SYLLABUS

1. General information on the course

Full course name	Medical and Biological Physics
Full official name of a higher education institution	Sumy State University
Full name of a structural unit	Faculty of Electronics and Informational Technologies. Department of Applied Mathematics and Complex Systems Modeling
Author(s)	Kniaz Ihor Oleksandrovych, Honcharov Oleksandr Andriiovych
Cycle/higher education level	The First Level Of Higher Education, National Qualifications Framework Of Ukraine – The 6th Level, QF-LLL – The 6th Level, FQ-EHEA – The First Cycle
Semester	18 weeks across 1 semester,9 weeks across 2 semester
Workload	4 ECTS credits, 120 hours: 22 hours of lectures, 50 hours of practical and 48 hours of independent work
Language(s)	English

2. Place in the study programme

Relation to curriculum	Compulsory course available for study programme "Medicine"
Prerequisites	There are no specific pre-requisites
Additional requirements	There are no specific requirements
Restrictions	There are no specific restrictions

3. Aims of the course

The purpose of teaching the discipline is to form among the students a system of knowledge about the basic physical principles and approaches to the study of processes in wildlife, physical and technical principles of functioning of medical and technical devices used in medicine.

4. Contents

Module 1. Mathematical analysis of medical and biological information
Topic 1 Functions. Setting functions. Derivative function. Types of functions, ways to set functions. Basic types of equations and methods of their solution. Physical quantities and their units of measurement. SI system. Determination of the derivative function. Table of derivatives of basic functions. Rules of differentiation. Derivative of a compound function.

Topic 2 The physical meaning of the derivative. Function analysis The physical meaning of the derivative. Application of the physical content of the derivative to find the speed and acceleration. Introduction to basic mathematical models used in biology and medicine. Pharmaco-kinetic models, models of population change, models of cell division rate. Using a derivative to analyze functions. Finding the minimum and maximum value of the function. Using mathematical analysis of the functions of finding the maximum bacterial population, the maximum rate of dissolution of the drug and the maximum rate of cell division.
Topic 3 Written test "Fundamentals of mathematical analysis of medical and biological information" Written test "Fundamentals of mathematical analysis of medical and biological information."
Module 2. Fundamentals of biomechanics, bioacoustics and hemodynamics
Topic 4 Biomechanics. Fluid mechanics. Fluids and the laws of their motion. Basic properties of liquids. Internal friction (viscosity) of the liquid. Newton's equation. Newtonian and non-Newtonian fluids. Blood. Laminar and turbulent fluid flow, Reynolds number. Methods for determining the viscosity of liquids. Fundamentals of the clinical method for determining blood viscosity. Influence of viscosity on some medical procedures. Introduction of liquids through a dropper and a syringe. Rhinomanometry. Photohemotherapy.
Topic 5 Physical bases of hemodynamics. Basic hemodynamic parameters The movement of blood through the vascular system. The main hemodynamic parameters that characterize the movement of blood: stroke volume, blood pressure, linear blood flow velocity, volumetric blood flow velocity, hydraulic resistance. Relationship between hemodynamic parameters. Poiseuille's formula. Dependence of pressure and blood flow velocity on the radius of the vessel. Vasoconstrictors and vasodilators to normalize blood pressure. Work and power of the heart. Fundamentals of the clinical method for determining blood pressure. Bernoulli's equation. Corollary of the Bernoulli equation. The principle of operation of the injector, inhaler.
Topic 6 Mechanical properties of materials. The concept of deformation. Absolute and relative deformation. Ways to deform tel. Elastic limit and material strength limit. Mechanical properties of materials and methods of their research. Mechanical properties of biological tissues. Mechanical models describing the mechanical properties of biological tissues.
Topic 7 Mechanical oscillations and waves Fluctuation. Periodic fluctuations. Harmonic oscillations. Free oscillations. Non-damping and damping oscillations. Forced oscillations. Resonance. Comparison of oscillatory processes. Energy of undamped harmonic oscillations. Self-oscillation. Periodic and oscillatory processes in biosystems. Oscillations of the human body and their registration. Mechanical waves. Doppler effect, application of Doppler effect in medicine. Vibration, the effect of vibration on the body. Vibration protection.

