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

Translational Medical Bioengineering

Human Anatomy and Physiology. Part 2. Fundamentals of Human Anatomy and Physiology

Working program of basic discipline (Syllabus)

Requisites for basic discipline	
Level of higher education	***First (bachelor's)***
Field of knowledge	***16 Chemical and Bioengineering***
Specialty	***163 Biomedical Engineering***
Educational program	***Medical engineering***
Discipline status	***Normative discipline***
Form of study	***full-time / day / mixed / remote***
Year of training, semester	***1th course, spring semester***
Course volume	***5 ECTS credits / 150 hours***
Semester control / Control measures	***Exam / modular test / essay***
Lessons schedule	***36 lecture hours and 36 hours of practical classes***
Language of instruction	***English, Ukrainian***
Information about course leader / teachers	***Lecturer:*** ***Associate Professor, Bespalova Olena*** *http://bi.fbmi.kpi.ua/uk/bespalovaua/, o.bespalova@kpi.ua* ***Practical:*** ***Associate Professor, Bespalova Olena*** *http://bi.fbmi.kpi.ua/uk/bespalovaua/, o.bespalova@kpi.ua*
Course placement	*https://do.ipo.kpi.ua*

Program educational disciplines

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

What will be studied. The form and structure of the human body, its constituent organs and systems, understanding the regularities of the structure of the organs of each system of the body, the interdependence of their structure and functions, and physiological processes.

Why is this interesting/needs to be studied?

- In the process of studying this discipline, the musculoskeletal system is first considered, that is, bones, ligaments, joints and muscles. Then the internal organs are considered by organ systems. In particular, these are the digestive organs, respiratory organs, cardiovascular system and other systems. The course ends with the study of the nervous system and sensory organs. Human anatomy and physiology is one of the fundamental sciences, both for medicine and for biology and bioengineering. Knowledge of human anatomy and physiology will allow you to form a bioengineering view of the implementation of information processes in the structure and

function of cells, tissues, organs and physiological and anatomical systems of the human body, which will allow you to solve engineering problems related to the interaction between living and non-living systems.

Why can you learn?

Knowledge of:

- the structure of systems, organs and tissues, based on modern achievements in macro- and microanatomy, physiology, biology;
- the basics of the structure and function of the relevant physiological and anatomical systems of the body and their application in the creation, design and engineering maintenance of biological and medical devices and systems;
- basic physical and physicochemical laws of functioning of biological objects;
- general information about the human body and its functions from the standpoint of a systems approach and their use in biomedical engineering;
- universal principles of the structure of complex biological systems, including the human body.

Ability to:

• apply the acquired knowledge in the creation, design and development of artificial organs and systems taking into account the structure and function of the human body;

• form a bioengineering view of the implementation of information processes in the structure and function of cells, tissues, organs and physiological and anatomical systems of the human body;

• evaluate and use bioelectric phenomena, the nature of the potentials of the human body and its individual structures and their role in the information processes of the human body when assessing the state of health and its correction;

• navigate in the basic physical and physicochemical laws that underlie the functioning of biological objects;

• find similarities and differences between the functional systems of the human body and engineering and technical devices and automatic systems;

• develop engineering thinking and approaches to the study of medical and biological objects;

How can you use the acquired knowledge and skills?

The acquired knowledge and skills are an important tool in conducting research and organizational and production work in the field of biomedical engineering in the creation, design and development of artificial organs and systems taking into account the structure and function of the human body.

Program competencies that must be formed after studying the discipline and that correspond to the educational program "Medical Engineering":

General competencies (EP put into effect by the Order of the Rector NON/434/2024 dated June 10, 2024):

GC – **02** Knowledge and understanding of the subject area and understanding

Special (professional) competencies (EP put into effect by the Order of the Rector NON/434/2024 dated June 10, 2024):

P**C - 09-** Ability to identify, formulate, and solve engineering problems related to the interaction between living and non-living systems

The program learning outcomes after studying the discipline " *Human Anatomy and Physiology. Part 2. Fundamentals of Human Anatomy and Physiology" are (EP put into effect by the Order of the Rector NON/434/2024 dated June 10, 2024):*

PLO - 18- Understanding of fundamental-applied, medical-physical, and physico-chemical principles governing the functioning of biological objects, as well as bioengineering fundamentals of technologies and equipment for researching human body processes

PLO - 22- Knowledge of general principles and structure of complex biological systems, including the human body and its functions from the perspective of a systemic approach and their utilization in biomedical engineering, as well as basic methods and tools used for quantitative assessment of physiological system functioning

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

The study of the discipline " Human Anatomy and Physiology. Part 2. Fundamentals of Human Anatomy and Physiology" is preceded by the mastery of the following academic disciplines: Human Anatomy and Physiology. Part 1. Fundamentals of Biomedical Knowledge. Medical Terminology.

