COURSE DESCRIPTION CARD - SYLLABUS

Course name
Fundamentals of biomedical engineering [S1IBio1>PBM]

Course

Field of study
Biomedical Engineering

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
15

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge in physics, chemistry and materials science.

Course objective

The student should acquire the knowledge on fundamentals of medical bioengineering, notably on fundamentals on medical biomaterials engineering and design of the treatment protocols for natural biomaterials and engineering biomaterial/tissue system.

Course-related learning outcomes

Knowledge:
1. student characterizes the anatomy of basic human body systems and tissue biostructure, in particular organs of the musculoskeletal system and bioelectrochemical sources of electrical signals of cells and tissues.
2. student characterizes biomaterials as divided into natural biomaterials (biological tissue) and artificial (biosubstitutes) and is able to characterize processes of the preparation of bio-organic biomaterials and methods of testing.

Skills:
1. student is able to identify the properties of biostructure of tissue.
2. student is able to design and implement the processes of preparation of natural biomaterials and bio-substitute material/tissue systems.

Social competences:
1. student works in a group and sets priorities for the implementation of the task specified by himself or other.
2. student is aware of the interdisciplinary nature of biomedical engineering as a field of knowledge dealing with the design, production and optimization of materials for medicine and the necessary cooperation between engineer and doctor in this field.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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Lecture: Test covering all the knowledge of the subject, carried out at the end of the semester. Completion of the course - in the case of a correct answer to min. 50% of the final test questions; proportional scale of positive marks (dst, dst +, db, db +, very good).

Project: Credit based on the developed and implemented project of bone (organ) preparation and selected tissue (biomaterial) of the skeletal system. The project grade is the average of two grades: 1) for the project submitted in brochure form at the end of the semester, 2) for partial progress in the project implementation (reported in the form of a multimedia presentation).

Programme content

Obtaining knowledge from basic knowledge in the field of biomedical engineering. Acquainting with the physical phenomena occurring in physiological processes and the activity of tissues, organs and biosystems in terms of their functional description and the possibility of supporting lost functions or replacing them with technical devices. Transfer of the necessary knowledge needed to describe and analyze phenomena and to design, build and operate medical equipment (diagnostic, therapeutic and rehabilitation) and medical devices.

Course topics

Lectures:
1. History of medical bioengineering (biomedical engineering) as a technical science with division to primary sections.
2. Anatomy of fundamental systems of human organism: musculoskeletal system, cardiovascular system, neurohormonal system.
3. Fundamentals of biomaterials engineering with division to natural biomaterials (biologic tissues) and artificial (biosubstitutes). Fundamentals of bioengineering materials include the knowledge concerning the structure of the biomaterials, the properties and requirements of biosubstitute materials.
4. Characteristics of tissues biostructures, in particular the biostructure organs of musculoskeletal system (cortical and trabecular bone tissue, cartilaginous tissue, connective tissue, ligaments and tendons, muscle tissue; biomechanical, bioelectrical and biomechatronic properties of tissues of musculoskeletal system).
5. Bioelectrochemical generators of electrical signals of cells and tissues, passive electrical properties of tissues.

Projects:

During the first class, the choice of topic from the proposed project topics proposed by the lecturer, then its analysis, the emergence of medical aspects, possible methods of treatment/use, and the possible direction of development of the analyzed issue.
Project topics:
1. Electrohysterography (EHG) – non-invasive registration of uterine functional biopotentials.
2. Artificial heart valves - surgical treatment of valvular defects.
3. Thermography in the analysis of soft tissue periarthritis in patients with chronic arthritis.
4. Neuroprostheses - restoring the functionality of the nervous system.

5. Thermography in the diagnosis of breast cancer
6. Analysis of speech sounds for biomedical purposes.
7. Biomedical tremor - essential positional tremor, methods of supporting patients.
8. 3D bioprinting - printing scaffolds for the regeneration of bone and cartilage tissue.
9. Electroglotography in the treatment of diseases of the speech apparatus.
10. Nerve guide - restoring the continuity of peripheral nerves.11. Supporting the therapy of the auditory system
12. Cardiostimulation - prevention of heart irregularities, improvement of methods.
13. Guided bone tissue regeneration
14. Electrical methods of visualization of vocal fold vibrations
15. Acoustic methods of visualization of vocal fold vibrations
16. Optical methods of visualization of vocal fold vibrations
17. Biotribology - analysis of tribological properties of joints (friction and accompanying processes)
18. Tribological tests of dental materials used in prosthetic reconstructions
19. Brain-computer interface. Non-invasive BCI methods.
20. Brain-computer interface. Invasive BCI methods.
21. Polysomnography
22. Capsule endoscopy

Teaching methods

1. Lecture: presentation with illustrated examples, films, scientific discussion.
2. Project classes: solving practical problems, teamwork, discussion.

Bibliography

Basic
1. Pawlicki G.: Podstawy inżynierii medycznej. Oficyna Wydawnicza Politechniki Warszawskiej, 1997.
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3. Tadeusiewicz R., Augustyniak P.: Podstawy inżynierii biomedycznej,t.1,2. Wyd. Naukowo-Dydaktyczne AGH, Kraków 2009.
4. Jaroszyk A.: Biofizyka, PZWL, Warszawa 2002.
5. Marciniak J.: Biomateriały. Wyd. Politechniki Śląskiej, Gliwice 2002.
6. Ostrowski K.: Histologia, Wyd. PZWL, Warszawa 2001.
7. Sawicki W.: Histologia, PZWL, Wyd. IV, Warszawa 2006.
8. An Y.H. (red.), Martin K.L., (red.): Handbook of Histology Methods for Bone and Cartilage, Humana Press; Totowa, New Jersey, 2003.
9. An Y.H. (red.), Draughn R.A. (red.): Mechanical Testing of Bone and the Bone-Implant Interface, CRC Press, Boca Raton, London, New York, Washington, D.C., 1999.
Additional
1. Nałęcz M. (red.): Biocybernetyka i inżynieria biomedyczna, t.1-9. Wydawnictwo Exit, Warszawa 2000-2004.
2. Bronzino J.D. (red.): The Biomedical Engineering Handbook. CRC Press & IEEE Press, 1995 (II wyd. 2000).
3. Sokołowska-Pituchowa J.: Anatomia człowieka. PZWL, Wyd. VIII, Warszawa 2008.
4. Będziński R.: Biomechanika inżynierska, Wyd. Politechniki Wrocławskiej, 1997.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	55	2,00