Topic 8 Sound waves. Basics of acoustics. Sound, types of sound. Physical characteristics of sound. Characteristics of auditory sensation. Sound measurements. Audiometry is a method of determining hearing acuity. Physics of hearing. Hearing aids and prostheses. The passage of sound across the interface. Sound research methods. Factors that determine noise prevention. Noise protection.
Topic 9 Ultrasound and infrasound. Emitters and ultrasound receivers. Absorption of ultrasound in matter. Laws of absorption and reflection of ultrasound. Sound vision. Biophysical action of UZ. The use of ultrasound in medicine: therapy, surgery, diagnosis. Infrasound and its sources. Influence of infrasound on the person. The use of infrasound in medicine.
Topic 10 Substantive control work 2 Substantive control work 2
Module 3. Thermodynamics of open biological systems. Biophysics of membrane processes.
Topic 11 Thermodynamics of open biological systems. Biophysics of membrane processes Basic concepts of thermodynamics. The first law of thermodynamics. The second law of thermodynamics. Entropy. The body as an open thermodynamic system. Thermometry and calorimetry. Mechanisms of body heat exchange with the environment. Physical properties of heated and cold environments used in medicine. Cryomedicine.
Topic 12 Biophysics of membrane processes Membrane functions. Structural elements of biological membranes. Physical properties of biomembranes. Liquid crystalline state of biomembranes. Passive transport of substances through membrane structures. Diffusion. Fick's equation. Membrane permeability coefficient for a certain substance.
Topic 13 Bioelectric potentials Nernst-Planck equation. Active transport, main types. Membrane potentials of rest and action. The nature of the resting membrane potential. Goldman-Hodgkin-Katz equation. Action potential (PD) and mechanisms of its occurrence. Speed
Topic 14 Substantive control work 3 Written test “Thermodynamics of open biological systems. Biophysics of membrane processes ”
Module 4. The effect of electric, magnetic and electromagnetic fields on biological objects.
Topic 15 Electric field and electric current. The effect of an electric field on biological tissues Electrical charge. Coulomb's law. Electric field. Tension, potential, potential difference. Graphic representation of electric fields. Conductors and dielectrics, relative dielectric constant. Current, current strength, current density. Thermal action of current. Electrical properties of biological tissues and fluids. Direct electric current, its characteristics, mechanism of action on biological tissues. Alternating electric current, its characteristics, mechanism of action on biological tissues. Impedance (impedance) of biological tissues. Rheography. Diathermy. Electrosurgery. Physical and biophysical bases of electrocardiography.

Topic 16 Magnetic field. Elements of magnetobiology. Magnetic field and its characteristics. Magnetic properties of substances. Ferromagnets, paramagnetics, diamagnets. Magnetic induction. Magnetic field strength. Relative magnetic permeability. Bio-Savar-Laplace law. Foucault currents. Self-induction. The effect of a magnetic field on biological objects. Biomagnetism. Capacitor and inductor. Magneto-cardiography. Magnetic therapy. Electromagnetic waves. Properties of electromagnetic waves. Energy characteristics of an electromagnetic wave. Scale of electromagnetic waves. Energy of electric and magnetic fields.
Topic 17 The effect of electromagnetic fields on biological objects. Electronic medical equipment. Physical processes occurring in the human body under the action of electromagnetic fields. Influence of electromagnetic waves of different ranges on a person. Physical bases of therapeutic methods (galvanization, franklinization, diathermy, inductothermy, darsonvalization, UHF and microwave therapy, microwave resonance therapy). General characteristics and classification of electronic medical devices.
Module 5. Optics. Optical methods and their use in biology and medicine.
Topic 18 Fundamentals of geometric optics Lenses. Optical devices. Laws of reflection and refraction of light. Full reflection of light. Refractometry. Optical microscopy. The main characteristics of the microscope. Special methods of microscopy. Bouguer's law. Absorption of light by matter, Bouguer-Lambert-Behr law. Concentration colorimetry.
Topic 19 Optical eye system. Optical visual impairments and their correction. Eye lens system. Accommodation. Binocular vision. Disadvantages of the optical system of the eye. Myopia and hyperopia. Adjustment of visual defects with the help of lenses. Angle of view. Resolution. Visual acuity. Acoustic biomechanics of the eyes.
Topic 20 Fundamentals of wave optics Diffraction of light. Diffraction beds. Interference of light. Interferometers, interference microscope. Electron microscope. Polarization of light. Methods of obtaining polarized light. Application of polarized light to solve medical and biological problems.
Module 6. Ionizing radiation. X-rays. Radioactivity. Basics of dosimetry.
Topic 21 Ionizing radiation. X-rays Types of ionizing radiation. Inhibitory and characteristic X-rays. X-ray tubes. Mechanisms and laws of interaction of X-rays with matter. X-ray protection. The use of X-rays in medicine. X-ray diagnostics. Computed tomography
Topic 22 Radioactivity, main types and properties Radioactivity. The basic law of radioactive decay. Activity. The main types of radioactive decay. Quantitative characteristics of the interaction of ionizing radiation with matter. Natural and artificial radioactivity. Radioactive series. The use of radionuclides in medicine. Charged particle accelerators and their use in medicine. Biophysical bases of ionizing radiation action.

