National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"

Department of Biosafety and Human Health

PROSTHETIC AND ORTHOPEDIC AND REHABILITATION EQUIPMENT

Working program of basic discipline (Silabus)

Реквізити навчальної дисципліни

Level of higher education	***Second (master's)***
Branch of knowledge	*16 Chemical and Bioengineering*
Specialty	*163 Biomedical Engineering*
Educational program	*Medical Engineering*
Discipline status	*Elective discipline*
Form of study	*full-time / day / mixed / remote*
Year of preparation, semester	*5 course (autumn semester)*
The scope of discipline	*4 ECTS credits / 120 hours*
Semester control / Control measures	*Modular control work, Test Work*
Lessons schedule	*According to the schedule on the site http://rozklad.kpi.ua/*
Language of instruction	*Ukrainian / English*
Information about course leader / teachers	*Lecturer: Doctor of Medical Sciences, prof. Khudetsky Igor Yulianovich, igorkhudetskyy@gmail.com 0672830011, Ph.D., Associate Professor, Antonova-Rafi Julia Valerievna antonova-rafi@ukr.net 0675063994 Practical: Ph.D., Associate Professor, Antonova-Rafi Julia Valerievna antonova-rafi@ukr.net 0675063994 assistant of the department of Biosafety and Human Health Snitsar Yevhen Viktorovych snitsarye@gmail.com 0982460212*
Course placement	*Moodle https://do.ipo.kpi.ua*

Distribution of hours

Semester	Lectures	Practical	Independent Work
autumn semester	*28*	*44*	*48*

Curriculum of the discipline

1. Description of the discipline, its purpose, subject of study and learning outcomes

The discipline "Prosthetic and orthopedic and rehabilitation equipment" is focused on the formation of applicants for competencies to acquire deep knowledge, skills and abilities in the areas of: conceptual principles of research, development, design, operation of biological, medical and biotechnical devices and systems; modern technologies of manufacturing prosthetic and orthopedic products, techniques, methods and means of development, design of prosthetic and orthopedic and accessories.

The purpose of the discipline: formation of professional competencies necessary for experts who are able to solve complex problems either in the field of biomedical engineering or in the course

of education that to include research and innovative activity under undefined conditions observation on the interaction of biological, natural and artificial systems (prostheses, implants, etc.), to plan biotechnical tests of artificial prostheses and systems, as well as the ability to develop models and conduct experiments to solve problems, related to human health according to the specific needs of scientific research, analyze, explain the results and evaluate the cost of research.

General competencies:

GC 1 Ability to abstract thinking, analysis and synthesis.

GC 2 Ability to search, process and analyze information from various sources.

GC 3 Ability to identify, formulate and solve problems.

GC 4 Ability to work in a team.

Special (professional) competencies:

PC 1 Ability to solve complex problems of biomedical engineering using the methods of mathematics, natural and engineering sciences.

PC 2 Ability to develop a working hypothesis, plan and set experiments to test the hypothesis and achieve the engineering goal using appropriate technologies, technical means and tools.

PC 4 Ability to create and improve tools, methods and technologies of biomedical engineering for research and development of bioengineering facilities and systems for medical and technical purposes.

PC 5 Ability to develop terms of reference for creation, as well as to model, evaluate, design and construct complex bioengineering and medical engineering systems and technologies.

PC 6 Ability to study biological and technical aspects of functioning and interaction of artificial biological and biotechnical systems.

PC 7 Ability to work in a multidisciplinary team.

PC 8 Ability to develop models and perform experiments aimed at solving problems related to human health, according to the specific needs of scientific research, to analyze, explain the results and evaluate the cost of research.

PC 12 Ability to perform research and observations on the interaction of biological, natural and artificial systems (prostheses, artificial organs, etc.), to plan biotechnical tests of artificial prostheses and systems.

The program learning outcomes after studying the discipline:

PLO 1 Understanding of fundamental-applied, medical-physical and bioengineering bases of technologies and equipment for research of physiological and pathological processes of the person .