The academic discipline belongs to the cycle of normative academic disciplines; according to the structural and logical scheme of the specialist training program, the discipline " Human Anatomy and Physiology. Part 2. Fundamentals of Human Anatomy and Physiology" is closely related to the discipline "Quantitative Physiology".

3. Content educational disciplines

Human Anatomy and Physiology. Part 2. Fundamentals of Human Anatomy and Physiology

Lecture topics*:*

Topic 1. Introduction to human anatomy and physiology, understanding of fundamental and applied laws of functioning of biological objects.

Topic 2. General characteristics and classification of tissues, patterns of functioning of biological objects, and bioengineering fundamentals of technologies.

Topic 3. Knowledge of general information and principles of the structure of complex biological systems, including the human body, anatomy and physiology of the human musculoskeletal system.

Topic 4. Anatomy and physiology of the muscular system from the perspective of a systems approach and their use in biomedical engineering,

Topic 5. Anatomy and physiology of internal organs and quantitative assessment of the functioning of physiological systems.

Topic 6. Anatomy and physiology of the cardiovascular system from the perspective of a systems approach and their use in biomedical engineering.

Topic 7. Knowledge of general information, anatomy and physiology of the nervous system and bioengineering fundamentals of technologies and equipment for studying processes in the human body.

Topic 8. Anatomy and physiology of the sensory system from the perspective of a systems approach and their use in biomedical engineering.

Topic 9. Anatomy and physiology of the endocrine system, as well as the main methods and tools used to quantify the functioning of the physiological system.

4. Training materials and resources

Basic literature:

1. Основи анатомії та фізіології людини: Навчальний посібник для практичних робіт з кредитного модуля дисципліни «Анатомія та фізіологія людини-2. Основи анатомії та фізіології людини» для здобувачів ступеня бакалавра спеціальності 163 «Біомедична інженерія» [Електронний ресурс]: навчальний посібник для студ. спеціальності 163 «Біомедична інженерія» / КПІ ім. Ігоря Сікорського: уклад. О.Я. Беспалова. – Київ : КПІ ім. Ігоря Сікорського, 2021. – 63 с. https://ela.kpi.ua/handle/123456789/42125

2. Федонюк Я. І., Дубінін С. І., Федонюк Л. Я., Котляренко Л. Т. Медична біологія, Анатомія, Фізіологія та Патологія людини. – Львів: «Новий Світ-2000», 2020. – 880 с.
3. Долгов О.М. Вивчаємо анатомію людини. Вчення про судини – ангіологія. – Навч. посібник. – Вінниця, ВДПУ, 2016. – 48 с.:
4. Вікова анатомія та фізіологія: практикум / О. Д. Боярчук, С. В. Гаврелюк; Держ. закл. «Луган. нац..ун-т імені Тараса Шевченка». – Старобільськ: Вид-во ДЗ «ЛНУ імені Тараса Шевченка», 2017. – 252 с.
5. 1. Медична термінологія. Навчальний посібник для самостійної роботи студентів з кредитного модуля дисципліни «Анатомія та фізіологія людини-1. Основи біомедичних знань. Медична термінологія» для здобувачів ступеня бакалавра спеціальності 163 «Біомедична інженерія» [Електронний ресурс]: навчальний посібник для студ. спеціальності 163 «Біомедична інженерія» / КПІ ім. Ігоря Сікорського: уклад. О.Я. Беспалова. - Електронні текстові дані (1 файл: 368 Кбайт). – Київ : КПІ ім. Ігоря Сікорського, 2021. – 61 с.