Topic 23 Fundamentals of ionizing radiation dosimetry. Dosimetry. Radiation doses. Dose rate. Biological effects of radiation doses. Dose limits. Dosimetric devices. Ionizing radiation detectors. Methods of protection against ionizing radiation.
Topic 24 Nanotechnology and nanomedicine The concept of nanotechnology and nanomaterials. Application of nanotechnology achievements in medicine. Biosensors. Delivery of drugs to certain organs. Contrasting substances. Modern methods of treating cancer.
Topic 25 Final modular control Written final modular test.

5. Intended learning outcomes of the course

After successful study of the course, the student will be able to:

LO1	Perform basic physical measurements and process results
LO2	Analyze physical processes in the body using physical laws and phenomena.

6. Role of the course in the achievement of programme learning outcomes

Programme learning outcomes achieved by the course.
For 222 Medicine:

PO1	To detect and identify the leading clinical symptoms and syndromes (according to the List 1); to establish the most probable nosological or syndromic preliminary clinical diagnosis of diseases (according to the List 2) using standard methods, preliminary data of the patient's anamnesis, patient's examination data, and knowledge about a human, his organs and systems.
PO2	To collect information about the patient's general condition; to assess the patient's psychomotor and physical development and the state of organs and systems of the body; to assess information on the diagnosis (according to the List 4) based on laboratory and instrumental findings.
PO3	PLO 3. To order and analyze additional (mandatory and optional) examinations (laboratory, radiological, functional and/or instrumental) (according to the List 4) in order to perform a differential diagnosis of diseases (according to the List 2).

7. Teaching and learning activities

7.1 Types of training

Topic 1. Functions. Setting functions. Derivative function.
pr.tr.1 "Functions. Ways to set functions. Derivative function." Functions. Ways to set functions. Derivative function.
Topic 2. The physical meaning of the derivative. Function analysis

pr.tr.2 "Physical content of the derivative. Analysis of functions"

The physical meaning of the derivative. Application of the physical content of the derivative to find the speed and acceleration. Introduction to basic mathematical models used in biology and medicine. Pharmaco-kinetic models, models of population change, models of cell division rate. Using a derivative to analyze functions. Finding the minimum and maximum value of the function. Using mathematical analysis of the functions of finding the maximum population of bacteria, the maximum rate of dissolution of the drug and the maximum rate of cell division.

Topic 3. Written test "Fundamentals of mathematical analysis of medical and biological information"

pr.tr.3 "Written test" Fundamentals of mathematical analysis of medical and biological information"

Written test "Fundamentals of mathematical analysis of medical and biological information."