PLO 4 Application of calculation methods and selection of classical and new designs of biomaterials, elements of devices and systems of medical appointment .

PLO 6 Possession of methods of designing digital microprocessor and biotechnical systems for medical purposes

PLO 7 Possession methods research, design and construction of objects of biomedical engineering, analysis and processing of experimental data .

PLO 8 Knowledge of general requirements for the conditions of engineering, technological and scientific projects .

PLO 11 Understanding the latest achieving in Biomedical Engineering

PLO 1 6 Knowledge of methods of design, construction, improvement and application of medical-technical and bioengineering products, devices and systems in compliance with technical requirements, as well as to support their operation.

PLO 18 Creation and improvement of means, methods and technologies of biomedical engineering for comprehensive research and development of bioengineering objects and systems of medical and technical purpose.

PLO 19 Development, planning, use and substantiation of innovative projects of bioengineering facilities and systems for medical-technical purposes, taking into account engineering,

medical, legal, economic, environmental and social aspects, the implementation of their information and methodological support.

PLO 21 Solving in practice the tasks of biomedical engineering with awareness of their own ethical and social responsibility in personal activities and / or in a team.

2. Prerequisites and postrequisites of the discipline (place in the structural and logical scheme of education according to the relevant educational program)

The discipline "Prosthetic and orthopedic and rehabilitation equipment" is interdisciplinary. It integrates according to its subject knowledge from other educational and scientific fields: physiology, biophysics, mechanics, materials science, laboratory, medical and diagnostic medical equipment. According to the structural and logical scheme of the master's program "Biomedical Engineering and Technology" is closely related to other disciplines in modern research in the specialty.

Required skills:

1. Fundamentally applied, medical-physical and bioengineering bases of technologies for prosthetics.
2. Ability to abstract thinking, analysis and synthesis.
3. Ability to work in a team.
4. Ability to study biological and technical aspects of functioning and interaction of artificial biological and biotechnical systems.
5. Implementation of market laws to update the range of prosthetic, orthotic products and artificial organs.
6. Preservation of scientific and technical potential.

3. Content of the discipline

Програмні результати навчання, контрольні заходи та терміни виконання оголошуються студентам на першому занятті.

№ s/n	Subject	Program learning outcomes	The main tasks	
			Control measure	Deadline
1	Basic information and classification of prosthetic and orthopedic and rehabilitation equipment	PLO 1 PLO 11	Practical work №1	1st week
2	Regulatory and legal provision of citizens with technical means of rehabilitation in Ukraine. Requirements for technical means of rehabilitation	PLO 8 PLO 16 PLO 19	Practical work №2	2nd week
3	Simulators: types and classification	PLO 18	Practical work №3, Practical work №4	3rd week
4	Professional ergometers: characteristics and general requirements	PLO 7 PLO 11 PLO 16	Practical work №5, Practical work №6,	4th week
5	Technical means for suspension therapy	PLO 7 PLO 11 PLO 16	Practical work №7	5th week
6	Apparatus for restoring the amplitude of movements and	PLO 7 PLO 11	Practical work №8, Practical work №9	6th week

	muscle strength	PLO 16		
7	Apparatus for training balance and coordination of the body	PLO 7 PLO 11 PLO 16	Practical work №10, Practical work №11,	7th week
8	Orthosis and prosthetics: tasks, classification of orthoses and prostheses	PLO 1 PLO 8 PLO 11	Practical work №12	8th week
9	Joint arthroplasty and features of rehabilitation	PLO 1 PLO 7	Practical work №13,	9th week
10	Amputations: types, indications	PLO 1	Practical work №14,	10th week
11	Prosthetics and orthoses of the upper extremities: types of prostheses and their characteristics	PLO 4 PLO 6 PLO 16 PLO 18 PLO 19 PLO 21	Practical work №15	11th week
12	Prosthetics and orthoses of the lower extremities: types of prostheses and their characteristics	PLO 4 PLO 6 PLO 16 PLO 18 PLO 19 PLO 21	Practical work №16, Practical work №17	12th week
13	Aesthetic prosthetics in mammology and ophthalmology. Phalloprosthesis	PLO 4 PLO 16 PLO 18 PLO 19 PLO 21	Practical work №18,	13th week
14	Prosthetics in maxillofacial surgery.	PLO 4 PLO 16 PLO 18 PLO 19 PLO 21	Practical work №19	14th week
15	Technical means of transportation	PLO 1 PLO 8 PLO 11	Practical work №20	15th week
16	Torso orthosis	PLO 1 PLO 8 PLO 11	Practical work №21	16th week
17	Modular control work	all	Practical work №22	17th week
18	Test Work	all		18th week

