T2A_W05
Skills (U)		
K_U10	The student can select the proper modules and use the integrated information systems in telemedical services	T2A_U07
K_U14	The student can integrate knowledge of the various fields ie. informatics, biology, medical science and knows the rules associated with safety of medical data	T2A_U10

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	T2A_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	30 hours
Becoming familiar with indicated literature	15 hours
Preparation of reports	15 hours
Prepare for the exam	30 hours
Total:	150 hours = 6 ECTS

RECOMMENDED READING:

1. Kącki E., Kulikowski J.L., Nowakowski A., Waniewski E. (red.): Systemy komputerowe i teleinformatyczne w służbie zdrowia Tom 7, Exit, 2003.
2. Martyniak J. (red.): Podstawy informatyki i z elementami telemedycyny, Wydawnictwo Uniwersytetu Jagiellońskiego, Kraków, 2005.
3. Rotman-Konieczna I. (red): Elementy informatyki medycznej. Wydawnictwo Uniwersytetu Jagielońskiego, Kraków 2011.
4. Rudowski R. (red.): Informatyka medyczna, Wydawnictwo Naukowe PWN, Warszawa 2003.

OPTIONAL READING:

1. Zajdel R., Kęcki E., Szczepaniak P., Kurzyński M.: Kompendium informatyki medycznej, Alfa-Medica Press, 2003
2. Piętka E.: Zintegrowany system informacyjny w pracy szpitala, Wydawnictwo PWN, Warszawa 2004.

TISSUE AND GENETIC ENGINEERING

Course code: 6.9-WM-IB-S2-EP-004_13
6.9-WM-IB-N2-EP-004_13

Type of the course Major course

Language of instruction: Polish

Director of studies dr hab. Katarzyna Baldy-Chudzik

Name of lecturer dr hab. Katarzyna Baldy-Chudzik

Form of instruction	[illegible] 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	Grade	
Laboratory	15	1		Grade	
Part-time studies					
Lecture	18	2	I	Grade	
Laboratory	9	1		Grade	

COURSE AIMS:

The objective of the course is to get students acquainted with the possible utilisation of tissue engineering for the reconstruction of tissues and organs.

PREREQUISITES:

Student should have knowledge of biochemistry and biology of the cell required within the undergraduate studies program T2A.

COURSE CONTENTS:

Objectives and assumptions to tissue engineering. Cell and tissue cultures.

Phenomena at the interface of base material/biological systems (protein adsorption, cell adhesion, degradation). Methods of the interface phenomena examination and monitoring in the micro- and nano-scale. Base materials for tissue engineering. Physical, chemical and biological modification of base material surface. Modelling of microstructure and biological properties of materials. In vitro systems for growing tissues and organs. The conception of gene therapy. Enzymes and gene cloning. Construction and

analysis of a recombinant DNA. Analysis and cloning of eukaryotic DNA. Oligonucleotide probe designation. Detection and analysis of cloned gene products.

TEACHING METHODS:

1. Feeding method – Lecture in the form of a multimedia presentation

2. Practical method – laboratory classes - based on the lecturer's talks and tasks performed by students individually, according to the delivered instruction in a laboratory.

LEARNING outcomes:

In the field of technical sciences	Knowledge, skills, competence
K_W10	The student has the knowledge about the development trends and the latest achievements in the field of the studied and related sciences; of basic methods, techniques, tools and materials used in solving complex engineering tasks within the studied science.
K_U01, K_U02	The student can – while formulating and solving engineering tasks – integrate knowledge of the fields of science and scientific disciplines relevant to the studied discipline and apply a systemic approach taking into account the non-technical aspects
K_U17, 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_W10	Grade based on written test. 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_U01, K_U02, K_U17, K_K02	Grade based on laboratory classes. A passing grade in laboratory part comprises positive evaluation of reports based on each laboratory class and final test summarizing the laboratory program, attendance and initiative on the part of the student.

Verification of learning outcomes methods and credit conditions:

Laboratory: evaluation of reports of the carried out experiments; a final test summarizing the course program including constructing a simple scheme of an experiment within a narrow range of problems selected among the subjects included in the lecture program; The credit for the laboratory is granted after all experiments to be realised under the laboratory program are performed and the reports are positively evaluated. The written test in the form of 3-5 open questions, a positive mark above 50% of scored points. The final grade received by the student is the arithmetic mean of the above grades.

Lecture: condition of obtaining credit points is to get positive results from the written final test. The written test is conducted in the form of 10 open questions, a positive mark above 60% of scored points.

STUDENT'S WORKLOAD:

FULL-TIME STUDIES:

The determined student workload of 150 hours (6 ECTS) include the workload of the direct assistance of the academic teacher (the contact hours): lectures - 30 hours, the practical classes workload- 15 hours, the consultations -30 hours, final test – 2 hours and the unassisted student work: the teamwork study preparations of the given issue (10 hours),work with literature (15 hours), preparations of reports (20 hours) and revising for test summarizing the laboratory program (20 hours) and final test (10 hours).

RECOMMENDED READING:

1. Alberts B. et al. Molecular Biology of the Cell Academic Press, 1994;
2. Kłyszejko-Stefanowicz l. , Cytobiochemia PWN,1995;
3. Lanza, R.P., Langner, R., Chick. W.L. Principles of tissue engineering. Academic Press 2000;
4. Nałęcz, M. Biocybernetyka i inżynieria biomedyczna. Tom 3: Sztuczne narządy. Akademicka Oficyna Wydawnicza Exit 2000.

REMARKS:

BIOMATERIALS AND TISSUES RESEARCH METHODS

Course code: 6.9-WM-IB-S2-EP-005_13
6.9-WM-IB-N2-EP-005_13

Type of course: optional

Language of instruction: Polish

Director of studies: Elżbieta Krasicka-Cydzik, Prof

Name of lecturer: dr hab. inż. Elżbieta Krasicka-Cydzik, prof.UZ
dr inż. Izabela Głazowska,
dr inż. Agnieszka Kierzkowska,
dr inż. Ryszard Gorockiewicz,
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					6
Lecture	30	2	I	Exam	
Laboratory	15	1		Grade	
Part-time studies					
Lecture	18	2	I	Exam	
Laboratory	9	1		Grade	

COURSE AIM:

The aim of this course to learn how to use the methods of research of biomaterials and tissue in the biomedical engineering.

PREREQUISITES:

Chemistry, Biochemistry, Biomaterials, Biophysics at the first level of studies.

COURSE CONTENTS:

Lecture content: The physical and mechanical properties of biomaterials and tissue research methods: static, ultrasonic, cyclic fatigue (creep, hardness, abrasion). Microstructure research methods: optical, electron, scanning and transmission microscopy, X-ray diffraction. Research methods for biomaterial surfaces (hydrophilic-

hydrophobic properties, zeta potential, isoelectric point), photoelectron spectroscopy, atomic force microscopy, tunneling microscopy, infrared spectroscopy. The study of biomaterials in a simulated biological environment. Extract chemical research. Tracking biodegradable.

Laboratory content. X-ray diffraction x2. The mechanical properties study (roughness, abrasion). The surface layer impedance method study x2. Wetting angle measurement. Biomaterials hardness and microhardness study. Porosity study. Morphology, topography and metallic and ceramic biomaterials chemical composition study with the scanning microscope usage.

TEACHING METHODS:

Lecture: Regular lecture

Laboratory: Laboratory classes.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence.
K_W03	The student has extensive and in-depth knowledge of chemistry, biochemistry and chemistry of metallurgical processes useful to formulate and solve complex problems in the field of Biomedical Engineering.
K_W06	The student has an ordered and theoretically based knowledge of biological and medical phenomena simulation, and the knowledge about development trends and the latest most important achievements in the field of Biomedical Engineering
K_W10	The student has theoretically based and detailed knowledge of testing methods of biomaterials and tissues
K_U01	The student can - in formulating and solving engineering tasks - integrate knowledge of chemistry, physics, biochemistry, biophysics, biomaterials and apply a systemic approach, taking into account the non-technical aspects of issues related to biomaterials.
K_U04	The student can prepare, record and elaborate in written form, also in English, issues of technical science and scientific disciplines specific to the field of Biomedical Engineering, presenting the results of his/her own studies.
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:

In the field of technical sciences	The learning outcome assessment method.
K_W03, K_W06, K_W10, K_K04	Exam in the form of the written test. A passing grade in the lecture part of the course is determined by positive grade for written answers about the theoretical aspects of the subject.
K_U01, K_U04, K_K03	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.

Lecture: A test with final grade.

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

STUDENT WORKLOAD:

Full-time studies: The student workload of 150 hours (6 ECTS), including work in the auditorium 45 hours, exam 5 hours, preparing for classes 25 hours, preparing for exam 25 hours, preparing for test 20 hours, preparing of control work and reports 15 hours, reading the subject literature 15 hours.

Part-time studies: The student workload of 150 hours (6 ECTS), including work in the auditorium 27 hours, preparing for classes 43 hours, preparing for exam 30 hours, preparing for test 20 hours, preparing of control work and reports 20 hours, reading the subject literature 10 hours.