Topic 4. Biomechanics. Fluid mechanics.

lect.1 "Biomechanics. Fluid mechanics"

Fluids and the laws of their motion. Basic properties of liquids. Internal friction (viscosity) of the liquid. Newton's equation. Newtonian and non-Newtonian fluids. Blood. Laminar and turbulent fluid flow, Reynolds number. Methods for determining the viscosity of liquids. Fundamentals of the clinical method for determining blood viscosity. Influence of viscosity on some medical procedures. Introduction of liquids through a dropper and a syringe. Rhinomanometry. Photohemotherapy.

pr.tr.4 "Biomechanics. Mechanics of fluids. Basics of clinical method of determining blood viscosity. Influence of viscosity on some medical procedures. Introduction of fluids through a dropper and a syringe. Rhinomanometry. Photohemotherapy"

Fluids and the laws of their motion. Basic properties of liquids. Internal friction (viscosity) of the liquid. Newton's equation. Newtonian and non-Newtonian fluids. Blood. Laminar and turbulent fluid flow, Reynolds number. Methods for determining the viscosity of liquids. Fundamentals of the clinical method for determining blood viscosity. Influence of viscosity on some medical procedures. Introduction of liquids through a dropper and a syringe. Rhinomanometry. Photohemotherapy.

Topic 5. Physical bases of hemodynamics. Basic hemodynamic parameters

lect.2 "Physical bases of hemodynamics. Basic hemodynamic indicators"

The movement of blood through the vascular system. The main hemodynamic parameters that characterize the movement of blood: stroke volume, blood pressure, linear blood flow velocity, volumetric blood flow velocity, hydraulic resistance. Relationship between hemodynamic parameters. Poiseuille's formula. Dependence of pressure and blood flow velocity on the radius of the vessel. Vasoconstrictors and vasodilators to normalize blood pressure. Work and power of the heart. Fundamentals of the clinical method for determining blood pressure. Bernoulli's equation. Corollary of the Bernoulli equation. The principle of operation of the injector, inhaler.

pr.tr.5 "Physical basis of hemodynamics. Basic hemodynamic parameters"

The movement of blood through the vascular system. The main hemodynamic parameters that characterize the movement of blood: stroke volume, blood pressure, linear blood flow velocity, volumetric blood flow velocity, hydraulic resistance. Relationship between hemodynamic parameters. Poiseuille's formula. Dependence of pressure and blood flow velocity on the radius of the vessel. Vasoconstrictors and vasodilators to normalize blood pressure. Work and power of the heart. Fundamentals of the clinical method for determining blood pressure. Bernoulli's equation. Corollary of the Bernoulli equation. The principle of operation of the injector, inhaler.

Topic 6. Mechanical properties of materials.

lect.3 "Fluid mechanics. Hemodynamics. Fluid viscosity, blood viscosity. The flow of viscous fluids in biological systems. Bernoulli equations. Mechanical properties of biological tissues"

Fluid mechanics. Hemodynamics. Fluid viscosity, blood viscosity. Flow of viscous liquids in biological systems. Bernoulli's equation. Mechanical properties of biological tissues.

pr.tr.6 "Mechanical properties of materials"

Mechanical properties of materials and methods of their research. Mechanical properties of biological tissues. Mechanical models describing the mechanical properties of biological tissues.

Topic 7. Mechanical oscillations and waves

lect.4 "Mechanical oscillations and waves"

Periodic and oscillatory processes in biosystems. Oscillations of the human body and their registration. Mechanical waves. Doppler effect, application of Doppler effect in medicine. Vibration, the effect of vibration on the body. Vibration protection.

pr.tr.7 "Mechanical oscillations and waves"

Periodic and oscillatory processes in biosystems. Oscillations of the human body and their registration. Mechanical waves. Doppler effect, application of Doppler effect in medicine. Vibration, the effect of vibration on the body. Vibration protection.

Topic 8. Sound waves. Basics of acoustics.

pr.tr.8 "Sound waves. Basics of acoustics"

Physical characteristics of sound. Characteristics of auditory sensation. Sound measurements. Audiometry is a method of determining hearing acuity. Physics of hearing. Hearing aids and prostheses. The passage of sound across the interface. Sound research methods. Factors that determine noise prevention. Noise protection.

Topic 9. Ultrasound and infrasound.

pr.tr.9 "Ultrasound and infrasound"

Laws of absorption and reflection of ultrasound. Sound vision. Biophysical action of UZ. The use of ultrasound in medicine: therapy, surgery, diagnosis. Infrasound and its sources. Influence of infrasound on the person. The use of infrasound in medicine.

