COURSE DESCRIPTION CARD - SYLLABUS

Course name
Engineering of bioprocesses and biomaterials surfaces [S2IBio1E-IIiP>IBiPB]

Course

Field of study
Biomedical Engineering

Year/Semester
1/2

Area of study (specialization)
Engineering of Implants and Prosthesis

Profile of study
general academic

Level of study
second-cycle

Course offered in
English

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

4,00

Coordinators

Lecturers

Prerequisites

Basic knowledge of the basics of biomaterials, medical bioengineering, including biomaterials engineering and tissue engineering. Knowledge of basic engineering groups of biomaterials, bionanomaterials. Ability to think logically, use information from the library and the Internet. Able to use laboratory techniques in the field of materials engineering, chemical engineering. Basic knowledge of methods to study the properties of biomaterials. Understands the need to learn and acquire new knowledge and improve their professional competences.

Course objective

1.Provide students with basic knowledge of bioprocess engineering and surface modification methods of biomaterials/bionanomaterials, to the extent specified by the curriculum content specific to the field of study. 2.Develop students" skills for solving problems related to the selection of biomaterials, distinguishing them and analysing research results based on the knowledge gained. 3.Shaping teamwork skills in students.

Course-related learning outcomes

Knowledge:
1. The student should characterize the basic biomaterials
2. The student should characterize the basic processes of obtaining biomaterials and modifying their

surface

Skills:
1. Student can choose material for medical application
2. The student can propose the use of biomaterials
3. Student can conduct in vitro and corrosive tests

Social competences:
1. Student can collaborate in a group
2. The student is aware of the role of biomaterials for society

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Ongoing knowledge control from the preparation for classes. Lecture: Exam consisting of a series of 5 general questions (pass in case of correct answer to min. 3 questions).
Project: Completion on the basis of an oral response from the content of each project carried out, a report on the implementation of the project according to the indications of the presenter. To be credited, projects must be credited (positive rating).

Programme content

Lecture:
Biomaterials/Bionanomaterials. Manufacturing methods and characteristics. Technological processes of the manufacture of dentures. Shaping the microstructure. Modification of the chemical composition of biomaterials. Surface modification: bioactive coatings, bactericidal coatings, multifunctional coatings. Corrosion. In vitro studies. In vivo studies. Characteristics of the biological environment and physiological bioprocesses occurring in tissues and in the human tissue/biomaterial system. Designing the properties of biomaterials and bioprocesses in the interphase human tissue/biomaterial taking into account functionalisation processes and nano-functionalisation of the surface (nano-coverings: nanofibres, nanotubes, nanocomposites, thin film deposition and hybrid surface nanostructuring, production of porous coverings with a hierarchical microstructure).
Requirements for artificial biomaterials (biotolerance, corrosion resistance, atrombogenicity, magnetic properties of implants, condition of implant surfaces, chemical composition of implants, toxicity and carcinogenicity, selected issues related to biocompatibility testing of medical biomaterials (PN-EN ISO 10993).
Project:
Execution and presentation of a project containing, determination of operating and operating conditions, determination of technical requirements, selection of material and technology for the manufacture of a simple element made of biomaterial. Design of surface properties of biomaterials, bone graft substitutes and bone-implant interphase properties.

Course topics

none

Teaching methods

1. Lecture: multimedia presentation, presentation illustrated by examples given on the board.
2. Design: implementation and presentation of a project containing, determination of working and operating conditions, determination of technical requirements, selection of material and technology for the manufacture of asimple element made of biomaterial, at the discussion during the presentation.

Bibliography

Basic
M. Jurczyk (Ed.), Bionanomaterials for Dental Applications, Pan Stanford Publishing Pte. 2013 Ltd, ISBN: 9789814303835
K. Jurczyk, M. Jurczyk, Applications of nanomaterials in dentistry chapter 37 in Handbook of Clinical Nanomedicine: Nanoparticles, Imaging, Therapy, and Clinical Applications, Edited by Raj Bawa, Gerald F.