RECOMMENDED READING:

1. Craig R.G.: Materiały stomatologiczne, (red. wydania pierwszego polskiego: Shaw H., Shaw J.G.), Wydawnictwo Urban & Partner, Wrocław 2008.
2. Dobrzański L.: Wprowadzenie do nauki o materiałach, Gliwice 2007.
3. Gzik M.: Biomechanika kręgosłupa człowieka, Gliwice 2007.
4. Marciniak J.: Biomateriały, Wyd. Politechniki Śląskiej, Gliwice 2002.
5. Marciniak J., Chrzanowski W., Kaizer A.: Gwoździowanie śródszpikowe w osteosyntezie, Gliwice 2008.

6. Marciniak J., Kaczmarek M., Ziębowicz A.: Biomateriały w stomatologii, Gliwice 2008.

OPTIONAL READING:

1. Shi D. (Ed.), Biomaterials and Tissue Engineering, Springer-Verlag, Berlin Heidelberg 2004, ISSN 1618-7210, ISBN 3-540-22203-0
2. Tofail Syed A.M. (Ed.), Biological Interactions with Surface Charge in Biomaterials, RSC Publishing, 2012, ISBN 978-1-84973-185-0

REHABILITATION ENGINEERING

Course code: 6.9-WM-IB-S2-EP-006_13
6.9-WM-IB-N2-EP-006_13

Type of course: compulsory

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					3
Lecture	30	2		Grade	
Laboratory	15	1		Grade	
Project	15	1		Grade	
Part-time studies					
Lecture	18	2		Grade	
Laboratory	9	1		Grade	
Project	9	1		Grade	

COURSE AIM:

The purpose of course is to gain the ability to design and use of prosthetic, orthopedic devices and other equipment to support of rehabilitation.

PREREQUISITES:

[Kliknij i wpisz wymagania wstępne]

COURSE CONTENTS:

Lecture: Biomedical Engineering in rehabilitation. Fundamentals of rehabilitation engineering. Analysis, evaluation of human motion and gait. Fundamentals of Kinesiotherapy. Orthopedic equipment for upper and lower limbs (ortozy, dentures) and

spine. Modern technology support of functions of damaged limbs - bioprosthesis, functional electrical stimulation - stimulation devices. Wheelchairs. Introduction to physical medicine. Mechanotherapy (methods of immobilization, lifts, hearing rehabilitation, orthopedic footwear).

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.

Laboratory:

Topics laboratory exercises:

a) Exercises performed together for the whole group:

1. Determination of center of gravity
2. Kinetic analysis of the knee
3. Determination of mobility biokinematic systems
4. Analysis of gait phases based on video recording

b) Exercises performed in subgroups:

5. Drills selected muscle groups
6. Analysis of the balance of power in the upper limb muscle
7. Modeling of lower limb during the squat
8. Modeling of activity of muscles during exercise
9. Analysis of activity of muscles during exercise using EMG method
10. The term ownership of rehabilitation exercises on the machine ORBITRACK
11. Analysis of the balance on the stabilometric platform.
12. Diagnostic evaluation of the patient
13. Diagnosis of spine

Among the topics are selected six performed during laboratory classes. On the basis of practice is carried out a report which is evaluated. The reports is evaluated in term of the analysis of the results and conclusions. To obtain an assessment of the laboratory is to perform all the exercises to be performed.

TEACHING METHODS:

Conventional lecture, discussion, and research of the source document, teamwork during the execution of the project, taking laboratory exercises accordance with the instructions.

LEARNING OUTCOMES:

Field specific learning outcomes	Knowledge, skills, competence
K_W08	Has knowledge of the typical equipment used in the process of rehabilitation
K_W18	Has knowledge of rehabilitation equipment recycling
K_W20	Has background knowledge necessary to understand the social, economic, legal and other non-technical considerations engineering activities and their integration in engineering practice.
K_W22	Has a basic knowledge of industrial property protection on rehabilitation equipment
K_U07	Able to find and discuss the principle of rehabilitation equipment for the assumed destiny
K_U10	Able to use a terminology associated with the issue of rehabilitation in English.
K_U14	Able to select and use appropriate equipment and apparatus for selected rehabilitation methods
K_U20	Able to design complex biomechanical system including materials selection
K_K07	Has knowledge of the importance of technical measures in the lives of people with disabilities

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The reference to the effects of field of study	The method of the learning outcomes assessment
K_W08, K_W18,	Grading of the lecture The pass of the lecture is to provide a positive evaluation of the test.

K_W20, K_W22	
K_U20	Grading of the project 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_U07, K_U10, K_U14, K_K07	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: credit with a grade

Laboratory: Grading (subject to completion of the project is the implementation and adoption by the operator of the project).

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 calculating according equation:

Eval=0.2*Lecture+0.3*Laboratory+0.5*Project

STUDENT WORKLOAD:

The student workload is 75 hours (3 credits), including contact hours: 60 hours, preparation for classes: 15 hours.

RECOMMENDED READING:

1. Biomechanika i Inżynieria Rehabilitacji, Tom 5.
2. T. Bober, J. Zawadzki, Biomechanika układu ruchu człowieka.
3. C. Ross Ethier, Craig A. Simmons, Introductory Biomechanics.
4. Romuald Będziński, Biomechanika Inżynierska, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1997
5. Poradnik rehabilitanta.
6. B. Kolster, G. Ebelt-Paprotny Poradnik fizjoterapeuty, Osolineum, 1996
7. Borkowska M. (red): ABC rehabilitacji dzieci. Najczęstsze schorzenia narządu ruchu. Wyd. Pelikan, Warszawa 1989.
8. Bruhl W. : Zarys reumatologii. PZWL, Warszawa 1987.
9. Dega., Senger A.: Ortopedia i rehabilitacja. PZWL, Warszawa 1996
10. Dega W., Milanowska K.: Rehabilitacja medyczna. PZWL, Warszawa 1993

OPTIONAL READING:

1. KiwerskiJ., Kowalski M., Krasuski M.: Schorzenia i urazy kręgosłupa. PZWL, Warszawa 1997
2. Kuch J.: Rehabilitacja. PZWL, Warszawa 1989
3. Larkowa H.: Człowiek niepełnosprawny – problemy psychologiczne. PWN, Warszawa 1987
4. Larkowa H.: Postawy otoczenia wobec osób niepełnosprawnych. PZWL, Warszawa 1970Podobnie postępuj w przypadku kolejnych pozycji bibliograficznych literatury podstawowej wciskając [Enter]. Pamiętaj o kolejności: autor, tytuł, wydawnictwo, miejsce, rok wydania! Przed wciśnięciem [Enter] skasuj ukryty tekst: „Podobnie …”.
5. Dziak A.: Ćwiczenia usprawniające w uszkodzeniach kości i stawów. PZWL, Warszawa 1990
6. Encyklopedyczny Słownik Rehabilitacji, 1986
7. Grochmal S., Zielińska- Chrzanowska S.: Rehabilitacja w chorobach układu nerwowego. PZWL, Warszawa 1986
8. Hulek A. (red.): Człowiek niepełnosprawny w społeczeństwie. PZWL, Warszawa 1986
9. Kaliszewski J.: Rehabilitacja w klinice chorób wewnętrznych.PZWL, Warszawa 1974

FUNDAMENTALS OF GENETICS

Course code: 6.9-WM-IB-S2-EP-007_13
6.9-WM-IB-N2-EP-007_13

Type of the course: Major course

Language of instruction: Polish

Director of studies: dr hab. Katarzyna Baldy-Chudzik

Name of lecturer: dr hab. Katarzyna Baldy-Chudzik, dr Ewa Bok

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

COURSE AIMS:

The objective of the course is to get students acquainted with basic laws of inheritanceand basic knowledge of the structure and function of genetic material.

PREREQUISITES:

Student should posses basic knowledge of biochemistry, biology of a cell required within the undergraduate studies program.

COURSE CONTENTS:

Watson and Crick's model of DNA and genetic material functioning. The chemical nature of polynucleotides.Organization of genetic material in Procaryota and Eucaryota. Replication and recombination. The basic mechanism of DNA synthesis. The mechanism of recombination and different forms of recombination. The fundamentals of transcription. The detailed mechanism of transcription. Specific DNA-protein interactions. Translation. The relationship between genes and proteins. Ribosomes: protein synthesis machines. Functions of ribosomal proteins,tRNA: the adapter molecule. The genetic code. Mechanism of translation.Chromosomal theory of inheritance. Mendel laws, mitosis and meiosis. Exceptions from Mendel law: semidominance, codominance, lethal genes, gene epistasis, maternal inheritance. Sex linked genes.Genetic chromosomal maps and linkage groups conception.Gene mutation and inborn error in metabolism.Point and genomic mutation.Mobile genetic elements.

TEACHING METHODS:

1. Feeding method - Lecture in the form of a multimedia presentation

2. Practical method – laboratory classes-based on the lecturer's talks and tasks performed by students individually, according to the delivered instruction in a laboratory.