Topic 10. Substantive control work 2

pr.tr.10 "Substantive control work 2"

Substantive control work 2

Topic 11. Thermodynamics of open biological systems. Biophysics of membrane processes

lect.5 "Thermodynamics of open biological systems"

Basic concepts of thermodynamics. The first law of thermodynamics. The second law of thermodynamics. Entropy. The body as an open thermodynamic system. Thermometry and calorimetry. Mechanisms of body heat exchange with the environment. Physical properties of heated and cold environments used in medicine. Cryomedicine.

pr.tr.11 "Thermodynamics of open biological systems"

Basic concepts of thermodynamics. The first law of thermodynamics. The second law of thermodynamics. Entropy. The body as an open thermodynamic system. Thermometry and calorimetry. Mechanisms of body heat exchange with the environment. Physical properties of heated and cold environments used in medicine. Cryomedicine

Topic 12. Biophysics of membrane processes

pr.tr.12 "Biophysics of membrane processes"

Membrane functions. Structural elements of biological membranes. Physical properties of biomembranes. Liquid crystalline state of biomembranes. Passive transport of substances through membrane structures. Diffusion. Fick's equation. Membrane permeability coefficient for a certain substance.

Topic 13. Bioelectric potentials

pr.tr.13 "Bioelectric potentials"

Nernst-Planck equation. Active transport, main types. Membrane potentials of rest and action. The nature of the resting membrane potential. Goldman-Hodgkin-Katz equation. Action potential (PD) and mechanisms of its occurrence. Speed

Topic 14. Substantive control work 3

pr.tr.14 "Substantial control work 3."

Substantial control work 3.

Topic 15. Electric field and electric current. The effect of an electric field on biological tissues

lect.6 "Electric field and electric current. The effect of an electric field on biological tissues"

Electrical charge. Coulomb's law. Electric field. Tension, potential, potential difference. Graphic representation of electric fields. Conductors and dielectrics, relative dielectric constant. Current, current strength, current density. Thermal action of current. Electrical properties of biological tissues and fluids. Direct electric current, its characteristics, mechanism of action on biological tissues. Alternating electric current, its characteristics, mechanism of action on biological tissues. Impedance (impedance) of biological tissues. Rheography. Diathermy. Electrosurgery. Physical and biophysical bases of electrocardiography.

pr.tr.15 "Electric field and electric current. The effect of an electric field on biological tissues"

Electrical charge. Coulomb's law. Electric field. Tension, potential, potential difference. Graphic representation of electric fields. Conductors and dielectrics, relative dielectric constant. Current, current strength, current density. Thermal action of current. Electrical properties of biological tissues and fluids. Direct electric current, its characteristics, mechanism of action on biological tissues. Alternating electric current, its characteristics, mechanism of action on biological tissues. Impedance (impedance) of biological tissues. Rheography. Diathermy. Electrosurgery. Physical and biophysical bases of electrocardiography.

Topic 16. Magnetic field. Elements of magnetobiology.

lect.7 "Magnetic field. Elements of magnetobiology"

Magnetic field and its characteristics. Magnetic properties of substances. Ferromagnets, paramagnetics, diamagnets. Magnetic induction. Magnetic field strength. Relative magnetic permeability. Bio-Savar-Laplace law. Foucault currents. Self-induction. The effect of a magnetic field on biological objects. Biomagnetism. Capacitor and inductor. Magneto-cardiography. Magnetic therapy. Electromagnetic waves. Properties of electromagnetic waves. Energy characteristics of an electromagnetic wave. Scale of electromagnetic waves. Energy of electric and magnetic fields.

pr.tr.16 "Magnetic field. Elements of magnetobiology"

Magnetic field and its characteristics. Magnetic properties of substances. Ferromagnets, paramagnetics, diamagnets. Magnetic induction. Magnetic field strength. Relative magnetic permeability. Bio-Savar-Laplace law. Foucault currents. Self-induction. The effect of a magnetic field on biological objects. Biomagnetism. Capacitor and inductor. Magneto-cardiography. Magnetic therapy. Electromagnetic waves. Properties of electromagnetic waves. Energy characteristics of an electromagnetic wave. Scale of electromagnetic waves. Energy of electric and magnetic fields.

Topic 17. The effect of electromagnetic fields on biological objects. Electronic medical equipment.

pr.tr.17 "The effect of the electromagnetic field on biological objects. Electronic medical equipment."