Additional literature:

1. Пластична анатомія: практикум / О. Д. Боярчук, О. І. Гужва; Держ. закл. «Луган. нац..ун-т імені Тараса Шевченка». – Старобільськ: Вид-во ДЗ «ЛНУ імені Тараса Шевченка», 2017. – 120 с.
2. Головацький А. С., Черкасов В. Г., Сапін М. Р., Парахін А. І. Анатомія людини. У трьох томах. Том другий /За редакцією В. Г. Черкасова та А. С. Головацького. — Вінниця: Нова Кйига, 2017,456 с.
3. Фізіологія: підручние для студ. вищ. мед. навч. закладів/ В.Г. Шевчук, В.М. Мороз, С.М. Белан та ін.; за редакцією В.Г. Шевчука.- Вінниця: Нова Книга. 2012.-448 с.

Educational content

5. Method mastery educational disciplines (educational component)

№ s/n	Lecture topics	Program learning outcomes	Main tasks	
			Control measure	Term implementation
1.	Introduction to human anatomy and physiology, understanding of fundamental and applied laws of functioning of biological objects.	PLO *18*	Practical work *1*	*1* - st week
2.	General characteristics and classification of tissues, patterns of functioning of biological objects, and bioengineering fundamentals of technologies.	PLO *18*	Practical work *2*	*2*-- nd week
3.	Knowledge of general information and principles of the structure of complex biological systems, including the human body, anatomy and physiology of the human musculoskeletal system. P.1. *General anatomical structure of bones. Anatomical structure of the human skeleton, physiological features* P.2. *Anatomical structure of the upper and lower extremities. Types of bone joints*	PLO *22*	Practical work *3,4*	*3-4*-- nd week
4.	Anatomy and physiology of the muscular system from the	PLO *22*	Practical work	*5-6*-- nd

№ s/n	Lecture topics	Program learning outcomes	Main tasks	
			Control measure	Term implementation
	perspective of a systems approach and their use in biomedical engineering, P.1. *Anatomy and physiology of the muscular system. Muscles and fascia of body parts.* P.2 Muscles of the back and upper and lower extremities		*5,6*	week
5.	Anatomy and physiology of internal organs and quantitative assessment of the functioning of physiological systems. P. *1. Anatomy and physiology of the digestive system.* P.*2. Anatomy and physiology of the glands of the digestive system* P.*3. General anatomy and physiology of the respiratory system organs* P.*4. General anatomy of the urinary system organs.*	PLO *22*	Practical work *7,8,9,10*	*7-8-9-10-* nd week
6.	Anatomy and physiology of the cardiovascular system from the perspective of a systems approach and their use in biomedical engineering. P.*1. Anatomical structure of the heart.* P.*2. Anatomy and physiology of blood vessels.* P.*3. Blood and lymph as the internal environment of the body. Physiological significance*	PLO *22*	Practical work *11,12,13*	*11-12-13-* nd week
7.	Knowledge of general information, anatomy and physiology of the nervous system and bioengineering fundamentals of technologies and equipment for studying processes in the human body. P.*1. Nervous system: general structure and functions of the brain* P.*2. Anatomy and physiology of the peripheral nervous system.*	PLO *18*	Practical work *14,15*	*14-15-* nd week
8.	Anatomy and physiology of the sensory system from the perspective of a systems approach and their use in biomedical engineering. P.*1. Anatomy and physiology of the visual sensory system* P.*2. Anatomy and physiology of the auditory system*	PLO *22*	Practical work *16*	*16-* nd week
9.	Anatomy and physiology of the endocrine system, as well as the main methods and tools used to quantify the functioning of the physiological system.	PLO *22*	Practical work *17*	*17-* nd week
10.	Modular test work		Practical work *18*	*18-* nd week

Topics of practical classes*:*

Practical work 1. The subject and tasks of anatomy and physiology, their relationship, significance in medicine.

The significance of anatomy and physiology in the system of pharmaceutical education. A brief historical sketch of the development of anatomy and physiology. The role of prominent scientists in the development of anatomy and physiology. M.I. Pirogov, I.M. Sechenov, I.P. Pavlov. Methods of anatomical and

physiological research. Cell. Structure, shape and types of cells. Structure, function and relationship of all organoids of the cell. Methods of physiological research. Functions of the cell membrane

Practical work 2. Tissue level of organization of the human body.
Structure and functions of tissues of the human body. Definition of the concept of tissue, their classification, functional purpose and ability to regenerate.