COURSE OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W05	The student hasthe knowledge about development trends and the latest most importantachievements in the field of Biomedical Engineeringand related sciences; of basic methods, techniques, tools and materials used in solving complex engineering tasks within the studied science.
K_W06	The studenthas an ordered and theoretically based knowledge ofbiological and medical phenomena simulation.
K_U01	The student can–while formulatingand solvingengineering tasks–integrateknowledge of thefields of science andscientific disciplinesrelevant tothe studied disciplineand applya systemic approach taking into account thenon-technicalaspects
K_U14	The student canintegrateknowledge of the various fields ie. informatics, biology, medical science and knows the rulesassociated with safety of medical data
K_U15	The student canformulate andtest hypothesesrelated toengineeringproblemsand simpleresearchproblems relevant to Biomedical Engineering
K_K02	The student is aware ofand understands theimportanceand impact ofnon-technicalaspectsof engineering, including its impacton the environment,and theresponsibility 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_W05, K_W06, K_K02	Exam based on written test. 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_U01, K_U14, K_U15	Grade based on laboratory classes. A passing grade in laboratory part comprises positive evaluation of reports based on each laboratory class and final test summarizing the laboratory program, attendance and initiative on the part of the student.

Verification of learning outcomes methods and credit conditions:

Laboratory:evaluation of reports of the carried out experiments; a final test summarizing the laboratory program. The credit for the laboratory is granted after all experiments to be realised under the laboratory program are performed and the reports and a final test are positively evaluated. The written test in the form of 3-5 open questions, a positive mark above 50% of scored points.The final grade received by the student is the arithmetic mean of the above grades.

Lecture: condition of obtaining credit points is to get positive results from the written examination test. The written test is conducted in the form of 6 open questions, a positive mark above 60% of scored points.

STUDENT'S WORKLOAD:

FULL-TIME STUDIES:

The determined student workload of 152 hours (6 ECTS) include the workload of the direct assistance of the academic teacher (the contact hours): lectures - 30hours, the practical classes workload- 30 hours, the consultations -30 hours, final exam – 2 hours and the unassisted student work: the teamwork study preparations of the given issue (20 hours), preparations of reports (10 hours) and revising for test summarizing the laboratory program (20 hours) and examination test (8 hours).

PART-TIME STUDIES:

The determined student workload of 150 hours (6 ECTS) include the workload of the direct

assistance of the academic teacher (the contact hours): lectures - 18 hours, the practical classes workload- 18 hours, the consultations -54 hours, final exam – 2 hours and the unassisted student work: the teamwork study preparations of the given issue (10 hours), preparations of reports (10 hours), work with literature (10) and revising for summarizing test (10 hours) and examination test (30 hours).

RECOMMENDED READING:

Gajewski W., Genetyka ogólna i molekularna , PWN,1999

Lewiński W., Genetyka dla kandydatów na Akademie Medyczne i Uniwersytety, PWN, 2000

Brown T. A., Genomy, PWN, 2005

Turner P. C., Krótkie wykłady- Genetyka, PWN, 2001

Lewiński W.: Genetyka Wyd. trzecie. Wydawn. ”Operon” ,Rumia 2001;

OPTIONAL READING:

3. Jones S.: Język genów. Biologia, historia i przyszłość ewolucji. Wydawn.”Książka i Wiedza”,W-wa 1998;
4. Dawkins R.: Samolubny gen. Prószyński i Sp-ka,W-wa 1996.
5. Weaver R. F., P.W. Hedrick: Genetics, WCB Publishers Third edition 1999.

REMARKS:

MICROBIOLOGY AND ELEMENTS OF IMMUNOLOGY

Course code: 6.9-WM-IB-S2-EP-008_13
6.9-WM-IB-S2-EP-008_13

Type of the course: Major course

Language of instruction: Polish

Tutor: dr hab. Katarzyna Baldy-Chudzik

Teacher: dr hab. Katarzyna Baldy-Chudzik, mgr Justyna Mazurek

Form of instruction	[illegible] 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	
Part-time studies					
Lecture	18	1	II	Exam	
Laboratory	18	2		grade	

COURSE AIMS:

The objective of the course is to get students acquainted with general biology and physiology of microorganisms in terms of their effect on human organism.

PREREQUISITES:

Student should posses knowledge in biochemistry, biology of a cell required within the undergraduate studies program.

COURSE CONTENTS:

The position of microorganisms in the world of living organisms.The bacterial cell structure and function.Basic strategies of bacterial cell metabolism. Regulation of metabolism in bacteria. Mutual interactions between bacteria. Interrelations between microorganisms and human body. Human and animal pathogenic bacteria. Structure of a human immunological system. Lymphatic organs. The notion of an antigen. Non-specific immune response. Specific immune response. The humoral immune response. Cellular immune response.

Regulation of the immune response.

TEACHING METHODS:

1. Feeding method - Lecture in the form of a multimedia presentation

2. Practical method – laboratory classes- based on the lecturer's talks and tasks performed by students individually, according to the delivered instruction in a laboratory.

COURSE OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W06	The student has the knowledge about development trends and the latest most important achievements in the field of Biomedical Engineering and related sciences; of basic methods, techniques, tools and materials used in solving complex engineering tasks within the studied science.
K_U01	The student can – while formulating and solving engineering tasks – integrate knowledge of the fields of science and scientific disciplines relevant to the studied discipline and apply a systemic approach taking into account the non-technical aspects
K_U15	The student can formulate and test hypotheses related to engineering problems and simple research problems relevant to 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_W06	Grade based on written test. 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_U04, K_U15, K_K02	Grade based on laboratory classes. A passing grade in laboratory part comprises positive evaluation of reports based on each laboratory class and final test summarizing the laboratory program, attendance and initiative on the part of the student.

Verification of learning outcomes methods and credit conditions:

Laboratory: evaluation of reports of the carried out experiments; a final test summarizing the laboratory program. The credit for the laboratory is granted after all experiments to be realised under the laboratory program are performed and the reports and a final test are positively evaluated. The written test in the form of 3-5 open questions, a positive mark above 50% of scored points. The final grade received by the student is the arithmetic mean of the above grades.

Lecture: condition of obtaining credit points is to get positive results from the written test. The written test is conducted in the form of 10 open questions, a positive mark above 60% of scored points.

STUDENT WORKLOAD:

FULL-TIME STUDIES:

The determined student workload of 150 hours (6 ECTS) include the workload of the direct assistance of the academic teacher (the contact hours): lectures - 30 hours, the practical classes workload- 30 hours, the consultations -15 hours, final exam – 2 hours and the unassisted student work: the teamwork study preparations of the given issue (20 hours), preparations of reports (10 hours) and revising for test summarizing the laboratory program (15 hours) and final test (30 hours).

PART-TIME STUDIES:

The determined student workload of 150 hours (6 ECTS) include the workload of the direct assistance of the academic teacher (the contact hours): lectures - 18 hours, the practical classes workload- 18 hours, final exam – 2 hours and the unassisted student work: the teamwork study preparations of the given issue (52 hours), preparations of reports (15 hours), work with literature (15) and revising for summarizing test (10 hours) and final test (20 hours).

RECOMMENDED READING:

1. Kunicki-Goldfinger W. Życie bakterii. Wydawnictwo Naukowe PWN, Warszawa 1998 Collier L., Oxford J. Wirusologia – podręcznik dla studentów medycyny, stomatologii i mikrobiologii. Wyd. Lek. PZWL, Warszawa 1996
2. Schlegel H. Mikrobiologia ogólna. Wyd. Naukowe PWN, Warszawa 1996
3. Węgleński P. (red.). Genetyka Molekularna. Wyd. Naukowe PWN, Warszawa 1996
4. Gołąb J., Jakóbisiak M., Lasek W. (redaktorzy): Immunologia. Wyd. Naukowe PWN, Warszawa 2002
5. Jakóbisiak M. (red.). Immunologia. Wyd. Naukowe PWN, Warszawa 1998

FUNDAMENTALS OF GENETIC ENGINEERING

Course code: 6.9-WM-IB-S2-EP-009_13
6.9-WM-IB-S2-EP-009_13

Type of the course Major course

Language of instruction: Polish

Tutor dr hab. Katarzyna Baldy-Chudzik

Teacher dr hab. Katarzyna Baldy-Chudzik,
dr Ewa Bok

Form of instruction	Number of hours per semester	Number of hours per week	Semester	Form of assessment	ECTS points
Full-time studies					3
Lecture	30	2	III	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	III	Grade	
Laboratory	18	2		Grade	

COURSE AIMS:

The objective of the course is to get students acquainted with basic methods in nucleic acids research and basic genetic engineering techniques – bacterial transformation.

PREREQUISITES:

Student should posses basic knowledge of biochemistry, biology of a cell required within the undergraduate studies program.

COURSE CONTENTS:

Techniques of DNA and RNA analyses. Methods of DNA isolation from pro- and eukaryote cells.

Utilisation of restriction enzymes. Hybridisation of DNA-DNA. Multiplication of a DNA fragment – PCR reaction. DNA sequencing methods. Cloning in bacterial cells. Carriers of extraneous genes – vectors.

Identification of mutations and polymorphic modifications. Screening methods. Detecting known mutations.

Gene mapping and identification.