Audette, and Israel Rubinstein, Copyright © 2015 Pan Stanford Publishing Pte. Ltd., ISBN 978-981-4669-20-7
K. Jurczyk, Urs Braegger, M. Jurczyk, chapter Nanotechnology in dental implants, in Innovations in Nanoscience and Nanotechnology - Nanotechnology and health sciences, Ed.Marcel VAN DE VOORDE, publisher De Guyter, Berlin, Germany, 2018 https://doi.org/10.1515/9783110547221-004
M. Jurczyk, J. Jakubowicz, Bionanomaterials, Ed. Pol. Pozn. 2008
J, Jakubowicz, Surface treatment of titanium biomaterials, Ed. PP 2019
B. Locuscuscus. Multifunctional titanium biomaterials, Ed. Polish Biomaterials Association. Monograph of tom. 3, 2019. Ed. AGH, Krakow
K. Skalski (Ed.), monograph Endoprostrinal spine endoprostrinal disc – design, manufacturing and preparation technology for clinical applications, Institute of Plastic Treatment, Poznań 2013
Z. Święcki, Bioceramica for orthopaedics, IPPT, Warsaw 1992
R. Pampuch and others, New carbon materials in medicine, PWN, Warsaw 1988
J. Marciniak, Biomaterials in bone surgery, Silesian University of Technology Publishing House, Gliwice 1992
Błażewicz S., Stoch L. (ed.): Biomaterials, t.4; In: Biocybernetics and Biomedical Engineering (ed. M. Nałęcz). Exit Publishing House, Warsaw 2004
Gracious J., Michalin R.: Theoretical and application issues in implants. Ed. Silesian University of Technology. Gliwice 2002
Additional
M. Tulinski, M. Jurczyk, Nanomaterials Synthesis Methods, chapter 4 in “Metrology and Standardization of Nanomaterials: Protocols and Industrial Innovations”, pp. 75-98 Eds Elisabeth Mansfield, Debra Kaiser, Daisuki Fujita, Marcel Van de Voorde
Wiley-VCH 2017 - ISBN 978-3-527-34039-2
Publikacje naukowe M. Jurczyka dot. tematyki wykładu, np.:
M. Tulinski, M. Jurczyk, Nanostructured Nickel-free Austenitic Stainless Steel Composites With Different Content Of Hydroxyapatite, Applied Surface Science 260 (2012) 80– 83
A. Miklaszewski, M.U. Jurczyk, M. Jurczyk, Microstructural development of Ti-B alloyed layer for hard tissue applications, Journal of Materials Science & Technology 29 (6) (2013) 565-572
M. Kaczmarek, M.U. Jurczyk, B. Rubis, A. Banaszak, A. Kolecka, A. Paszel, K. Jurczyk, M. Murias, J. Sikora,
M. Jurczyk, In vitro biocompatibility of Ti-45S5 Bioglass nanocomposites and their scaffolds, J Biomed Mater Res Part A 102A (2014)1316–1324.
K. Jurczyk, G. Adamek, M.M. Kubicka, J. Jakubowicz, M. Jurczyk, Nanostructured titanium-10 wt. % 45S5 Bioglass-Ag composite foams for medical applications
Materials 8 (2015) 1398-1412
K. Jurczyk, A. Miklaszewski, K. Niespodziana, M. Kubicka, M.U. Jurczyk, M. Jurczyk
Synthesis and properties of Ag-doped titanium-10 wt.% 45S5 Bioglass nanostructured scaffolds, Acta Metall. Sin. (Engl. Lett.), 2015, 28(4), 467–476
K. Jurczyk, A. Miklaszewski, M.U. Jurczyk, M. Jurczyk, Development of type Ti23Mo-45S5 Bioglass nanocomposites for dental applications, Materials 8 (2015) 8032-8046
K. Jurczyk, M.M. Kubicka, M. Ratajczak, M.U. Jurczyk, K. Niespodziana, D.M. Nowak,
M. Gajecka, M. Jurczyk, Antibacterial activity of nanostructured Ti-45S5 Bioglas-Ag composite against Streptococcus mutans and Staphylococcus aureus, Trans. Nonferrous Met. Soc. China 26 (2016) 118−125
A. Miklaszewski, M. U. Jurczyk; M. Kaczmarek; A. Paszel-Jaworska; A. Romaniuk; N. Lipinska; J. Zurawski; P. Urbaniak; M. Jurczyk, Nanoscale size effect in in situ titanium based composites with cell viability and cytocompatibility studies
Materials Science and Engineering: C, Volume 73, 1 April 2017, Pages 525-536
K. Kowalski, M.U. Jurczyk, P.K. Wirstlein, J. Jakubowicz, M. Jurczyk,
Influence of 45S5 Bioglass addition on microstructure and properties of ultrafine grained (Mg-4Y-5.5Dy-0.5Zr) alloy, Materials Science Engineering B 219 (2017) 28–36
M. Marczewski, A. Miklaszewski, M. Jurczyk, Structure evolution analysis in ultrafine grained Zr and Nb-based beta titanium alloys, J Alloys Compds 765 (2018) 459-469
Andrzej Miklaszewski, Kamil Kowalski, Mieczyslaw Jurczyk, Multilevel approach in the enhancement of properties of biodegradable Mg-materials, Metals 2018, 8, 894; doi:10.3390/met8110894
Patrycja Sochacka, Andrzej Miklaszewski, Mieczyslaw Jurczyk, Development of type Ti-x at. %
Mo alloys by mechanical alloying and powder metallurgy: phase evolution and mechanical properties (10≤x≤35), J. Alloys Compds 776 (2019) 370-378
Andrzej Miklaszewski, Mieczyslaw Jurczyk, Mechanical alloying and the electrical current assisted sintering adopt for the in situ Ti-TiB metal matrix composite processing, Materials 2019, 12, 653.

Patrycja Sochacka, Andrzej Miklaszewski, Kamil Kowalski, Mieczyslaw Jurczyk, Influence of the Processing Method on the Properties of Ti-23 at.% Mo Alloy, Metals 2019, Volume 9, Issue 9, 931
Mieczyslawa U. Jurczyk Jakub Żurawski, Przemyslaw K. Wirstlein, Kamil Kowalski, Mieczyslaw Jurczyk, Response of inflammatory cells to biodegradable ultra-fine grained Mg-based composites, Micron 129 (2020) 102796 doi.org/10.1016/j.micron.2019.102796
Patrycja Sochacka, Andrzej Miklaszewski, Mieczysław Jurczyk, Paulina Pecyna, Magdalena Ratajczak, Marzena Gajecka, Mieczysława U. Jurczyk, Effect of hydroxyapatite and Ag, Ta2O5 or CeO2 addition on the properties of ultrafine-grained Ti31Mo alloy, J. Alloys Compounds Volume 823, 15 May 2020, 153749
Mateusz Marczewski, Andrzej Miklaszewski, Xavier Maeder, Mieczyslaw Jurczyk
Crystal structure evolution, microstructure formation and properties of mechanically alloyed ultrafine-grained Ti-Zr-Nb alloys at 36≤Ti≤70 (at %) , Materials 2020, 13, 587 doi:10.3390/ma13030587
Some of the inter journals : Biomaterials, Acta Biomaterialia, Surface and Coatings Technology, Applied Surface Science, Journal of Nanoscience and Nanotechnology, J Biomed Mater Res Part A, Mater. Sci. Eng. C, Materials, Micron,

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	47	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	53	2,00