Modular control work is an ongoing control measure that covers the practical skills of using science tools to quantify, analyze and evaluate functional systems and processes of interacting natural and artificial systems, which will: research, develop, apply, improve and implement solutions, tools and methods engineering and exact sciences, as well as methods and technologies of medical and bioengineering to solve problems related to human health and quality of life.

4. Training materials and resources

Basic literature:

1. Баумгартнер Р. Ампутация и протезирование нижних конечностей / Р. Баумгартнер, П. Ботта., 2002. – 504 с
2. Технология изготовления протезов верхних конечностей / [В. Г. Петров, Ю. И. Замилмцкий, Г. Н. Буров та ін.]., 2008. – 128 с,(Гипократ).
3. Копейкин В. Н. Зубопротезная техника / В. Н. Копейкин, Л. М. Демнер., 1998. – 416 с.
4. Фліс П. С. Техніка виготовлення знімних протезів. Підручник / П. С. Фліс, Т. М. Банних., 2012. – 296 с.
5. Основы несъемного протезирования / [Г. Шиллинбург, С. Хобо, Л. Уитсетт та ін.]., 2008. – 592 с.
6. Вульфес Х. Современные технологии протезирования / Хеннинг Вульфес., 2004. – 280 с.
7. Использование тренажеров в оздоровительных целях / А. А. Шелюженко, С.А. Душанин, Е.А. Нирогова, Л.Я. Ивашенко. К.: Здоров'я, 1984. – 135 с.
8. Технічні засоби в фізичній реабілітації:Опорний навчально-методичний інтерактивний комплекс / За заг.ред. Т. В. Кухтик. - Краматорськ: ДІТМ МНТУ ім. Ю.Бугая, 2010. – 106 с.
9. Ціж Л. М. Актуальні проблеми забезпечення технічними засобами реабілітації осіб з інвалідністю в Україні / Л. М. Ціж. // Вісник Запорізького національного університету: Збірник наук. статей. - Фізичне виховання та спорт. – 2017. – №1. – С. 183–191.

Additional literature:

1. Мухін В. М. Фізична реабілітація / В. М. Мухін., 2009. – 488 с.
2. Белик К. Д. Биомеханика. Основные понятия. Эндопротезирование тканей и органов / К. Д. Белик, А. Н. Пель., 2014. – 104 с. – (Новосибирский государственный технический университет).
3. Jacofsky D. Fundamentals of Revision Hip Arthroplasty: Diagnosis, Evaluation, and Treatment / D. Jacofsky, A. Hedley., 2012. – 232 с.
4. Загородний Н. В. Эндопротезирование тазобедренного сустава. Основы и практика. Руководство / Николай Васильевич Загородний., 2013. – 704 с.
5. Дрижак В. І. Рак молочної залози [Електронний ресурс] / В. І. Дрижак, М. І. Домбрович // Укрмедкнига. – 2005. – Режим доступу до ресурсу: https://repository.tdmu.edu.ua/bitstream/handle/1/9035/rak_drushak.pdf?sequence=1&isAllowed=y.
6. Загорский В. А. Протезирование зубов на имплантах / В. А. Загорский, Т. Г. Робустова., 2016. – 368 с.
7. Современные методы механотерапии в медицинской реабилитации : науч.-метод. пособие / под ред. И. З. Самосюка. – Киев : Науч.свит, 2009. – 184 с.