TEACHING METHODS:

1. Feeding method - Lecture in the form of a multimedia presentation

2. Practical method – laboratory classes- based on the lecturer's talks and tasks performed by students individually, according to the delivered instruction in a laboratory.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W05	The student has an ordered and theoretically based knowledge of biological and medical phenomena simulation.
K_W06	The student has the knowledge about development trends and the latest most important achievements in the field of Biomedical Engineering and related sciences; of basic methods, techniques, tools and materials used in solving complex engineering tasks within the studied science.
K_U01	The student can – while formulating and solving engineering tasks – integrate knowledge of the fields of science and scientific disciplines relevant to the studied discipline and apply a systemic approach taking into account the non-technical aspects
K_U14	The student can integrate knowledge of the various fields ie. informatics, biology, medical science and knows the rules associated with safety of medical data
K_U15	The student can formulate and test hypotheses related to engineering problems and simple research problems relevant to 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_W05, K_W06, K_K02	Grade based on written test. 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_U01, K_U14, K_U15	Grade based on laboratory classes. A passing grade in laboratory part comprises positive evaluation of reports based on each laboratory class and final test summarizing the laboratory program, attendance and initiative on the part of the student.

Verification of learning outcomes methods and credit conditions:

Laboratory: evaluation of reports of the carried out experiments; a final test summarizing the laboratory program. The credit for the laboratory is granted after all experiments to be realised under the laboratory program are performed and the reports are positively evaluated. The written test in the form of 3-5 open questions, a positive mark above 50% of scored points. The final grade received by the student is the arithmetic mean of the above grades.

Lecture: condition of obtaining credit points is to get positive results from the written test. The written test is conducted in the form of 10 open questions, a positive mark above 60% of scored points.

STUDENT'S WORKLOAD:

FULL-TIME STUDIES:

The determined student workload of 75 hours (3 ECTS) include the workload of the direct assistance of the academic teacher (the contact hours): lectures - 30 hours, the practical classes workload- 30 hours, the consultations -5 hours, the unassisted student work (5) revising for test summarizing the laboratory program (5 hours).

PART-TIME STUDIES:

The determined student workload of 75 hours (3 ECTS) include the workload of the direct assistance of the academic teacher (the contact hours): lectures - 18 hours, the practical classes workload- 18 hours, hours and the unassisted student work (29), work with literature (10)

RECOMMENDED READING:

1. Gajewski W., Genetyka ogólna i molekularna , PWN,1999

2. Lewiński W., Genetyka dla kandydatów na Akademie Medyczne i Uniwersytety, PWN, 2000
3. Brown T. A., Genomy, PWN, 2005
4. Turner P. C., Krótkie wykłady- Genetyka, PWN, 2001
5. Lewiński W.: Genetyka Wyd. trzecie. Wydawn. ”Operon” ,Rumia 2001;

OPTIONAL READING:

1. Jones S.: Język genów. Biologia, historia i przyszłość ewolucji. Wydawn.”Książka i Wiedza”,W-wa 1998;
2. Dawkins R.: Samolubny gen. Prószyński i Sp-ka,W-wa 1996.
3. Weaver R. F., P.W. Hedrick: Genetics, WCB Publishers Third edition 1999.

REMARKS:

CELL BIOLOGY

Course code: 6.9-WM-IB-S2-EP-010_13
6.9-WM-IB-N2-EP-010_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
Full-time studies					3
Lecture	30	2	III	Grade	
Laboratory	30	2		Grade	
Part-time studies					3
Lecture	18	2	III	Grade	
Laboratory	18	2		Grade	

COURSE AIMS:

The aim of education is to obtain the skills and competencies of student in understanding issues relating to the structure and molecular mechanisms of cell function. Using the basic techniques used in cell biology during preparation, quantitative and qualitative characteristic of sub-cellular structures and proteins.

PREREQUISITES:

Biology, biochemistry, biophysics and molecular biology course contents:

COURSE CONTENTS:

Lecture and laboratory. Methods in cell biology. Transport of small molecules through the membrane. Intracellular compartments and protein sorting. Vesicular transport,

endocytosis and exocytosis. Comunication extra- and intracellular.cell cycle and cell death.

TEACHING METHODS

Conventional lecture, discussion, working with the source paper, teamwork during the execution of laboratory exercises.

Conventional lecture, discussion, working with the source document, teamwork during the execution of laboratory exercises..

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
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_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.

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_W06	Exam based on written work. A pass of the lecture is to provide a positive mark of the test..
K_U01 K_K02	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.

STUDENT WORKLOAD:

Intramural studies:

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

Extramural studies:

The student workload of 75 hours (3 ECTS), including work in the auditorium 36 hours, , preparing of control work and reports 10 hours, preparing for classes 29 hours.

RECOMMENDED READING:

1. Biochemia, L. Stryer, wyd. V, PWN, Warszawa, 2005.
2. Podstawy Biologii Komórki - B. Alberts i inni, wyd. PWN, Warszawa, 1999r.
3. Molekularna organizacja komórki cz.1 pod red. J. Szopy, Wyd. Uniwersytetu Wrocławskiego, 1994remarks:

DESIGNING AND SELECTION OF MATERIALS

FOR MEDICAL USE

Course code: 6.9-WM-IB-S2-EP-011_13
6.9-WM-IB-N2-EP-011_13

Type of course: Optional

Language of instruction: Polish

Director of studies: Izabela Głazowska, PhD

Name of lecturer: Izabela Głazowska, PhD
Ryszard Gorockiewicz, PhD
Chrystian Klonecki-Olech, 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					4
Lecture	30	2	II	Exam	
Laboratory	30	2	II	Grade	
Part-time studies					
Lecture	18	2	II	Exam	
Laboratory	18	2	II	Grade	

COURSE AIMS:

The aim of the course is to learn the principles of design and materials selection in engineering design for medical devices intended to interact with biological systems in purpose of the treatment, diagnosis, improvement or replacement of partial or total living tissue, organ, or the fulfillment of their functions in the body, and to acquire the ability of designing and selection of materials for medical devices.

PREREQUISITES:

Bachelors Degree in Major: Biomedical Engineering or related (courses: Materials Science, Information Technology, Computer-aided Engineering Design (CAD), Biomaterials, mechanics and strength of materials, Biomechanics, Medical Devices Manufacturing Techniques).

COURSE CONTENTS:

Lecture content: Basic requirements for physical, chemical, mechanical and biological properties and limitations of the materials used for medical devices. Technological requirements of the state of the surface. Classic and contemporary materials, structural and functional materials: metal, polymer, ceramic, composite and carbon. Intelligent materials, shape memory alloys and nanomaterials. Planning and research selection. Design, manufacture, packaging materials for medicine. Methods for producing products made of materials with special properties (physical, chemical, mechanical, biological, electrical, biocompatibility). Products surface treatment. The procedures for the selection of materials - Ashby charts. Selection of materials including interdependencies that occur in the system: the function of the product - the material and its properties - the required shape - the technological process. Computer-aided design and selection of materials for medical devices – Grant's software: CES Selector. Verification of design tasks by MES method.

Laboratory content. Introduction to CES EduPack Exercise. Start with the CES Selector instruction - commands Browse, Search and Select – creating bar charts and bubble charts. Using the classification and characteristics of the materials and processes. Searching materials with specific properties and that meet specific operating conditions of a medical device - the limit method. The choice of materials formed by specific processes (casting, extrusion, injection molding, pressing). Tasks with solutions - based on M. Ashby-Exercises, Grant Design / Education). Using graphs to design a selection of sample materials for medical devices: hip prosthesis (knee), not cutting instruments for tooth extraction, surgical scalpel, rib bones scissors and other thin bones, implant (prosthesis) of the eye, intraocular lens, valve heart (anticoagulants), hernia mesh, stent, orthopedic lift the membrane in meters for testing blood pressure.

TEACHING METHODS:

Lectures with use of audiovisual aids. Group work in laboratory classes. Tasks with use of computer program Grant CES Selector, the choice of material in medical device engineering project.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence.
K_W03, K_W02, K_W01	The student has expanded knowledge of mathematics, physics chemistry and mechanics needed to describe the chemical, physical, mechanical and functional properties of structural and functional biomaterials.
K_W05, K_W10	Able to explain concepts related to material selection in engineering design (design stages, the functionality of the product, the manufacturing processes of products).
K_U16,	Knows how to characterize biomaterials research

K_W10, K_W05	methods.
K_W10	The student has theoretically based and detailed knowledge of materials degradation, advanced methods of materials, biomaterials and tissues testing, recent trends and the latest achievements in the field of biomaterials
K_W14	The student is familiar with the basic methods, techniques and tools used in materials selection for medical devices
K_U01	The student can obtain information from literature, databases and other carefully selected sources, in English or any other foreign language.
K_U05	The student can prepare and present an oral presentation concerning specific issues of the field of materials selection for medical devices.
K_U12	Able to plan and carry out computer simulations in the field of materials selection, can use analytical and experimental methods in engineering design.
K_U09	Can use information and communication technologies for the project product.
K_U01	Able to interpret the results of the measurements, make a critical evaluation, fully formulate conclusions.
K_U19	The student can evaluate the primary cost of engineering projects and make a preliminary economic analysis of undertaken engineering activities.
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_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:

In the field of technical sciences	The learning outcome assessment method.
K_W01, K_W02, K_W03, K_W05, K_W10, K_W14	Exam in the form of the written test and oral examination 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_U01, K_U05, K_U09, K_U12, K_U16, K_U19, K_K02, K_K03, K_K04	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.

