MINISTRY OF HEALTH OF UKRAINE HIGHER STATE EDUCATIONAL ESTABLISHMENT OF UKRAINE «BUKOVINIAN STATE MEDICAL UNIVERSUTY»

"APPROVE"	
Vice-rector for scientific and perago	gical work
Associate Professor	I.V. Gerush
"à 6 " 08 " 0 "	2020

STUDENT GUIDE (SYLLABUS) of studying the discipline

BIOLOGICAL PHYSICS AND PHYSICAL METHODS OF ANALYSIS

Field of knowledge _	22 Healthcare	
		(code and name of the field of knowledge)
Specialty <u>226</u>	Pharmacy, industr	rial pharmacy
· · <u> </u>		(code and name of the specialty)
Educational degree	master	
0 _		(master, bachelor, junior bachelor)
Educational year	<u>I</u>	
Form of study	full-time	
		(full-time, part-time, distance)
Department	biological physi	cs and medical informatics
		(name of the department)

Approved at the methodical session of the department of biological physics and medical informatics " \mathscr{N} " June 20 \mathscr{D} (Protocol No.31).

Head of the Department	Sterl	(V.I. Fediv)
	(signature)	

Approved by the subject methodical commission in medical and biological disciplines of physiological and physicochemical profile " $\underline{\mathcal{I}}$ " June 20 $\underline{\mathcal{U}}$ (Protocol No $\underline{\mathcal{I}}$).

Chair of the commission	subject methodical ${\cal A}$	2		(S.S.Tkach	uk)
	(signature) /				
	C1		2020		

Chernivtsi – 2020

WORKERS WHO IEACH THE	SUBJECT
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1. GENERAL INFORMATION ABOUT SCIENTIFIC AND PEDAGOGICAL WORKERS WHO TEACH THE SUBJECT

2. GENERAL INFORMATION ABOUT THE DISCIPLINE

Status of the discipline	normative
Number of credits	4,5
Total amount of hours	135
Lectures	20
Practical lessons	60
Individual work	55
Type of final control	final module control

3. DESCRIPTION OF THE DISCIPLINE (ABSTRACT)

The study of the discipline "Biological physics and physical methods of analysis" provides knowledge about physical processes occurring in biological environments, the impact of external physical factors on living organisms and physical methods used to analyze the quality and composition of chemicals and pharmaceuticals.

4. POLICY OF THE SUBJECT

4.1. List of normative documents:

- Regulations on the organization of the educational process (https://www.bsmu.edu.ua/wp-content/uploads/2020/03/polozhennya-proorganizacziyu-osvitnogo-proczesu-u-vdnzu-bukovinskij-derzhavnij-medichnijuniversitet.pdf);
- Instructions for assessing the educational activities of BSMU students in the implementation of the European credit transfer system of the educational process

(https://www.bsmu.edu.ua/wp-content/uploads/2020/03/bdmu-instrukcziya-shhodooczinyuvannya-%D1%94kts-2014-3.pdf);

- Regulations on the procedure for reworking missed and uncredited classes (<u>https://www.bsmu.edu.ua/wp-content/uploads/2019/12/reworks.pdf</u>);
- Regulations on the appeal of the results of the final control of knowledge of higher education (<u>https://www.bsmu.edu.ua/wp-content/uploads/2020/07/polozhennya-pro-apelyacziyu-rezultativ-pidsumkovogo-kontrolyu-znan.pdf</u>);
- Codex of Academic Integrity (<u>https://www.bsmu.edu.ua/wp-content/uploads/2019/12/kodeks_academic_faith.pdf</u>);
- Moral and ethical codex of students (<u>https://www.bsmu.edu.ua/wp-content/uploads/2019/12/ethics_code.docx</u>);
- Regulations on the prevention and detection of academic plagiarism (https://www.bsmu.edu.ua/wp-content/uploads/2019/12/antiplagiat-1.pdf);
- Regulations on the procedure and conditions for students to choose elective courses (<u>https://www.bsmu.edu.ua/wp-</u>content/uploads/2020/04/nakaz polozhennyz vybirkovi dyscypliny 2020.pdf);
- Rules of internal labor regulations of the Higher State Educational Institution of Ukraine "Bucovynian State Medical University" (<u>https://www.bsmu.edu.ua/wp-content/uploads/2020/03/17.1-bdmu-kolektivnij-dogovir-dodatok.doc</u>).

