

## IMPLEMENTATION OF THE INTERNATIONAL ERASMUS+ BIOART PROJECT AT VINNYTSIA NATIONAL TECHNICAL UNIVERSITY

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*The current status of the project development issue of the Erasmus + “Innovative Multidisciplinary Curriculum for Artificial Implants for Bio-Engineering BSc/MSc Degrees” program (BIOART) in Vinnytsia National Technical University has been considered. Targeted specialties and specializations that are selected for pilot training are noted. The basic competencies that students should have as a result of training are given.*

**Keywords:** Erasmus +, BIOART, pilot teaching, competencies, Artificial Implants, Bio-Engineering

From November 2017, at VNTU launched the project of the European Union Erasmus + Program "Innovative multidisciplinary educational program on artificial implants for bio-engineering for bachelors and masters" (№586114-EPP-1-2017-1-ES-EPPKA2-CBHE-JP ) (short name BIOART) from the direction of K2 - building potential of higher education. Together with VNTU, 13 partners are involved in the project (Universidad Politécnica de Madrid - Grantholder, Spain; Sami Shamoon College of Engineering, Israel; Cracow University of Technology, Poland; University for Continuing Education – Danube University Krems, Austria; Leuven Catholic University (KU Leuven), Belgium; Holon Institute of Technology and Inter-University Computation Center, Israel, Zaporizhzhia National Technical University, Sytenko Institute of Spine and Joint Pathology of National Ukrainian Academy of Medical Sciences, Ukraine; Donbass State Engineering Academy, Ukraine; State Higher Education Institution «Pryazovskyi State Technical University», Ukraine). The beneficiaries are institutions of Ukraine and Israel. The aim of the project is to train highly qualified graduates from intelligent artificial implants, improve internationalization and interregional cooperation, as well as develop innovations in the knowledge triangle in the field of design, manufacture and maintenance of artificial implants (<https://bioart.iucc.ac.il>). It is obvious that potential of each participant, regardless of whether he is a donor or beneficiary, differs significantly due to national characteristics of the educational and scientific process, the specifics of the historical development of partner institutions, different specializations of units involved and specific performers ect. VNTU also has specifics in the implementation of its tasks.

Leading scientists and specialists of VNTU from those departments where it is planned to train students with the acquisition of competencies in the field of intelligent artificial implants are involved in the implementation of the multidisciplinary project. These are teachers of BME department, which is graduating in the specialty 163 - biomedical engineering, teachers of TAME department in the specialty 131 - applied mechanics and teachers of the departments who are involved in the development of the project in its individual directions and tasks - SMAM, HM, LSSP.

In VNTU from 2019-2021 academic year the educational-professional program of the 2nd level of higher education (master's degree) of training on a specialty 163 under the name "Intelligent artificial implants and medical devices in bioengineering" within which together

with a bachelor's level was implemented in the education process the total number of 43 credits in new and updated disciplines. Within the framework of the Bologna Process, a number of competencies have been developed, which widely cover the range of future knowledge and skills of students. It is worth focusing on new important competencies that biomechanics students will master at VNTU, which we will conditionally divide into the following areas. In the field of biomaterials - the ability to formulate requirements for biomedical materials and products made from them, to study their physical and mechanical properties and methods of their analysis; in the field of sensors and bio-sensors - the ability to choose the types and methods of using various types of intelligent sensors and sensor systems to obtain indicators of the state of the human body, as well as to process the information received from the sensors; in the field of design and manufacture - the ability for computer modeling in the design of biomedical equipment and implants in accordance with the individual characteristics of a person using computer-aided design systems, the ability to make a 3D model of an implant and its prototype using additive technologies.

Recent advances are allowing bio-engineers to develop smart artificial implants with enhanced capabilities. Some key contributions in this area are the following:

- Low-power microelectronics, advanced fabrication processes, and packaging for device miniaturization [1].
- Wearable sensors (including biosensors) that allow us to measure an ever increasing range of biosignals with a reduced burden for the user and an improved precision [2].
- Smart materials with the capacity of adaptively changing their properties over time and even repairing themselves [3].
- 3D printing of biocompatible materials, cells and other supporting components to obtain 3D complex living tissues and organs [4].
- Advanced machine learning and signal processing techniques to manage large amounts of data, and to extract information from signals corrupted by noise and interferences [5].

Today, VNTU conducts pilot teaching in 14 disciplines to master new competencies. A laboratory center for the specialty "BIOART" was created with the necessary equipment for conducting the laboratory-practical part of the disciplines ([http://bmi.vntu.edu.ua/bioart\\_lab.php?lang=en](http://bmi.vntu.edu.ua/bioart_lab.php?lang=en)). The following equipment was purchased within the project - Universal testing machine, Smart board with projector, Virtual reality helmet, 3D scanner, Desktop 3D printer FDM, Desktop 3D printer SLA, Laser cutting machine, Programmable power supply, Digital oscilloscope, Digital microscope trinocular.

At the end of 2020, accreditation (mark B) of the 2nd level of training (master's degree) in specialty 163 entitled "Intelligent artificial implants and medical devices in bioengineering" was passed. Due to the implementation of the project, the contingent of students enrolled in the 1st year of study in 2020 has significantly increased.

At the end of the 3rd year of the project, VNTU held a student competition for the best Bioart development. The winners of the competition have the opportunity to take part in international competitions, get a unique "white gloves experience", teamwork with the participation of students from partner universities. In general, the project is successfully implemented and completed in 2021.

The great potential for opening opportunities for implementation of project results in the educational process have Mechanical specialties, in particular 131 - Applied Mechanics and 132 - Materials Science, as important competencies can be acquired through minor adjustments of curricula, including through the opening of new promising educational and professional program's. And the use of modern teaching methods and equipment will allow

students to better master the new educational material, which is not only interesting but relevant and in demand in the labor market of Ukraine.

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#### ІМПЛЕМЕНТАЦІЯ МІЖНАРОДНОГО ПРОЕКТ ЕРАЗМУС + БІОАРТ У ВІННИЦЬКОМУ НАЦІОНАЛЬНОМУ ТЕХНІЧНОМУ УНІВЕРСИТЕТІ

##### Анотація

*Розглянуто поточний стан питання розробки проекту програми «Еразмус +» «Інноваційна мультидисциплінарна навчальна програма зі штучних імплантатів для біоінженерії з підготовки бакалаврів та магістрів» (BIOART) у Вінницькому національному технічному університеті. Відзначаються цільові спеціальності та спеціалізації, які обрані для пілотного навчання. Подано основні компетенції, які повинні мати студенти в результаті навчання.*

**Ключові слова:** Erasmus +, BIOART, пілотне навчання, компетенції, штучні імплантати, біоінженерія

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