An oral examination- presentation of the project.

Laboratory – To pass student needs to get positive grades from all the laboratory exercises within the laboratory program (tasks, preliminary design of a medical device).

STUDENT WORKLOAD:

Full-time studies: The student workload of 100 hours (4 ECTS), including work in the auditorium 60 hours, exam 2 hours, preparing for classes 13 hours, preparing for test 10 hours, preparing of control work and reports 10 hours, reading the subject literature 5 hours.

Part-time studies: The student workload of 100 hours (4 ECTS), including work in the auditorium 36 hours, preparing for classes 29 hours, preparing for exam 15 hours, preparing of control work and reports 10 hours, reading the subject literature 10 hours.

RECOMMENDED READING:

1. Biomateriały, Tom 4, pod red. S. Błażewicz, Biocybernetyka i inżynieria biomedyczna, 2003, red. M. Nałęcz, Akademicka Oficyna Wydawnicza EXIT, 2003;
2. J. Marciniak, Biomateriały, Wydawnictwo Politechniki Śląskiej, Gliwice 2002.
3. M.F. Ashby, Dobór materiałów w projektowaniu inżynierskim, Pergamon Press, Oxford 1998
4. Michael F. Ashby, Materials Selection in Mechanical Design, 4-te wydanie, 2010
5. Materials Selection Granta CES Selector 2012, Cambridge.

STABILITY OF BIOMATERIALS

Course code: 6.9-WM-IB-S2-EP-012_13
6.9-WM-IB-N2-EP-012_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, dr inż. Izabela Głazowska, dr inż. A.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 studies					4
Lecture	30	2	II	Exam	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	II	Exam	
Laboratory	18	2		Grade	

COURSE AIMS:

The aim is to familiarize students with the phenomena of degradation of biomaterials under the mechanical and corrosion factors in a biological environment (in vitro and in vivo), as well as issues biotribology

PREREQUISITES:

Biomaterials. Biochemistry. Materials Science, Electrochemistry.

COURSE CONTENT:

Degradation and biodegradation of materials, biodegradable materials, characterization of bio-degradation mechanisms under mechanical, environmental, and combined effects of corrosion and stress. Degradation of implants in simulated biological media. Research biomaterial contact with biological tissue, the response (reaction) of biological tissues to biomaterials, biomaterial response to a living organism, biomaterials testing (biocompatibility, implant testing, strength, abrasive wear, degradation, corrosion).

Processes (friction, wear) occurring in the mobile interface of the implant-tissue (elbow, knee, hip) - biotribology. Tissues reaction to degradation products of biomaterials.

TEACHING METHODS:

Lectures with audiovisual aids. Use of other teaching materials from the substantive scope of the subject. During the laboratory classes - work in teams.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W01, K_W02, K_W03	The student has extended knowledge of mathematics, physics, chemistry, mechanics, useful to describe the chemical, physical, mechanical and functional properties of structural and functional biomaterials
K_W10	The student has detailed knowledge in terms of strength of materials, methods of testing of biomaterials and tissue and about development trends and new achievements in the field of biomaterials
K_U08	The student can explain concepts related to the choice of materials in engineering design (design stages, the functionality of the product, the manufacturing processes of products)
K_U11	The student is able to characterize biomaterials research methods

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, K_W02, K_W03,	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_W10	
K_U08, K_U11	Grade based on laboratory classes. A passing grade in laboratory part comprises positive evaluation of reports based on each laboratory classes.

Lecture: Exam

Laboratory: Grade (A passing grade in laboratory part comprises positive evaluation of reports based on each laboratory classes).

STUDENT WORKLOAD:

Full-time studies

The student workload of 100 hours (4 ECTS), including contact hours: 60 hours, consultations: 10 hours, exam: 2 hours, preparing for classes: 8 hours, preparing for test: 10 hours, preparing the reports, etc.:5 hours, familiarization with literature sources*: 5* hours

Part-time studies

The student workload of 100 hours (4 ECTS), including contact hours: 36 hours, consultations: 30 hours, exam: 2 hours, preparing for classes: 12 hours, preparing for test: 10 hours, preparing the reports, etc.:5 hours, familiarization with literature sources*: 5* hours

RECOMMENDED READING:

1. Biocybernetyka i inżynieria biomedyczna 2000 pod red. M. Nałęcza, tom 4 Biomateriały, Exit 2003
2. Marciniak J. : Biomateriały, Wyd. Politechniki Śląskiej, Gliwice 2002,
3. Norma ISO 10993, Biologiczna ocena wyrobów medycznych
4. Marciniak J., Kaczmarek M., Ziębowicz A.: Biomateriały w stomatologii, Gliwice 2008.
5. Galus Z. Teoretyczne podstawy elektroanalizy chemicznej , PWN Warszawa
6. Jiri Koryta, Jiri Dvorak, Vlasta Bohackowa, Elektrochemia, PWN, Warszawa 1980.
7. A.J.Bard and L.R. Faulkner, Electrochemical Methods, Wiley, New York 1980
8. L. Dobrzański, A. Hajduczek, Mikroskopia optyczna i elektronowa, WNT, 1987.

OPTIONAL READING:

1. Farmakopea Europejska , Polska Ustawa Farmaceutyczna

METHODS OF EVALUATION AND ASSESSMENT OF BIOMECHANICAL SYSTEMS

Course code: 6.9-WM-IB-S2-EP-013_13
6.9-WM-IB-N2-EP-013_13

Type of course: optional

Language of instruction: Polish

Director of studies: Dr inż. Krzysztof Białas-Heltowski

Name of lecturer: Dr inż. Agnieszka Kierzkowska
Dr inż. Tomasz Klekiel

Classes type	Number of hours per semester	Number of hours per week	Semester	Form of the credit	ECTS points
Full-time study					2
Lecture	30	2	II	Grade	
Laboratory	30	2		Grade	
Part-time study					
Lecture	18	2	II	Grade	
Laboratory	18	2		Grade	

COURSE AIMS:

The aim of the course is to acquire knowledge and practical skills in the field of modeling and biomechanical systems evaluation methods used in the design and research work.

PREREQUISITES:

Basic knowledge of the biomechanics engineering, designing the biomechanical systems.

COURSE CONTENTS:

Lecture:

Basic issues of biomechanics engineering, components, properties and functions of the passive and the active human motor system. Elements of the implantology and rehabilitation; discussion of medical devices (devices for rehabilitation, implants, prostheses, surgical instruments, etc.) in the context of the assigned functions. Overview of research methods to assess the suitability of a medical device. Engineering,

bioengineering, biological, clinical studies. *In vitro* and *in vivo* studies. The requirements for medical devices, classification. Criteria for evaluation. Regulatory directives and guidelines. Safety and risk analysis. Diagnostic devices and apparatus, and research and measurement apparatus. Construction and operation. Measurement Research Laboratory. Guidelines for conducting the experiment, method of the results assessment.

Laboratory:

In vitro studies using implant materials and bone specimens. Engineering-simulation research. Research of the state and properties of implant materials (metallic and non-metallic) surface, roughness and microhardness/hardness, biotribological properties of node connections, corrosion resistance, surface quality (scanning microscopy). Selected strength tests of selected biomaterials and tissues. Development of the selected methodology. Development of risk analysis for a selected product for use in therapy/rehabilitation.

TEACHING METHODS:

Transmission of the contents of lectures using multimedia presentations, and other didactic materials from the substantial range of the course.

During the laboratory classes – work in teams realizing the subject from the subject list, which is specified at the beginning of the semester.

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 or oral form.

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 60(50) hours, including: participation in the lecture 30 (18) and lab – 30 (18) hours, (14 hours- literature review)

RECOMMENDED READING::

1. Praca zbiorowa pod red. M. Nałęcza: Biomechanika i Inżyniera Rehabilitacyjna, EXIT, Warszawa 2004.
2. T. Bober T., J. Zawadzki: Biomechanika układu ruchu człowieka, Wydawnictwo BK, Wrocław 2006.
3. J. W. Błaszczyk: Biomechanika kliniczna, PWWL, Warszawa, 2004.
4. R. Będziński: Biomechanika Inżynierska, Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 1997.
5. C. Ross Ethier, Craig A. Simmons: Introductory Biomechanics, Cambridge University Press, 2008.

OPTIONAL READING:

1. Normu ASTM, ISO-PN.
2. Czasopisma branżowe, np. Acta of Bioengineering and Biomechanics, Engineering of Biomaterials.

REMARKS:

Information in parentheses are related to part-time study.

ENGINEERING ISSUES IN MEDICINE

Course code: 6.9-WM-IB-S2-EP-014_13
6.9-WM-IB-N2-EP-014_13

Type of course: optional

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					
Lecture	30	2	II	Grade	2
Laboratory	30	2		Grade	

COURSE AIMS:

The aim of the course is introducing the students into chosen enginnering issues in the range of medicine and gaining skills of solving of simple engineering problems concerning the field of medicine using modern computer methods and tools.

