Co-funded by the Erasmus+ Programme of the European Union

National University Zaporizhzhia Polytechnic
DESCRIPTION / Syllabus of discipline / module

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| **Short name of the university / department date (month / year)** | NU «Zaporizhzhya Polytechnic» 10/2019 |
| **Module name / Course name** | Biomedical materials and constructions |
| **Code:** | PPN 05 |

| **Teacher(s)** | **Department** |
|---|---|
| Shalomieiev Vadym | Radioengineering and Telecomunication |

| **Study cycle** | **Level of the module** | **Type of the module** |
|---|---|---|
| MSc | 1 | mandatory |

| **Form of delivery** | **Duration** | **Language(s)** |
|---|---|---|
| Lectures/Hands-on Lab session | 15 weeks | Ukrainian |
| **Connection with other disciplines** | | |
| **Previous:**<br>- mathematics, physics, chemistry and materials science. | **Related (if required):**<br>- term and graduation papers | |

| **Credits of the module** | **Total student workload** | **Contact hours** | **Individual work hours** |
|---|---|---|---|
| 5 | 150 | 60 | 90 |

**Aim of the module (course unit): competences foreseen by the study programme**

- knowledge of the characteristics of biocompatible and bioresorbable materials;
- ability to use biomedical materials correctly in accordance with the requirements for them;
- knowledge of the types and properties of polymers, ceramic and carbon biomaterials;
- ability to correctly use non-metallic biomaterials for the manufacture of implants depending on their purpose;
- knowledge of physical and mechanical properties of metallic biomaterials, their atomic-electronic structure, the relationship between structure and properties;
- ability to control the structure of metal alloys, to obtain the specified properties of biomaterials and apply them in practice.

| **Learning outcomes of module (course unit)** | **Teaching/learning methods** | **Assessment methods** |
|---|---|---|
| - to know and understand the different approaches and methods of system analysis in the choice of biomedical materials; | - theoretical and practical knowledge obtained during lectures and laboratory work; | - assessment during laboratory works; |
| - to be able to implement basic methods of scientific knowledge in the field of biotechnology; | - theoretical knowledge gained during lectures; | - assessment during the exam; |

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| - to know and understand different approaches and methods of solving professional problems;<br><br>- be able to use different technologies to solve professional problems;<br><br>- know, understand and assess the level of compliance of applied biomaterials to the proposed requirements;<br><br>- to be able to use modern technologies as a tool for research, development and evaluation in the manufacture of implants. | -practical knowledge gained during laboratory work;<br><br>- knowledge gained during laboratory work;<br><br>- theoretical and practical knowledge gained during independent work and consultations;<br><br>- theoretical and practical knowledge gained during independent work, lectures and laboratory work. | - assessment by the report on laboratory works;<br><br>- assessment by the report on laboratory work;<br><br>- assessment during the exam;<br><br>- assessment during laboratory work and exam. |

| **Themes** | **Contact work hours** | | | | | | **Time and tasks for individual work** | |
|---|---|---|---|---|---|---|---|---|
| | Lectures | Consultation | Seminars | Practical work | Laboratory work | **Total contact work** | **Individual work** | **Tasks** |
| **Content module 1.** Materials of biomedical application, their characteristics, features of application. Patterns of the structure formation of metallic materials. | | | | | | | | |
| **Theme 1.** Materials of biological application. The main characteristics of biomaterials. Purpose and requirements for biomaterials. | 2 | - | - | - | 2 | 10 | 6 | Knowledge of materials of biological application. The study of the main characteristics and requirements for biomaterials. |
| **Theme 2.** Natural and synthetic polymers. Their use in medicine. | 2 | - | - | - | 2 | 10 | 6 | The study of different types of polymers, their use in medicine. |