Physical processes occurring in the human body under the action of electromagnetic fields. Influence of electromagnetic waves of different ranges on a person. Physical bases of therapeutic methods (galvanization, franklinization, diathermy, inductothermy, darsonvalization, UHF and microwave therapy, microwave resonance therapy). General characteristics and classification of electronic medical devices.

Topic 18. Fundamentals of geometric optics

lect.8 "Fundamentals of geometric optics"

Lenses. Optical devices. Laws of reflection and refraction of light. Full reflection of light. Refractometry. Optical microscopy. The main characteristics of the microscope. Special methods of microscopy. Bouguer's law. Absorption of light by matter, Bouguer-Lambert-Behr law. Concentration colorimetry.

pr.tr.18 "Fundamentals of geometric optics."

Lenses. Optical devices. Laws of reflection and refraction of light. Full reflection of light. Refractometry. Optical microscopy. The main characteristics of the microscope. Special methods of microscopy. Bouguer's law. Absorption of light by matter, Bouguer-Lambert-Behr law. Concentration colorimetry.

Topic 19. Optical eye system. Optical visual impairments and their correction.

pr.tr.19 "Optical system of the eye. Optical visual defects and their correction"

Eye lens system. Accommodation. Binocular vision. Disadvantages of the optical system of the eye. Myopia and hyperopia. Adjustment of visual defects with the help of lenses. Angle of view. Resolution. Visual acuity. Acoustic biomechanics of the eyes.

Topic 20. Fundamentals of wave optics

lect.9 "Wave optics. Interference of light. Diffraction of light. Polarization of light. Interaction of light with matter"

Diffraction of light. Diffraction beds. Interference of light. Interferometers, interference microscope. Electron microscope. Polarization of light. Methods of obtaining polarized light. Application of polarized light to solve medical and biological problems.

pr.tr.20 "Fundamentals of wave optics"

Diffraction of light. Diffraction beds. Interference of light. Interferometers, interference microscope. Electron microscope. Polarization of light. Methods of obtaining polarized light. Application of polarized light to solve medical and biological problems.

Topic 21. Ionizing radiation. X-rays

lect.10 "Ionizing radiation. X-rays."

Types of ionizing radiation. Inhibitory and characteristic X-rays. X-ray tubes. Mechanisms and laws of interaction of X-rays with matter. X-ray protection. The use of X-rays in medicine. X-ray diagnostics. Computed tomography.

pr.tr.21 "Ionizing radiation. X-rays"

Types of ionizing radiation. Inhibitory and characteristic X-rays. X-ray tubes. Mechanisms and laws of interaction of X-rays with matter. X-ray protection. The use of X-rays in medicine. X-ray diagnostics. Computed tomography.

Topic 22. Radioactivity, main types and properties

lect.11 "Radioactivity, basic types and properties"

Radioactivity. The basic law of radioactive decay. Activity. The main types of radioactive decay. Quantitative characteristics of the interaction of ionizing radiation with matter. Natural and artificial radioactivity. Radioactive series. The use of radionuclides in medicine. Charged particle accelerators and their use in medicine. Biophysical bases of ionizing radiation action

pr.tr.22 "Radioactivity, basic types and properties" Radioactivity. The basic law of radioactive decay. Activity. The main types of radioactive decay. Quantitative characteristics of the interaction of ionizing radiation with matter. Natural and artificial radioactivity. Radioactive series. The use of radionuclides in medicine. Charged particle accelerators and their use in medicine. Biophysical bases of ionizing radiation action
Topic 23. Fundamentals of ionizing radiation dosimetry.
pr.tr.23 "Fundamentals of dosimetry of ionizing radiation" Dosimetry. Radiation doses Ionizing radiation detectors. Methods of protection against ionizing radiation .. Dose rate. Biological effects of radiation doses. Dose limits. Dosimetric devices.
Topic 24. Nanotechnology and nanomedicine
pr.tr.24 "Nanotechnology and nanomedicine" The concept of nanotechnology and nanomaterials. Application of nanotechnology achievements in medicine. Biosensors. Delivery of drugs to certain organs. Contrasting substances. Modern methods of treating cancer.
Topic 25. Final modular control
pr.tr.25 "Final modular control" Written final modular test

7.2 Learning activities

LA1	Execution of practical tasks
LA2	Completion of mandatory homework in the workbook
LA3	Preparation for practical classes
LA4	Preparation for current and final control

8. Teaching methods

Course involves learning through:

TM1	Interactive lectures
TM2	Demonstration method
TM3	Problem seminar

Verbal (lectures), explanatory-illustrative (schemes, tables), problem-solving methods, independent work of students under the guidance and outside the control of the teacher.