PREREQUISITES:

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COURSE CONTENTS:

Lecture:

Statistical analysis in medicine (e.g. correlation analysis, regression analysis, veryfication of statistical hypotheses, statistical report). Cluster analysis (hierarchical and non-hierarchical algorithms). Design of experiments (2-level, 3-level, multi-level, optimal). Quality of product/process (morphological analysis, FMEA, QFD). Finite Elements Method. Methods of Artificial Intelligence (genetic/evolution algorithms, neural networks, immunological systems). Optimisation/Multicritreria optimisation.

Laboratory:

Statistical analysis of given data using Statistica 8 software. Cluster analysis of given data using Statistica 8. Design of experiments for selected tasks using Statistica 8. Morphological,

FMEA and QFD analysis of chosen examples. FEM of selected object, e.g. implant. Applaying of GA/EA for searching of solutions in the case of multicriteria optimisation.

TEACHING METHODS:

Lecture: presentations using multimedia techniques. Laboratory: during meetings working individually or in groups using computers/software (Statistica, Mechanical). After the meeting students prepare reports with analysed results.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W14	The student is familiar with the basic methods, techniques, tools and materials used in solving engineering tasks in the field of Biomedical Engineering (also quality management).
K_U01	The student can obtain information from literature, databases and other carefully selected sources in the field of Biomedical Engineering; can integrate the information, make its interpretation and critical evaluation, draw conclusions and formulate and fully justify opinions.
K_U05	The student can prepare and present an oral presentation concerning specific issues of the field of Biomedical Engineering can determine the direction of their further education and provide self-directed education.
K_U09	The student can use information and communication technologies required to calculate, carry out simulation, design purposes (experiments) and verify engineering tasks in the field of Biomedical Engineering.
K_U15	The student can formulate and test (statistically) hypotheses related to engineering problems and simple research problems relevant to Biomedical Engineering.
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_W14	Lecture ends with grade. The final grades in full-time and part-time studies systems is based on the grade of colloquium.
K_U01, K_U05, K_U09, K_U15, K_K03	Laboratory ends with grade. The final grade is arithmetic average of all partial grades being results of reports of realizing tasks.

STUDENT WORKLOAD:

Full-time studies: contact hours (lecture) – 30 hours – 1 ECTS. Contact hours (laboratory) – 30 hours – 1 ECTS.

RECOMMENDED READING:

1. King M.R., Mody N.A., Numerical and statistical methods for bioengineering, 2011
2. Rakowski G., Kacprzyk Z., MES w mechanice konstrukcji, Warszawa, 2005
3. Proctor T., Twórcze rozwiązywanie problemów, Gdańsk, 2003
4. Michalewicz Z., Algorytmy genetyczne + struktury danych = programy ewolucyjne, WNT, Warszawa, 2003
5. Gach D., Wykorzystanie analizy morfologicznej w rozwiązywaniu problemów, QnowHow.pl, 2005
6. Osowski O., Sieci neuronowe w ujęciu algorytmicznym, WNT, Warszawa, 1997
7. Myszewski J.M., a.. b.. c.. FMEA (Analiza przyczyn i skutków wad), Warszawa, 1995
8. Atkinson A.C., Donev A.N., Optimum experimental designs, Oxford, 1992
9. Mańczak K., Technika planowania eksperymentu, WNT, Warszawa, 1976
10. Polański Z., Planowanie doświadczeń w technice, PWN, Warszawa, 1984

OPTIONAL READING:

1. Zdanowicz R., Kost G., Wykorzystanie metody FMEA do poprawy jakości produktów, „Problemy jakości" nr 7/2001
2. Goldberg D.E., Algorytmy genetyczne i ich zastosowania, WNT, Warszawa, 1995
3. Dacko M., Borkowski W., Dobrociński S., Niezgoda T., Wieczorek M., Metoda elementów skończonych w mechanice konstrukcji, Warszawa, 1994
4. Martyniak Z., Wstęp do inwentyki, Kraków, 1997
5. Mańczak K., Metody identyfikacji wielowymiarowych obiektów sterowania, WNT, warszawa, 1979
6. Kasprzycki B.L., Planowanie eksperymentu. Podstawy matematyczne, WNT, Warszawa, 1976

REMARKS:

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DIGITAL IMAGE PROCESSING TECHNIQUES FOR MEDICAL IMAGES

Course code: 6.9-WM-IB-S2-EP-015_13
6.9 –WM -IB-N2-EP-015_13

Type of course: Optional

Language of instruction: Polish

Director of studies: dr inż. Krzysztof Sozański

Name of lecturer: dr inż. Krzysztof Sozański

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	
Part-time studies					
Lecture	18	2	II	Exam	
Laboratory	18	2		Grade	

COURSE AIMS:

The aim of the course is to familiarize students with the the basic techniques of medical imaging, image filtering, image segmentation, basic techniques of image acquisition in medicine. Formation of basic skills in the operation, use and management of medical imaging systems. Ability to write simple computer programs for image processing.

PREREQUISITES:

Medical Imaging Techniques, Digital Signal Processing, Computer Graphics, Numerical Methods.

COURSE CONTENTS:

Lecture content.

Magnetic resonance, ultrasound, nuclear medicine visualization methods. Image acquisition: resolution, sampling, dynamic range - quantization. Images: binary, monochrome and color.

The image quality in medical diagnostics. Modulation transfer function. Endoscopic images. Visualization of the structure and function of internal organs using ionizing radiation. Physical principles of imaging.

X-ray radiography, analog and digital. Planar imaging. Image detectors.

Radiology. Imaging layer. Computer tomography. Data acquisition and image reconstruction methods for two-and three-dimensional. Imaging using radioactive isotopes. Emission tomography.

Visualization using non-ionizing radiation. Magnetic resonance of hydrogen - the physical basis of imaging. Rules imaging locations sources. The main characteristic size of the test object measured. Ultrasonography. Multimodal imaging.

Selected elements of digital signal processing. Quantization and sampling signals. Sampling theorem. Aliasing. Filtration of digital signals. Types of digital filters, FIR filters and IIR filters. The spectral analysis of signals, discrete Fourier transform. Changing the sample rate signals, decimation and interpolation of signals. Single and multi-dimensional signals. Acquisition of: sampling, the dynamic range - quantization. Image Analysis. Methods of correction, correction and filtering images. Digital Image filtration: high-pass and low-pass, nonlinear, morphological, segmentation, edge detection. Application of Matlab in image processing. Parameterization for the extraction of critical information from the images (from the point of view of diagnosis). Image compression methods. Image formats. Converting image types. Recording and archiving of images.

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_W08	The formation of basic skills in the operation, use and management of medical imaging systems.
K_W14	Knowledge of basic techniques in medical image acquisition.
K_U18	Ability to write simple programs for image processing.

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_W14	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_U18	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.

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

STUDENT WORKLOAD:

Full-time studies

The student workload of 150 hours (6 ECTS), including work in the auditorium 60 hours, consultations 15 hours, preparing for grade 30 hours, preparing of control work and reports 25 hours, preparing for classes 20 hours.

Part-time studies

The student workload of 150 hours (6 ECTS), including work in the auditorium 36 hours, preparing for grade 34 hours, preparing of control work and reports 40 hours, preparing for classes 40 hours.

RECOMMENDED READING:

1. Tadeusiewicz R., Śmietański J., *Pozyskiwanie obrazów medycznych oraz ich przetwarzanie, analiza, automatyczne rozpoznawanie i diagnostyczna interpretacja*, WSTN (Wydawnictwo Studenckiego Towarzystwa Naukowego), Kraków 2011.
2. J. Cytowski, J. Gielecki, A. Gola, *Cyfrowe przetwarzanie obrazów medycznych, algorytmy, technologie, zastosowania, Akademicka Oficyna Wydawnicza EXIT, Warszawa, 2008.*
3. Z. Wróbel, R. Koprowski, *Praktyka przetwarzania obrazów z zadaniami w programie Matlab*, Akademicka Oficyna Wydawnicza EXIT, Warszawa, 2008.
4. M. Domański, *Obraz cyfrowy*, Wydawnictwo Komunikacji i Łączności, Warszawa, 2010.
5. W. Malina, M. Smiatacz, *Cyfrowe przetwarzanie obrazów*, Akademicka Oficyna Wydawnicza EXIT, Warszawa, 2008.
6. R. Cierniak, *Tomografia komputerowa, budowa urządzeń CT, algorytmy rekonstrukcyjne*, Akademicka Oficyna Wydawnicza EXIT, Warszawa, 2005.
7. N. Bankman (ed.), *Handbook of Medical Imaging Processing and Analysis*, Academic Press, 2000.

OPTIONAL READING:

1. R.Tadeusiewicz, M. R. Ogiela, *Medical Image Understanding Technology*,Springer, 2004.
2. R. Tadeusiewicz, P. Korohoda, Komputerowa analiza i przetwarzanie obrazów, Wydawnictwo Fundacji Postępu Telekomunikacji, Kraków, 1997.A. Meyer-Base, *Pattern recognition for medical imaging*, Elsevier, 2004.