Practical work 3. Anatomical features of the musculoskeletal system.
The study of bones, classification of bones. Bone tissue cells, the structure of compact and spongy substances, osteon. Chemical composition of bones, types and their connections Skeleton of the head - skull, features of its structure. The structure of bone as an organ and osteon as a structural unit of bone; types of bone connections in the human skeleton.

Practical work 4. Anatomical features of the upper and lower extremities. Connections of the bones of the upper and lower extremities.
The study of bones, classification of bones and types of connections between them.. Components of the skeleton of the lower and upper extremities and their joints.

Practical work 5. Anatomy and physiology of the muscular system.
Muscles as an organ, their classification and functional purpose. Types of muscles, classification and functions. Unstriated and striated muscles. The structure of muscle fiber, skeletal muscle as an organ. Brief information about the main groups of human muscles. Muscles and fascia of the head, their functional purpose. Muscles and fascia of the neck, their functional purpose. Muscles of the trunk - muscles of the chest and their functional purpose. Muscles of the back - superficial and deep, their functional purpose

Practical work 6. Mechanism of skeletal muscle contraction.
Muscle physiology. Physical and physiological properties of muscles. Membrane potential, its origin. Action potential, its phases and origin. Mechanism of muscle contraction. Single contraction, phases. Tetanic contraction. Muscle strength and work. Muscle fatigue. Properties of unstriated, striated muscle tissue. The value of physical training. Muscle contraction. Muscle tone. Physiological features of striated and unstriated muscles. Muscle fatigue. Muscle work. The value of physical training.

Practical work 7. Anatomical and physiological features of the digestive system.
Features of digestion in the oral cavity; digestion in the stomach - secretory activity of the gastric glands and research methods; digestion in the small intestine - features of digestion in the duodenum and the role of the pancreas in this process, the role of the liver and its bile in the process of digestion and absorption of fats; types of motility and its regulation; absorption of substances in different parts of the digestive canal and the mechanisms that ensure it.

Practical work 8. Anatomical and physiological features of the glands of the digestive system.
Structural and functional unit of the liver, liver cells. Liver: topography, structure, functions. Bile: types, features, composition and importance for digestion. Mechanism of formation and secretion of bile. Gallbladder, bile ducts. Pancreas: structure and location. Composition of pancreatic juice and its effect on food. Mechanism of secretion of pancreatic juice Anatomical structure of the gallbladder. Pancreas features of the structure its functional purpose

Practical work 9. Anatomy and physiology of the respiratory system Respiratory physiology.
Mechanism of inhalation and exhalation. Pulmonary ventilation. Volume of pulmonary air. Spirometry. Gas exchange in the lungs. Composition of inhaled and exhaled air. Transport of gases by blood. Gas exchange in tissues. Regulation of breathing. Humoral influence on the respiratory center. Negative effect of smoking on the respiratory organs.

Practical work 10. Physiology of the urinary system.
The kidneys as the main organ of the excretory system and the nephron as a structural and functional unit, mechanisms of glomerular filtration and the composition of primary urine; reabsorption in the proximal and distal parts of the nephron, final urine and its composition.

Practical work 11. Physiology of the cardiovascular system. Conducting system of the heart.
Physiological properties of the myocardium and biogenesis of electropotentials of typical and atypical cardiomyocytes; cardiac cycle and its phase structure, the conduction mechanism in the passage of blood in the cavities of the heart and the role of the valvular apparatus during cardiac activity. Phases of cardiac activity. Blood movement in the heart and the importance of the valvular apparatus. Concept of heart defects. Heart sounds, their origin. Number of heart contractions per 1 min. Heart rhythm disturbances. Bradycardia, tachycardia. Conducting system of the heart. Regulation of heart function. Electrical phenomena in the heart.

Practical work 12. Physiology of the circulatory system.
Blood movement through the vessels. The influence of age, physical activity, body condition, and the central nervous system on the level of blood pressure. Blood pressure, its types (systolic, diastolic, pulse). Methods of measuring blood pressure. Arterial pulse and its parameters. Blood depot. Microcirculatory bed. Blood flow velocity in arteries, capillaries, and veins. Concept of the nervous and humoral mechanism of regulation of cardiovascular activity.

