COURSE DESCRIPTION CARD - SYLLABUS

Course name
Biomaterials and protection against corrosion [S1IBio1>BiOPK]

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
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

Lecturers

Prerequisites

Students should have a basic knowledge of materials science, physics and chemistry. They should also have the ability to think logically and to obtain information from various sources as well as be ready to cooperate within a team. In addition, they should understand the need to learn and acquire new knowledge

Course objective

Providing to students information about basic groups of biomaterials, their properties and application and about corrosion phenomena and damages, and methods of corrosion protection.

Course-related learning outcomes

Knowledge:
1. Students have knowledge of basic groups biomaterials, their properties and applications.
2. Students have knowledge of basic types of corrosion and methods of corrosion protection.

Skills:
1. Students are able to characterize the basic biomaterials and their properties.
2. Students are able to select biomaterials for various applications.
3. Students are able to choose the material to a corrosive environment.
4. Students are able to offer a way of protection against corrosion.

5. Students are able to perform corrosion tests.

Social competences:
1. Students can work together in a team.
2. Students are aware of the role of biomaterials, corrosion and protection against corrosion in modern economy and for societies.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

1) Knowledge acquired during the lectures is verified at the exam lasting 45 minutes. It consists of 3-5 questions. The pass threshold is 50% of the points.
2) Skills acquired as part of the laboratory classes are checked on an ongoing basis during each class in the form of an oral or written answer to the questions asked and assessed on the basis of reports from each laboratory exercise. Each laboratory exercise requires a positive evaluation. At the end of the semester, after completing compulsory exercises, there is a possibility to pass a corrective exam of selected exercises.

Programme content

Lecture:
1. Definition of biomaterials, the role of its chemical composition, work environment, applications and classification of biomaterials.
2. Metal-based biomaterials:
a) classification, chemical composition, mechanical and physical properties, applications,
b) austenitic steels,
c) cobalt alloys,
d) titanium alloys,
e) other alloys based on nickel, gold, silver, tantalum.
3. Ceramic biomaterials:
a) classification, chemical composition, mechanical and physical properties, applications,
b) resorbed in tissues (hydroxyapatite),
c) with controlled surface reactivity (bioglass),
d) inert (Al2O3, ZrO2).
4. Polymer-based biomaterials:
a) classification, properties and applications,
b) natural,
c) synthetic.
5. Carbon and composite biomaterials.
6. Electrochemical aspects of corrosion: types of electrodes, electrode reactions, polarity of the electrodes, electrochemical cell, double layer, electrode potential.
7. Thermodynamical aspects of corrosion processes: Pourbaix diagrams.
8. Passive state of metals.
9. Types of corrosion: general, galvanic, crevice, pitting, intergranular, stress, fatigue, hydrogen, selective, microbiological.
10. Oxidation at high temperatures and corrosive processes mechanism.
11. Effect of environment on corrosion processes: environment type, concentration of the oxidant, environment move, temperature, pH, aggressive ions.
12. Corrosion resistance of selected metals and their alloys.
13. Methods for corrosion protection of metals: materials, modification of the environment, protective coatings, electrochemical protection.
14. Corrosion of plastics and ceramics.
15. Methods of corrosion investigations.
Laboratory classes:
1. Materials for surgical instruments.
2. Titanium and its alloys.
3. Cobalt alloys.
4. Austenitic steels.
5. Ceramic biomaterials.
6. Identify of corrosion resistance based on polarization curves. part. 1.

7. Identify pf corrosion resistance based on polarization curves. part. 2.
8. High temperature corrosion. part. 1.
9. High temperature corrosion. part. 2.
10. Reasons of corrosive wear of machine parts.

Teaching methods

1. Lecture: multimedia presentation, illustrated with examples on the board.
2. Laboratory exercises: macro- and microscopic observations; corrosive measurements; performance of tasks given by the teacher - practical exercises.

Bibliography

Basic:
1. J. Marciniak, Biomateriały, Wyd. Politechniki Śląskiej, Gliwice 2002
2. Biomateriały, Tom 4, Biocybernetyka i Inżynieria Biomedyczna 2000, pod red. M. Nałęcza, Akademicka Oficyna Wydawnicza EXIT, Warszawa 2003.
3. J. Baszkiewicz, M. Kamiński, Korozja materiałów, Oficyna wydawnicza PW, Warszawa 2006.
4. H. Bala, Korozja materiałów - teoria i praktyka, WIPMiFS, Częstochowa 2002.

Additional:
1. M. Jurczyk, J. Jakubowicz, Bionanomateriały, Wyd. Politechniki Poznańskiej, Poznań 2008
2. W. Gumowska, E. Rudnik, I. Harańczyk, Korozja i ochrona metali, ćwiczenia laboratoryjne, AGH, Kraków 2007.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	62	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	38	1,50