Ability to abstract thinking, analysis and synthesis; ability to learn and master modern knowledge; ability to apply knowledge in practical situations; knowledge and understanding of the subject area and understanding of professional activity; ability to make informed decisions; skills of using information and communication technologies; certainty and persistence in the tasks and responsibilities.

9. Methods and criteria for assessment

9.1. Assessment criteria

ECTS	Definition	National scale	Rating scale
A	Outstanding performance without errors	5 (Excellent)	90 ≤ RD ≤ 100
B	Above the average standard but with minor errors	4 (Good)	82 ≤ RD < 89
C	Generally sound work with some errors	4 (Good)	74 ≤ RD < 81
D	Fair but with significant shortcomings	3 (Satisfactory)	64 ≤ RD < 73
E	Performance meets the minimum criteria	3 (Satisfactory)	60 ≤ RD < 63
FX	Fail – some more work required before the credit can be awarded	2 (Fail)	35 ≤ RD < 59
F	Fail – considerable further work is required	2 (Fail)	0 ≤ RD < 34

9.2 Formative assessment

FA1	Interviews and oral comments of the teacher on his results
FA2	Teacher's instructions in the process of performing practical tasks
FA3	Discussion and self-correction of the work done by students

9.3 Summative assessment

SA1	Report on the results of practical work
SA2	Current control works (intermediate modular control)
SA3	Written modular control

Form of assessment:

1 semester		**200 scores**
SA1. Report on the results of practical work		**80**
		80
SA2. Current control works (intermediate modular control)		**60**
	3x20	60
SA3. Written modular control		**60**
		60
2 semester		**200 scores**
SA1. Report on the results of practical work		**80**
		80
SA2. Current control works (intermediate modular control)		**60**
	3x20	60

SA3. Written modular control		**60**
		60

Form of assessment (special cases):

10. Learning resources

10.1 Material and technical support

MTS1	Library funds
MTS2	Multimedia, video and audio, projection equipment (video cameras, projectors, screens, smart boards, etc.)
MTS3	Software (to support distance learning, Internet surveys, virtual laboratories, virtual patients, to create computer graphics, modeling, etc.)

10.2 Information and methodical support

Essential Reading	
1	GS Kornyushchenko, US Shvets, LF Sukhodub. Medical and biological physics: workshop: textbook: in 2 hours Part 1, Sumy: Sumy State University, 2017. - 186 p.
2	VS Shvets, GS Kornyushchenko. Methodical instructions for control works on the topics of the I semester in the discipline "Medical and Biological Physics": for students. special 222 "Medicine" full-time, Sumy: SSU, 2018. - 59 p.
3	VS Shvets, GS Kornyushchenko. Methodical instructions for the performance of tests on the topics of the II semester in the discipline "Medical and Biological Physics": for students. special 222 "Medicine" full-time, Sumy: Sumy State University, 2018.
Supplemental Reading	
4	O.B. Khomenko, Collection of problems in physics with examples of solutions: textbook: in 2 hours Part 1. Mechanics. Thermodynamics. Electrostatics, Sumy: Sumy State University. - 2013. - 224 p.
5	AV Dvornichenko, Ya.O. Lyashenko, O.B. Khomenko, GS Kornyushchenko, Collection of problems in physics with examples of solutions: textbook: in 2 hours Part 2. Electric current. Magnetic field. Optics. Radioactivity, Sumy: Sumy State University. - 2015
6	A.N. Remizov, AG Maxina, A.Ya. Potapenko. Collection of problems in medical and biological physics. - M .: Дрофа, 2001. - 192 c. RM Litnarovich Biophysics. Medical physics, theoretical and applied physics. - Rivne: MEGU, 2011. - 208 p.