COURSE DESCRIPTION CARD - SYLLABUS

Course name
Fundamentals of medical bioengineering

Course

Field of study
Biomedical engineering

Year/Semester
2/3

Area of study (specialization)
-

Profile of study
general academic

Level of study
First-cycle studies

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other (e.g. online)
0

Tutorials
0

Projects/seminars
15

Number of credit points

4

Lecturers

Responsible for the course/lecturer:
mgr inż. Adam Patalas
Faculty of Mechanical Engineering

Responsible for the course/lecturer:

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:

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

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. Classification and characteristics of primary groups of engineering biosubstitute materials – metallic biomaterials, ceramic biomaterials, polymeric biomaterials, carbon biomaterials and composite biomaterials.
6. Bioelectrochemical generators of electrical signals of cells and tissues, passive electrical properties of tissues.

Projects:

1. Fundamentals of design of biocompatible substitute biomaterials implanted in the osteoarticular and cardiovascular system.
2. Assessment of the structure and chemical composition of the designed substitute biomaterials
3. Basics of designing metallic, ceramic and glass-ceramic, polymer, carbon, and composite substitute biomaterials as well as porous coatings of implants and porous scaffolds for the osteoarticular system.
4. Design of implants of the osteoarticular system and the cardiovascular system.
5. Design of the procedure of histomorphometric evaluation of biostructure of cortical bone tissue and cancellous bone tissue.
6. Design of processes of harvesting and fixing, cutting and grinding, dehydrating, degreasing and decalcification of bones for the biostructural and biomechanical tests.

Teaching methods

Lectures, fundamentals of designing (design of the treatment protocols for natural biomaterials and engineering biomaterial/tissue system).

Bibliography

Basic

1. Pawlicki G.: Podstawy inżynierii medycznej. Oficyna Wydawnicza Politechniki Warszawskiej, 1997.
2. Uklejewski R. (red.): Podstawy bioinżynierii medycznej. Wyd. Politechniki Poznańskiej 2011.
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	4,0
Classes requiring direct contact with the teacher	45	2,0
Student's own work (literature studies, preparation for tests, project preparation) [1]	55	2,0

[1] delete or add other activities as appropriate