Educational content

5. Methods of mastering the discipline (educational component)

Names of sections and topics	Number of hours									
	Total	including								
		Lectures		PRACTICAL				Laboratory	Individual classes	Independent work of students
				Seminars		Comp. practice.				
		According to the curriculum	Classroom	According to the curriculum	Classroom	According to the curriculum	Classroom			
1	2	3		4				5	6	7
Basic information and classification of prosthetic and orthopedic and rehabilitation equipment	6	1		2						3
Regulatory and legal provision of citizens with technical means of rehabilitation in Ukraine. Requirements for technical means of rehabilitation	6	1		2						3
Simulators: types and classification	8	1		4						3
Professional ergometers: characteristics and general requirements	8	1		4						3
Technical means for suspension therapy	6	1		2						3
Apparatus for restoring the amplitude of movements and muscle strength	8	2		4						2
Apparatus for training balance and coordination of the body	8	2		4						2
Orthosis and prosthetics: tasks, classification of orthoses and prostheses	6	2		2						2
Joint arthroplasty and features of rehabilitation	6	2		2						2
Amputations: types, indications	6	1		2						3
Prosthetics and orthoses of the	8	2		2						4

Names of sections and topics	Number of hours									
	Total	including								
		Lectures		PRACTICAL				Laboratory	Individual classes	Independent work of students
				Seminars		Comp. practice.				
		According to the curriculum	Classroom	According to the curriculum	Classroom	According to the curriculum	Classroom			
upper extremities: types of prostheses and their characteristics										
Prosthetics and orthoses of the lower extremities: types of prostheses and their characteristics	8	2		4						2
Aesthetic prosthetics in mammology and ophthalmology. Phalloprosthesis	8	2		2						4
Prosthetics in maxillofacial surgery.	6	2		2						2
Technical means of transportation	6	1		2						3
Torso orthosis	6	1		2						3
Modular control work	8	2		2						4
Test Work	2	2		-						2
Hours in general	**120**	**28**		**44**		**0**		**0**		**48**

6. Independent student work

Types of independent work: preparation for classroom classes is carried out according to the discipline plan, calculations based on primary data obtained in laboratory classes, problem solving, essay writing, calculation work, homework, etc. is sent to the teacher electronically through the MOODLE system and in terms of time specified in the current evaluation system.

Policy and control

7. Policy of academic discipline (educational component)

Violation of deadlines and incentive points

Encouragement points		Penalty points	
Criterion	Weight points	Criterion	Weight points
Improving practical work	1,5 points	Untimely implementation and test of practical work	- 0,5 points
Timely writing of MCW	0 points	Untimely writing MCW	- 5 points
Timely passing of the exam	0 points	Retake exam	- 5 points

Attending classes

Attendance at lectures, practical and field trips is not evaluated, for absence they are awarded penalty points. Students are encouraged to attend classes because they teach theoretical material and develop the skills needed to complete a semester individual assignment. The grading system is focused on obtaining points for student activity, as well as performing tasks that are able to develop practical skills and abilities.

Missed control measures can be rescheduled until the end of the certification week.

The thematic task, which is submitted for inspection in violation of the deadline - is not evaluated.

Semester certification of students

Intermediate attestation of students (hereinafter - attestation) is a calendar boundary control. The purpose of the certification is to improve the quality of student learning and monitor the implementation of the schedule of the educational process by students [1].

Criterion			The first certification	The second certification
Term of certification [1]			8th week	14th week
Conditions for obtaining certification	Current rating [1]		≥ 13 point	≥ 30 point
	Performing practical work	Practical work 1-10	+	+
		Practical work 11-18	-	+

Academic integrity

The policy and principles of academic integrity are defined in Section 3 of the Code of Honor of the National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute”. Read more: https://kpi.ua/code.