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| **Theme 3.** Ceramic and carbonaceous biomaterials. Basic types and assignments. | 2 | - | - | - | 4 | 16 | 10 | The study of ceramic and carbonaceous biomaterials, their main types and purpose. |
| **Theme 4.** Classification of metallic biomaterials. Atomic-crystalline composition of metals. | 8 | - | - | - | 4 | 34 | 18 | The study of the classification of metallic biomaterials. Knowledge of the atomic-crystalline composition of metals, types of crystal lattices. |
| **Theme 5.** Theory of alloys. Phases in metal alloys, double state diagrams. | 4 | - | - | - | 4 | 18 | 10 | Fundamentals of the theory of alloys. Knowledge of the phases in metal alloys and basic state diagrams. |
| Together on the content module 1 | 18 | - | - | - | 16 | 84 | 50 | |
| **Content module 2.** Iron and iron-based alloys. Deformation of alloys. Theory and technology of heat treatment. Non-ferrous biocompatible and biosoluble materials. | | | | | | | | |
| **Theme 6.** Deformation of alloys and the theory of heat treatment. | 4 | - | - | - | 6 | 28 | 18 | The study of the types of deformation of alloys and its influence on the properties of the metal. Fundamentals of the theory of heat treatment. |
| **Theme 7.** Iron based alloys, controlling their structure and properties. | 4 | - | - | - | 4 | 18 | 10 | Knowledge of the Iron based alloys. The study of ways to control their structure and properties. |
| **Theme 8.** Cobalt and titanium alloys. Their characteristics and application. | 2 | - | - | - | 2 | 10 | 6 | The study of the characteristics and applications of cobalt and titanium alloys. |
| **Theme 9.** Bioresorptive alloys. Special features of their production and application. | 2 | - | - | - | 2 | 10 | 6 | Knowledge of the concept of "bio-solubility". The study of the characteristics of the production and application of bioresorptive materials. |

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| Together on the content module 2 | 12 | - | - | - | 14 | 40 | 40 | |
| Total **150** hours | **30** | - | - | - | **30** | **60** | **90** | |

| **Assessment strategy** | **Weight in %** | **Deadlines** | **Assessment criteria** |
|---|---|---|---|
| current assessment | 10 | during the semester | theoretical report on each topic |
| laboratory work defense | 10 | | defense of laboratory work №1 |
| | 10 | | defense of laboratory work №2 |
| | 10 | | defense of laboratory work №3 |
| | 10 | | defense of laboratory work №4 |
| | 10 | | defense of laboratory work №5 |
| | 10 | | defense of laboratory work №6 |
| | 10 | | defense of laboratory work №7 |
| | 10 | | defense of laboratory work №8 |
| | 10 | | defense of laboratory work №9 |
| passing a written exam | 60-100 | after the module | credited |
| | 35-59 | | not credited with the possibility of re-taking |
| | 1-34 | | not credited with mandatory re-study of the discipline |

| **Author** | **Year of issue** | **Title** | **Information about the publication** | **Place of printing. Printing house or internet link** |
|---|---|---|---|---|
| **Compulsory literature** | | | | |
| Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons | 2013 | Biomaterials Science | Educational manual | An Introduction to Materials in Medicine. Elsevier Inc, 1573p., ISBN: 978-0-12-374626-9. |
| Joon Park, R.S. Lakes. | 2007 | Biomaterials: AnIntroduction. | Educational manual | Springer, 2007, 574p., ISBN: 978-0387378794. |
| Gary E. Wnek, Gary L. Bowlin | 2008 | Encyclopedia of Biomaterials and Biomedical Engineering. | Encyclopedia | Informa Health care USA Inc.Vol. 1-4, 3552p., ISBN: 978-1-4200-7953-1. |

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|---|---|---|---|---|
| Lakhtin Y.M., Leont'yeva V.P. | 1980 | Materials Science | Textbook | Mechanical engineering, Moscow, 493 p. |
| Aftandilyants Y.H., Zazymko O.V., Lopat′ko K.H.. | 2013 | Materials Science | Textbook | Lira-K, Oldy-plyus, Kyiv, 612 p. |
| Merezhko N.V., Zimina N.K., Sirenko S.O., Sim″yachko O.I.. | 2010 | Materials science and technology of materials | Textbook | Nat. trade-ekon. un-ty, Kyiv, 352 p. |
| V.A. Shalomeev, A.A. Glotka, E.V. Lisitsa, G.V. Tabunshchik | 2020 | Materials science of medical devices. | Textbook | Zhytomyr: publishing OO Evenyuk, 212 p. |
| **Additional literature** | | | | |
| Lisa A. Pruitt, Ayyana M. Chakravartula. | 2011 | Mechanics of Biomaterials. | Textbook | Cambridge University Press, 2011, 645p., ISBN: 978-0-521-76221-2. |
| M.B. Altman, A.F. Belov, V.I. Dobatkin | 1978 | Magnesium alloys: the handbook | Textbook | Metallurgy, Moscow, 232 p. |
| G.V. Raynor | 1964 | The Physical Metallurgy of Magnesium and Its Alloys | Textbook | Metallurgy, Moscow, 487 p. |

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