Practical work 13. Physiological significance of blood and lymph.
Blood as the internal environment of the human body (IBO), its composition, quantity and main functions; characteristics of blood cells and their physiological purpose; hemostasis, its types and mechanisms for maintaining the liquid state of blood

Practical work 14. Physiology of the nervous system.
Nervous regulation and mechanisms of its implementation; reflex principle of the CNS activity and its levels in ensuring adaptive reactions of the organism. The concept of the central and peripheral nervous system and their functional unity; reflex as the main form of implementation of nervous activity.

Practical work 15. The mechanism of excitation transmission in synapses. Basic physiological processes, irritability, excitability.
The synapse as a functional contact between the membranes of excitable tissues. The structure and classification of synapses. The mechanism of excitation transmission in synapses. Mediators, their synthesis, secretion, exit into the synaptic cleft, interaction with receptors of the postsynaptic membrane. Types of mediators. The mechanism of synaptic transmission along nerves and nerve ganglia (nodes); the spinal cord, its functions, the role of its anterior and posterior roots, the formation of spinal nerves. The mechanism of action of mediators of the nervous system.

Practical work 16. Sensory system and its significance for human life.
The significance of analyzers in the cognition of the external world, its objective reality. I. Pavlov's teachings about analyzers. Receptors, classification, basic properties, their features, excitation mechanism. The process of information transmission. Conversion of signals into information. Visual sensory system, structural organization and conductive path of the visual analyzer.

Practical work 17. Physiology of the auditory and endocrine systems.
Auditory analyzer. Brief data on the structure of the organ of hearing. Receptor department. Mechanism of transmission of sound vibrations. Central mechanisms of processing sound information.. Olfactory sensory system. Receptors. Conducting and central departments. Thyroid gland: topography, structure, hormones and control of its activity. Endocrine function of the pancreas regulation of its endocrine. Activity.

Practical work 18. Modular test work

6. Independent work student

he total amount of independent work within the discipline is 78 hours, including:

- preparation for practical classes – 38 hours;

preparation of abstract work – 6 hours.

- preparation for modular test work (MKR) – 4 hours;
- preparation for the exam – 30 hours

An individual assignment in the form of an essay is planned for the discipline "Human Anatomy and Physiology. Part 2. Fundamentals of Human Anatomy and Physiology". The main goal of the essay is to deepen and expand students' theoretical knowledge on individual topics of the academic discipline, to gain experience in independent work with educational and scientific literature. The essay is completed in accordance with the requirements, within the time specified by the teacher.

The main topics of the abstract:

Topic 1. Characteristics and classification of tissues.

Topic 2. Human musculoskeletal system

Topic 3. Anatomy of the cardiovascular and lymphatic systems.

Topic 4. General anatomy of the respiratory system;

Topic 5. Physiology of the nervous system

Topic 6 Physiological circulatory system.

Essay topics are attached (Appendix No. 1)

Policy and control

7. Policy educational disciplines (educational component)

Violation of task deadlines and incentive points

Applicants may be awarded incentive points. The total amount of incentive points cannot exceed 5 points.
Incentive points are awarded for the following activities:

- participation in international or all-Ukrainian scientific conferences, congresses, etc. (on the subject of the academic discipline) (subject to publication of abstracts) (5 points;

Attending classes

No penalty points are awarded for absence from classes. However, applicants are encouraged to attend classes, as they teach theoretical material and develop practical skills necessary for the thorough formation of relevant competencies.

The assessment system is focused on receiving points for student activity, as well as completing tasks that can develop practical skills and abilities.

Missed assessment controls

Assessment tests scheduled to be administered during class are conducted on a pre-determined day, which is announced to students during the first week of the educational process. Conducting such assessment tests on another day is permitted in cases of serious and/or force majeure circumstances.

A practical assignment submitted for verification after the deadline, but before the deadline for issuing the current certification (or test/exam), is evaluated with penalty points.

Missing express control (tests) are not processed.

The result of the module test for an applicant who did not appear for the test is zero. In this case, the applicant has the opportunity to complete the module test at another time in agreement with the teacher.