Norms of ethical behavior

Normative principles of behavior of students and employees, defined in sections 2 of the Code of Honor of the National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute”. Read more: https://kpi.ua/code.

Procedure for appealing the results of control measures

The student has the right to appeal the results of the control measure according to the approved provision on appeals in the National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute” (approved by the order №NON/128/2021 from 20.05.2021) - https://osvita.kpi.ua/index.php/node/182

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[1] Rating systems for assessing learning outcomes: Recommendations for development and application. Kyiv: KPI named after Igor Sikorsky, 2018. 20 p.

8. Types of control and rating system for assessing learning outcomes

Modular control work is an ongoing control measure that covers the practical skills of using science tools to quantify, analyze and evaluate functional systems and processes of interacting natural and artificial systems, which will: research, develop, apply, improve and implement solutions, tools and methods engineering and exact sciences, as well as methods and technologies of medical and bioengineering to solve problems related to human health and quality of life.

9. Evaluation system

№ s/n	Control measure	%	Weight points	Number	Total
1.	Practical work	33	1,5	22	33
2.	Modular control work	12	12	1	12
3.	Distance learning / Scientific activity	15	15	1	15
4.	Test Work	40	40	1	40
	Total				100

The results are announced to each student individually in the presence or remotely (in the Moodle system or by e-mail).

№ s/n	Modular control work	%	Weight points	Number	Total
1.	The answer is correct (at least 90% of the required information)	90	30	3	90
2.	Minor errors in the answer (at least 75% of the required information)	75	25	3	75
3.	There are shortcomings in the answer and some errors (at least 60% of the required information)	60	20	3	60
4.	Answer the test question with answer options	10	10	1	10
5.	The answer is missing or incorrect	0	0	3	0
	Maximum number of points				100

№ s/n	Distance Learning	%	Weight points	Number	Total
1.	Answer the control questions in the online system Webex or Zoom	40	10	4	40
2.	Answer the tests in the Moodle system	50	10	5	50
3.	Timeliness of distance learning	10	10	1	10
	Total				100

№ s/n	Test Work	%	Weight points	Number	Total
1.	The answer is correct (at least 90% of the required information)	90	30	3	90
2.	Minor errors in the answer (at least 75% of the required information)	75	25	3	75
3.	There are shortcomings in the answer and some errors (at least 60% of the required information)	60	20	3	60
4.	Answer the test question with answer options	10	10	1	10
5.	The answer is missing or incorrect	0	0	3	0
	Maximum number of points				100

Semester certification of students

Mandatory condition for admission to the exam /Test Work		Criterion
1	Current rating	RD > 60
2	Completion of a semester individual task	Distance learning RD > 60
3	Execution of modular control work	Number of points > 6
4	Test Work	Number of points > 60

Additional conditions for admission to the exam /Test Work:

1. Execution of practical works;
2. Positive result of the first attestation and the second attestation;
3. Attendance of 60% of lectures.

Table of translation of rating points to grades on a university scale [2]

Rating points, RD	Score for university scale	Ability to receive "automatic" ratings
95 ≤ RD ≤ 100	Perfectly	Perfectly
85 ≤ RD ≤ 94	Very good	Very good
75 ≤ RD ≤ 84	Good	Good
65 ≤ RD ≤ 74	Satisfactorily	-
60 ≤ RD ≤ 64	Enough	-
RD < 60	Unsatisfactorily	-
Failure to comply with the conditions of admission	Not allowed	-

[2] Assessment of learning outcomes is carried out according to the rating system of assessment in accordance with the recommendations of the Methodical Council of KPI. Igor Sikorsky, approved by the protocol №7 dated March 29, 2018.

Work program of the discipline (syllabus):

Compiled by Head of the Department of Biosafety and Human Health, Doctor of Medicine, Professor, I. Yu. Khudetsky

Approved by the Department of _____ (protocol № ___ to _____)

Approved by the Methodical Commission of the Faculty of Biomedical Engineering (protocol № ___ to _____)