KNOWLEDGE DISCOVERY IN MEDICAL IMAGES

Course code: 6.9-WM-IB-S2-EP-016_13
6.9-WM-IB-N2-EP-016_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					6
Lecture	30	2	II	Exam	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	II	Exam	
Laboratory	18	2		Grade	

COURSE AIMS:

The purpose of the training is to acquire knowledge and skills in the processing of static and video medical images using artificial intelligence techniques, the application of intelligent computations for design and implementation of IT systems to support diagnosis and treatment monitoring.

PREREQUISITES:

medical imaging techniques, digital signal processing, pattern recognition

COURSE CONTENTS:

Lectures:

Color models and methods of color coding. Elementary operations and transformations performed on the image. Methods of edge detection and image enhancement. Radon and Hough transform. Description and analysis of shapes. Segmentation and search for region of interest. Numerical description of the image content and morphometric features. Texture and fractal dimension. Estimating the motion of objects in the video. Methods of

dimensionality reduction. Statistical aspects of medical diagnostics. Artificial intelligence techniques in pattern recognition and classification. Construction of a typical medical image diagnosis system. Problems with archiving medical images. Parallel image processing and analysis. Prototyping image processing applications using Matlab.

Laboratory:

Image processing using Matlab environment. Color models and methods of color coding. Arithmetic operations and morphological processing. Contour and edge detection. Techniques to improve image quality. Line, circle, ellipse and model based shape detection. Shape description using polar coordinates, Fourier descriptors and Freeman chain codes. Bi-level and multi-level thresholding. Region growing segmentation: watershed algorithm, active contours and cellular automata. Hierarchical segmentation techniques and quad-tree structures. Numerical description of objects and regions of interests. Video motion detection and prediction of motion direction. Methods of dimensionality reduction. Artificial neural networks, evolutionary algorithms, rule-based and nearest neighbors classifier applied to pattern recognition tasks. Medical diagnostic system - case studies. Methods of archiving medical images. Parallel image processing and analysis.

TEACHING METHODS:

Lectures - conventional lecture using video projector

Laboratory - laboratory exercises, computer simulations

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W04	Introduction to digital image representation, processing and analysis of 2D images
K_W11	The student knows the characteristics of the medical diagnostic systems
K_W08	The student has a knowledge of the operation and management of medical imaging systems
K_U16	The student can select image processing and analysis techniques for specific problems
K_U18	The student can design and implement decision support system for cytological diagnosis issues.
K_U21	The student knows how to evaluate the effectiveness of automated system for medical image processing and analysis.

K_U08, K_U02, K_U18	The student can interpret the results of research and write short scientific report

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_W04, K_W08, K_W11	The main condition to get a pass is positive grade in written exam conducted once per semester.
K_U02, K_U08, K_U16, K_U18, K_U21	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 30, hours preparing for classes 20 hours, preparing for exam 20 hours, preparing of control work and reports 10 hours, reading literature 10 hours

Part-time studies

The student workload of 150 hours (6 ECTS), including contact hours 36 hours, hours preparing for classes 44 hours, preparing of control work and reports 40 hours, reading literature 30 hours

RECOMMENDED READING:

1. Duda P., Hart R., Stork O.: Pattern Classification, Wiley, New York, 2000
2. Kwiatkowski W.: Metody automatycznego rozpoznawania wzorców, BEL-Studio, Warszawa, 2001
3. Tadeusiewicz R., Flasiński M.: Rozpoznawanie obrazów, PWN, Warszawa, 1991

OPTIONAL READING:

1. Cytowski J., Gielecki J., Gola A.: Cyfrowe przetwarzanie obrazów medycznych. Algorytmy. Technologie. Zastosowania, Exit, 2008
2. Nałęcz, M. (red.): Biocybernetyka i Inżynieria Biomedyczna 2000. Tom 6 Sztuczne sieci neuronowe, Tom 10 Obrazowanie medyczne. Akademicka Oficyna Wydaw. EXIT, Warszawa 2000
3. Tadeusiewicz R., Korohoda P.: Komputerowa analiza i przetwarzanie obrazów, FPT, Warszawa, 1997
4. Watkins C.D., Sadun A., Marenka S.: Nowoczesne metody przetwarzania obrazu, WNT, Warszawa, 1995

5. Larose D. T.: Odkrywanie wiedzy z danych, PWN, Warszawa, 2006

REMARKS:

MEDICAL TELECONCULTATIONS AND TELECONFERENCES

Course code:	6.9-WM-IB-S2-EP-017_13 6.9-WM-IB-N2-EP-017_13
Type of course:	eligible
Language of instruction:	Polish
Director of studies:	Doc. dr inż. Emil Michta
Name of lecturer:	Doc.dr inż. E.Michta; mgr inż. Dariusz Eljasz

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	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	III	Grade	
Laboratory	18	2		Grade	

COURSE AIMS:

- to familiarize students with the basics of the implementation of telemedicine services using IT solutions,
- introduce students to the hardware and software infrastructure necessary to setup tele- and videoconferences,
- formation of student skills in the use of ICT tools in telemedicine applications.

PREREQUISITES:

- has an elementary knowledge of the basics of information technology and telematics,
- knows and understands the functioning of basic medical services,
- 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:

Information technology and the Internet for telemedicine services. Mobile technologies in telemedicine services. Introduction to the multimedia. Multimedia network applications. Streaming audio and video recorded. Text and image standards of medical

data. Audio teleconferencing. Video teleconferencing. Videoconferencing. IP video conferencing. HD video conferencing systems. PC as a terminal video conferencing. Video cameras for HD. Telemedical Portals. The structure and operation of the portal. Available services. Tele-consultation and tele-education services. Sample projects of teleconsultation, tele- and videoconferencing services.

TEACHING 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_W04	The student has extensive and in-depth knowledge of informatics, operational studies, numerical methods and computer networks useful to formulate and solve complex problems in the field of Biomedical Engineering	T2A_W01 T2A_W02
K_W07	The student has theoretically based and detailed knowledge of digital techniques, tele-consultations and medical teleconferences, medical images elaboration, and the knowledge about development trends and the latest achievements in the field of Telemedicine	T2A_W04 T2A_W05
Skills (U)		
K_U10	The student can select the proper modules and use the integrated information systems in telemedical services	T2A_U07
K_U14	The student can integrate knowledge of the various fields ie. informatics, biology, medical science and knows the rules associated with safety of medical data	T2A_U10
Social Competences (K)		
K_K02	The student is aware of and understands the importance and	T2A_K02

	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:

- 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	10 hours
Becoming familiar with indicated literature	10 hours
Preparation of reports	10 hours
Prepare for the exam	10 hours
Total:	100 hours = 4 ECTS

RECOMMENDED READING:

1. Cieciury M., Olchowik W.: Modelowanie i zastosowanie komputerowych systemów medycznych. Wydawnictwo Wizja Press IT, Warszawa 2009.
2. Martyniak J. (red.): Podstawy informatyki z elementami telemedycyny, Wydawnictwo Uniwersytetu Jagiellońskiego, Kraków, 2005.
3. Kurose J.F., Rose K.W.: Sieci komputerowe. Od ogółu do szczegółu z Internetem w tle. Helion, Gliwice, 2006.
4. Norris M.: Teleinformatyka. Wydawnictwa Komunikacji i Łączności WKŁ, Warszawa, 2002.
5. Vademecum Teleinformatyka. IDG Poland, Warszawa 2010.

OPTIONAL READING:

1. Rudowski R. (red.): Informatyka medyczna, Wydawnictwo Naukowe PWN, Warszawa 2003.
2. Zajdel R., Kęcki E., Szczepaniak P., Kurzyński M.: Kompendium informatyki medycznej, Alfa-Medica Press, 2003.

INTERDISCIPLINARY TEAM WORKING

Course code: 6.9-WM-IB-S2-EP-018_13
6.9-WM-IB-N2-EP-018_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	III	Grade	
Laboratory	30	2		Grade	
Part-time studies					
Lecture	18	2	III	Grade	
Laboratory	18	2		Grade	

COURSE AIMS:

The objective of this course is to introduce students to the basic aspects of working in interdisciplinary teams.

PREREQUISITES:

COURSE CONTENTS:

The aspects of working in interdisciplinary teams (the patients and their families, the medical staff, the technical staff).
1. Group work - strengths and weaknesses.
2. Teamwork.
3. Role and tasks of interdisciplinary teams
• Benefits of team-building.
• Design activities. Identify the tasks and activities of the interdisciplinary team.
• Stages of work.
• Strategies for optimal team functioning.
4. The making of effective teamwork.

5. Cooperation between representatives of different professional groups.
6. Participate in collaboration and conflict management.
7. The software for teamwork.

TEACHING METHODS:

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

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W09	The student has theoretically based and detailed knowledge of decision supporting systems and rules of cooperation in multidisciplinary team
K_W12	The student has the knowledge necessary to understand social, economic, legal and other non-technical considerations of engineering and their role in engineering practice
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 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_W09 K_W12	The main condition to get a pass are sufficient marks in written or oral tests conducted at least once per semester.
K_K01, K_K03, K_K04	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, laboratory 30 hours,
2. preparation for classes - 15 hours,
3. preparation of reports - 15 hours,
4. bibliographical research - 10 hours.