Ensuring objectivity in assessing applicants

The objectivity of assessing applicants at all stages of mastering the discipline is ensured through the following mechanisms. First, the use of test forms for assessing knowledge. Second, detailed recommendations on the rating system for assessing learning outcomes (Section 8 of the Syllabus). Third, the use by applicants and teachers of all possible communication tools that ensure the preservation of communication history (e-mail, social networks, messengers, etc.). Fourthly, in case of disagreement with the assessment results, another teacher with appropriate professional competence and appointed by the department for the current academic year may be involved in checking the written works of applicants. In the absence of a coordinated opinion of the teachers regarding the assessment of the applicant's work, the issue is brought to a meeting of the department, and the issue is resolved in accordance with the "Regulations on Appeals at Igor Sikorsky Kyiv Polytechnic Institute" http://osvita.kpi.ua/node/182.

Procedure for appealing the results of assessment control measures

After receiving comments from the teacher with arguments regarding the assessment, the applicant has the right to individually ask all questions of interest regarding the results of the assessment control measures. If the applicant disagrees with the assessment, he must also provide arguments for his position and contact the dean of the faculty for further resolution of the issue (for details, see "Regulations on Appeals at Igor Sikorsky Kyiv Polytechnic Institute" http://osvita.kpi.ua/node/182).

Academic integrity

When using copyrighted content, analytical research results, and/or other information, applicants must cite the source. 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" (https://kpi.ua/code). In the event of a need to check academic texts prepared for applicants for the presence of text borrowings, the applicant may contact the teacher or the responsible person of the department for checking academic texts.

Norms of ethical behavior

The norms of ethical behavior of applicants and employees are defined in Section 2 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (https://kpi.ua/code).

Distance learning

Distance learning takes place through the Sikorsky Distance Learning Platform.

Online courses are provided in case of force majeure circumstances (in particular, quarantine measures) and for inclusive education of applicants with special needs.

Inclusive learning

The academic discipline is designed for students with special educational needs, but it should be taken into account that it places a heavy load on the visual apparatus. Depending on the special needs of students, distance learning may be used.

8. Types control and rating system evaluation results teaching (ERT)

Current control.

Working in practical classes involves:

- completion of a practical task, weighted score – 2. The maximum number of points for 8 practical sessions is 2 points x 8 = 16 points.
- completing a test task containing 10 questions, each worth 0.5 points for a correct answer, is equal to 5 points. There are 5 tests x 5 points = 25 points.

Modular test work (MCW) is conducted in the form of a test, which is evaluated at 14 points.

Abstract work is evaluated at 5 points

Essay evaluation criteria.

"Excellent", all work requirements met	5- points
"Good", all work requirements are met, or there are minor errors	3-4 points
"Satisfactory", there are shortcomings in fulfilling the work requirements and some errors	1-2 points
"Unsatisfactory", work not submitted or does not meet the requirements for "Satisfactory"	0 points

Calendar control: is carried out twice a semester as a monitoring of the current status of implementation of the syllabus requirements. The first calendar control involves the completion of practical work No. 1-3, test No. 1, the second calendar control involves the completion of practical work No. 4-7, test tasks No. 2-4.

Maximum semester rating of the applicant: 60 points

The sum of the weighted points of the control measures during the semester is:

R c= 16+25+ 14+5= 60 points**.**

Semester control: exam.

Conditions for admission to semester control: completion of practical tasks, MCR (with a total rating of at least 30 points).

All students must take an oral exam.

Examination paper (Based on the size of the scale $\mathbf{R_E}$ = 40 points)

Weight point – 10.

The examination ticket contains four theoretical questions.

The maximum number of points for the exam is 10x4=40 points

Evaluation criterion for the theoretical task - (with the definition of 3-5 levels.)

"Excellent", the answer is correct (at least 90% of the required information)	- 10-9 points
"Good", there are minor errors in the answer (at least 75% of the required information)	- 8-7 points
"Satisfactory", there are shortcomings in the answer and certain errors (at least 60% of the required information).	6 -4 points
"Unsatisfactory", the answer is missing or does not meet the requirements for "Satisfactory"	- 0 points

Table of correspondence of rating scores to university scale grades:

Number of points	Rating
100-95	*Perfect*
94-85	*Very good*
84-75	*Good*
74-65	*Satisfactorily*
64-60	*Enough*
<60	*Unsatisfactorily*
Admission conditions are not met	*Not allowed*

9. Additional information with disciplines (educational component)

- The approximate topics of the abstracts are given in **Appendix 1.**
- A list of questions for preparing for the module test, as well as for preparing for the exam, is provided in **Appendix 2**.

  The questions submitted for semester control correspond to the topics of lectures and practical classes. Recognition of learning outcomes acquired in non-formal/informal education is carried out in accordance with the "Temporary Regulation on the Procedure for Recognition of Learning Outcomes Acquired by Students of Igor Sikorsky Kyiv Polytechnic Institute in Non-formal/Informal Education" (https://osvita.kpi.ua/node/119).
- Program learning outcomes (extended form) for the discipline "Human Anatomy and Physiology. Part 2. Fundamentals of Human Anatomy and Physiology" are given in **Appendix 3**.

Working program educational disciplines (syllabus):

Compiled Candidate of Biological Sciences, Bespalova O. Ya.

Approved by the Department of Translational Medical Bioengineering (protocol No. 14 from 06.06.2024)

Approved by methodical by the commission faculty BME (protocol No. 9 from 26.06.2024)

Appendix 1 to the syllabus discipline
«Human Anatomy and Physiology. Part 2.
Fundamentals of Human Anatomy and Physiology»

Approximate topic of the essay:

Topic 1. Characteristics and classification of tissues.
Topic 2. Human musculoskeletal system;
Topic 3. Anatomy of the cardiovascular and lymphatic systems.
Topic 4. General anatomy of the respiratory system;
Topic 5. Physiology of the nervous system;
Topic 6 Physiological circulatory system
1. The structure of human skin and its functional purpose.
2. The skeleton of the head, its components and functional purpose.
3. The skeleton of the trunk, its components and functional purpose.
4. The skeleton of the upper and lower extremities, its components and functional purpose. 5. Features of the structure of the human musculoskeletal system, which are associated with the vertical position of the body.
6. Muscles and fascia of the trunk and their functional purpose.
7. Muscles and fascia of the upper and lower extremities, their functional purpose.
8. The structure of the spinal cord and spinal nerves, their functional purpose.
9. Features of the structure of the autonomic nervous system and its functional purpose. 10. The structure of the pathways of the brain and spinal cord, their functional purpose.
11. Cranial nerves, features of the structure and location of nerve centers, their functional purpose.
12. Components of the brain and their functional purpose.
13. Structure of taste and olfactory analyzers, their functional purpose.
14. Structure of the human endocrine system and the functional purpose of its components.
15. Structure of the auditory sensory system and its functional purpose.
16. Structure of the digestive canal and the functional purpose of its components.
17. General physiology of the cell membrane of excitable structures and its role in maintaining ionic asymmetry.
18. Physiology of striated muscles and modern ideas about the mechanism of muscle contraction.
19. Mechanisms and patterns of conduction of excitation along nerve fibers and through the neuromuscular synapse.
20. Mechanisms and conduction of excitation through synapses of the central nervous system.
21. Mechanisms of implementation of the functions of the auditory sensory system.
22. Mechanisms of realization of functions of the visual nervous system.
23. Mechanisms of realization of functions of taste and olfactory sensory systems and their role in formation of behavioral reactions.
24. Mechanisms of formation of regulation of human motor functions.
25. Hormonal regulation of physiological functions.
26. Modern ideas about the mechanism of action of hormones on target cells.
27. Modern ideas about the structure of the respiratory center and mechanisms of respiratory rhythm.
28. Physiological mechanisms of maintenance of gas composition of blood.
29. Mechanisms of regulation of heart activity at rest and during physical exertion.
30. Mechanisms of regulation of digestion and absorption in the small intestine, methods of their research.

Appendix 2 to the syllabus discipline
«Human Anatomy and Physiology. Part 2.
Fundamentals of Human Anatomy and Physiology»

List of questions submitted for semester control

Topic 1 General characteristics and classification of tissues
1.1 Definition of the concept of tissue, their classification, functional purpose and ability to regenerate.
1.2. Connective tissues, their types, location, structural features.
1.3. Muscle tissue, structural features of unstriated and striated (skeletal and cardiac), location in the body, functional purpose and ability to regenerate.
1.4. Epithelial tissues, structural features, location in the body, functional significance, ability to regenerate.
1.5. Nervous tissue and its structural and functional element - neuron, their types and significance.
1.6. Connective tissue with special properties - reticular tissue, adipose, pigment and mucous.
1.7. Structural features of the epithelium, its types and location in the body.
1.8. Structural features of adipose tissue, its location in the body.
1.9. Types of bone tissue, its cellular composition and location, intercellular substance.
1.10. The main component of nervous tissue, location and functional purpose.