RECOMMENDED READING:

1. Belbin Meredith, Twoja rola w zespole, Gdańskie Wydawnictwo Psychologiczne, 2008.
2. Gordon Thomas, Edwards W. Sterling, Rozmawiać z pacjentem.
3. Podręcznik doskonalenia umiejętności komunikacyjnych i budowania partnerskich relacji. Wskazówki dla: lekarzy, personelu medycznego, wolontariuszy, rodziny chorego, Academica, 2009.
4. Pawlak Marek, Zarządzanie projektami, Wydawnictwo Naukowe PWN, 2008.

OPTIONAL READING:

1. Degen Ursula, Sztuka nawiązywania pierwszego kontaktu, Gdańskie Wydawnictwo Psychologiczne, 2004.
2. Dolińska-Zygmunt Grażyna, Podstawy psychologii zdrowia, Wydawnictwo Uniwersytetu Wrocławskiego, 2001.
3. Kamiński Jacek, Negocjowanie. Techniki rozwiązywania konfliktów, Poltext, 2007.

REMARKS:

MONOGRAPHIC LECTURE

Course code: 6.9-WM-IB-S2-EP-019_13
6.9-WM-IB-N2-EP-019_13

Type of course: Optional

Language of instruction: Polish

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

Name of lecturer: Prof dr hab inż Romuald Będziński

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	
Part-time studies					
Lecture	18	2	III	Grade	

COURSE AIMS:

The aim of the course is to acquire extensive knowledge in the field of biomedical engineering.

COURSE CONTENT:

The course comprises a series of lectures on selected topics in biomedical engineering.

TEACHING METHODS:

Conventional lecture, discussion, work with literature sources.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W12	The student has the basic knowledge necessary to understand the social, economic, legal and other non-technical considerations engineering activities

	and their role in engineering practice.
K_W15	The student has an elementary knowledge of the operation in the field of biomedical engineering and business.
K_U05	The student can prepare and present orally (in Polish and foreign) presentation on selected topics in the field of Biomedical Engineering.
K_U07	The student can fluently communicate using a variety of techniques in the scientific community and other communities, also in English or another foreign language considered as a language of international communication in Biomedical Engineering.
K_K05	The student correctly identifies and resolves dilemmas associated with the practice.

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_W06, K_U06	Lecture: Grade Positive evaluation of the test.
K_U09, K_K05	The base created during the course.

Lecture: Grade

STUDENT WORKLOAD:

Full-time studies

The student workload of 75 hours (3 ECTS), including consultations 30 hours and familiarization with literature sources*: 45* hours

Part-time studies

The student workload of 75 hours (3 ECTS), including consultations : 18 hours, familiarization with literature sources*: 57* hours

RECOMMENDED READING:

Literature specified by lecturer

TEMPORARY EMPLOYMENT

Course code: 6.9-WM-IB-S2-EP-020_13
6.9-WM-IB-N2-EP-020_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					7
Laboratory	45	3	II	Grade	
Part-time studies					
Laboratory	36	1	II	Grade	

COURSE AIMS:

The purpose of education is to acquire skills in solving complex engineering problem, the development of the results, analysis and conclusions.

COURSE CONTENTS:

The topic of thesis is given individually accordingly to the diploma profile that the future graduate chooses for his engineering thesis. The topic should be latter with this thesis in the way to facilitate the master thesis writing by means of literature search, building a test stand, a model, etc. Accepting the topic is equivalent with select elective subject in the department responsible for the given diploma profile. The work may be descriptive, technological, design-type, technological, consist in scientific measures, creation of bibliography or have material character. In the latter case its final results may take shape of a piece of equipment, be an algorithm, model or project in electronic format. Means to perform the work and conditions for receiving credit are to be established by supervisor.

TEACHING METHODS:

Conventional lecture. Discussion. Working with source document.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W14	The student is familiar with the basic methods, techniques, tools and materials used in solving complex engineering tasks in the field of Biomedical Engineering
K_U03	The student can prepare a study in Polish and a short scientific report in a foreign language including the results of his/her own studies
K_U13	The student can – while formulating and solving engineering tasks – integrate knowledge of the fields of science and scientific disciplines relevant to Biomedical Engineering and apply a systemic approach taking into account the non-technical aspects
K_U17	The student is property prepared to work in laboratories with electronic equipment, in chemical and biological laboratories, and knows safety rules associated with this work
K_U19	The student can evaluate the primary cost of engineering projects and make a preliminary economic analysis of undertaken engineering activities
K_K01	The student understands the need for lifelong learning; 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_W14	Grade based on accuracy of selection techniques and methods the

	student uses and the quality of the project
K_U03, K_U13, K_U17, K_U19	Grade based on accuracy of selection techniques and methods the student uses and the quality of the project
K_K01	The course of the seminar classes

Laboratory - In order to get a credit it is necessary to prepare project report.

STUDENT WORKLOAD:

Full-time studies

The student workload of 175 hours (7 ECTS), including consultations: 45 hours, preparing for classes: 25 hours, preparing a project: 45 hours, work with literature: 60 hours

Part-time studies

The student workload of 175 hours (7 ECTS), including consultations: 36 hours, preparing for classes: 44 hours, preparing a project: 65 hours, 30 hours

RECOMMENDED READING:

Literature specified by supervisors depending on topic of thesis.

SPECIALIST SEMINAR

Course code: 6.9-WM-IB-S2-EP-021_13
6.9-WM-IB-N2-EP-021_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	
Part-time studies					
Laboratory	36	1	III	Grade	

COURSE AIMS:

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

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.

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
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_K02, K_K03, K_K04	The evaluation of the use of knowledge and skills acquired during their studies to realization BSc thesis

Seminar: Grade.

STUDENT WORKLOAD:

Full-time studies

The student workload of 75 hours (3 ECTS), including consultations: 60 hours, work with literature 15 hours

Part-time studies

The student workload of 75 hours (3 ECTS), including consultations: 37 hours, preparing for classes: 20 hours, work with literature: 19 hours

RECOMMENDED READING:

Literature specified by supervisors depending on topic of thesis.

MSC SEMINAR-01

Course code: 6.9-WM-IB-S2-EP-022_13
6.9-WM-IB-N2-EP-022_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					5
Seminar	30	2	II	Grade	
Part-time studies					
Seminar	18	1	II	Grade	

COURSE AIMS:

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

PREREQUISITES:

None

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:

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
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 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_K01, K_K02, K_K03, K_K04	The evaluation of the use of knowledge and skills acquired during their studies to realization MSc thesis

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

STUDENT WORKLOAD:

Full-time studies

The student workload of 125 hours (5 ECTS), consultations: 32 hours, preparing for classes: 45 hours, work with literature: 48 hour

Part-time studies

The student workload of 125 hours (5 ECTS), consultations: 18 hours, preparing for classes: 60 hours, work with literature: 47 hour

RECOMMENDED LITERATURE:

Literature specified by supervisors depending on topic of thesis

MSC SEMINAR 02

Course code: 6.9-WM-IB-S2-EP-023_13
6.9-WM-IB-N2-EP-023_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	60	4	III	Grade	
Part-time studies					
Seminar	36	2	III	Grade	

COURSE AIMS:

The students should to know how to present and discuss a selected topic 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 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:

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
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 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_K01, K_K02, K_K03, K_K04	The evaluation of the use of knowledge and skills acquired during their studies to realization MSc thesis

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

STUDENT WORKLOAD:

Full-time studies

The student workload of 150 hours (6 ECTS), consultations: 62 hours, preparing for classes: 30 hours, work with literature: 60 hour

Part-time studies

The student workload of 150 hours (6 ECTS), consultations: 36 hours, preparing for classes: 60 hours, work with literature: 54 hours

RECOMMENDED LITERATURE:

Literature specified by supervisors depending on topic of thesis.

DIPLOMA THESIS

Course code: 6.9-WM-IB-S2-EP-024_13
6.9-WM-IB-N2-EP-024_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					10
Project	0	0	III	Course without grade	
Part-time studies					
Seminar	0	0	III	Course without grade	

COURSE AIMS:

The technical (paper) thesis.

PREREQUISITES:

COURSE CONTENTS:

The students should realize paper documentation the done thesis in the format specified by the Dean of Mechanical Department.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_U06 K_U07 K_U08	The student can fluently communicate using various techniques in scientific milieu and other environment, also in English or any other foreign language considered as a language of international communication in the field of

	Biomedical Engineering
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.
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_U08, K_K06, K_K07	The evaluation of the use of knowledge and skills acquired during their studies to realization MSc thesis

In order to get a credit its necessary to get grade and adopt MSc thesis edited by the principles set out in the Faculty

STUDENT WORKLOAD:

Full-time studies

The student workload of 250 hours (10 ECTS), including work in the consultations:30 hours,

Part-time studies

The student workload of 250 hours (10 ECTS), including work in the consultations: 0 hours