Topic 2. Human musculoskeletal system
2.1. The human skeleton as a passive component of the musculoskeletal system - the skeleton of the trunk, chest, upper and lower extremities, their components and functional purpose.
2.2. Features of the structure of the human skeleton in contrast to animals.
2.3. Muscles as an active part of the musculoskeletal system, classification, muscles of the head, neck, trunk and their functional purpose.
2.4. The study of bones and their joints, general data of osteology, bone as an organ and data of arthrosyndesmology and its types.
2.5. Peculiarities of the structure of the human skeleton in connection with upright walking.
2.6. Peculiarities of the structure of striated muscle tissue; muscles of the back - superficial and deep, abdominal muscles, muscles of the upper and lower extremities.
2.7. Possible movements around the frontal and sagittal axes.
2.8. The main elements of the joint, types of joints by the number of axes and the shape of the articular surfaces.
2.9. Names of the bones of the pelvic girdle, their joints and sexual differences of the female pelvis from the male.
2.10. Bones of the cerebral and facial skull, their significance

Topic 3. Anatomy of the cardiovascular and lymphatic systems
3.1. The process of blood circulation - definition, structures that carry it out, functional purpose.
3.2. Vessels - types, structure of the walls of arteries, veins, capillaries as fenestrated vessels.
3.3. General plan of the structure of the lymphatic system - primary and secondary lymphatic organs, lymphatic trunks and ducts.
3.4. The heart as the main component of the circulatory process - location, heart chambers, its valves, structure of the heart wall, coronary circulation.
3.5. Large and small circulation - its main components and functional purpose.
3.6. Features of the structure of lymphatic capillaries and vessels; lymph and its composition, lymph outflow pathways.
3.7. The importance of the cardiovascular system for human life.
3.8. Valves of the pulmonary trunk and aorta.
3.9. Departments of the aorta and their functional purpose.
3.10.The importance of the lymphatic system in the vital activity of the organism.

Topic 4. General anatomy of the respiratory system

4.1. Airway and its respiratory part, functional purpose.
4.2. Nose, its structure and nasal cavities, paranasal sinuses, functional purpose.
4.3. Trachea, its topography, structure, departments and main bronchi.
4.4. General structure of the respiratory system, features of the structure of the walls of the airways and their functional purpose.
4.5. Larynx, its topography, structure, functions.
4.6. Lungs, topography, structure - acinus as their structural and functional unit; aerohematic barrier, their functional purpose.
4.7. 3significance for the human body of the respiratory system in terrestrial conditions. 4.8. Features of the structure of the walls of the respiratory tract and the mucous membrane of the nasal cavity.
4.9. 3function of the lungs in the respiratory system - the acinus as a structural and functional unit, the boundaries of the lungs, the pleura and its boundaries.
4.10. Bronchial and alveolar trees, their structure and functional purpose.

Appendix 3 to the syllabus discipline
«Human Anatomy and Physiology. Part 2.
Fundamentals of Human Anatomy and Physiology»

Program learning outcomes (extended form)

As a result of studying the academic discipline " *Human Anatomy and Physiology. Part 2. Fundamentals of Human Anatomy and Physiology* ", students will be able to:

Learning outcomes		Relevance of learning outcomes to competencies in the educational and professional program [1]	
		General Competence (soft skills)	Special competence (professional)
PLO 18	Understanding of fundamental-applied, medical-physical, and physico-chemical principles governing the functioning of biological objects, as well as bioengineering fundamentals of technologies and equipment for researching human body processes	GC 2 - Knowledge and understanding of the subject area and understanding	PC 09- Ability to identify, formulate, and solve engineering problems related to the interaction between living and non-living systems -
PLO 22	Knowledge of general principles and structure of complex biological systems, including the human body and its functions from the perspective of a systemic approach and their utilization in biomedical engineering, as well as basic methods and tools used for quantitative assessment of physiological system functioning	GC 2 - Knowledge and understanding of the subject area and understanding	PC 09- Ability to identify, formulate, and solve engineering problems related to the interaction between living and non-living systems -

[1] Order of the Ministry of Education and Science of Ukraine No. 1204 dated November 19, 2018 “On approval of the standard of higher education in the specialty 163 Biomedical Engineering” for the first bachelor's level of higher education».