4.2. Policy on adherence to the principles of academic integrity of higher education students:

- independent performance of educational tasks of current and final controls without the use of external sources of information;

- cheating during control of knowledge is prohibited;

- independent performance of individual tasks and correct registration of references to sources of information in case of borrowing of ideas, statements, information.

4.3. Policy on adherence to the principles and norms of ethics and deontology by higher education students:

- actions in professional and educational situations from the standpoint of academic integrity and professional ethics and deontology;

- compliance with the rules of internal regulations of the university, to be tolerant, friendly and balanced in communication with students and teachers, medical staff of health care institutions;

- awareness of the importance of examples of human behavior in accordance with the norms of academic integrity and medical ethics.

4.4. Attendance policy for higher education students:

- attendance at all training sessions (lectures, practical (seminar) classes, final modular control) is mandatory for the purpose of current and final assessment of knowledge (except for respectable reasons).

4.5. Deadline policy and completion of missed or uncredited classes by higher education students:

- reworks of missed classes are held according to the schedule of missed or uncredited classes and consultations.

List of disciplines, on which the study of academic discipline is based	List of academic disciplines, for which the basis is laid as a result of studying the discipline
higher mathematics and statistics	biological chemistry
general and inorganic chemistry	physical and colloid chemistry
organic chemistry	drug technology
	hygiene in pharmacy and ecology
	Life Safety
	pharmacotherapy

5. PRECISIONS AND POST-REQUIREMENTS OF THE EDUCATIONAL DISCIPLINE (INTERDISCIPLINARY RELATIONS)

6. PURPOSE AND TASKS OF THE EDDUCATIONAL DISCIPLINE:

6.1. The purpose of studying the discipline is improving knowledge, skills and practical understanding of biophysical processes in a living organism; physical methods of disease diagnosis and research of biological systems; the impact of physical factors on the human body; physical properties and characteristics of substances used in industrial pharmacy.

6.2. The main tasks of studying the discipline are:

- mastering by students of the basic principles and theoretical principles of biophysics;

- explanation of the relationship between physical and biological aspects of the functioning of living systems;

- study of biological problems related to physical and physicochemical mechanisms of interactions underlying biological processes;

- study of the mechanisms of energy transformation in biological systems

- study of physicochemical properties of drugs.

7. COMPETENCIES, THE FORMATION OF WHICH IS CONTRIBUTED BY THE DISCIPLINE:

7.1. Integral competence:

Ability to solve typical and complex specialized problems and critically comprehend and solve practical problems in professional pharmaceutical and / or research and innovation activities using the provisions, theories and methods of basic, chemical, technological, biomedical sciences; integrate knowledge and solve complex issues, formulate judgments on insufficient or limited information; clearly and unambiguously convey their own knowledge, conclusions and their validity to professional and non-professional audience.

7.2. General competencies:

GC 2. Ability to apply knowledge in practical situations.

GC 4. Ability to abstract thinking, analysis and synthesis, to learn and be modernly trained.

GC12. Ability to conduct research at the appropriate level

7.3. Professional (special) competencies:

PC 14. Ability to develop methods for quality control of medicines, including active pharmaceutical ingredients, herbal medicines using physical, chemical, physicochemical, biological, microbiological, pharmacotechnological and pharmacoorganoleptic control methods.

8. RESULTS OF STUDYING THE DISCIPLINE.

As a result of studying the discipline student must:

8.1. Know:

- physical bases and biophysical mechanisms of action of external factors on the systems of the human body;

- theoretical bases of physical methods of research of medicinal substances, principles of structure and work of the corresponding equipment;

- opportunities and scope of mastered methods;

- general physical and biophysical patterns that underlie human life;

- physical bases of diagnostic and physiotherapeutic (therapeutic) methods used in medical equipment.

8.2. Be able to:

- choose appropriate physical research methods to solve specific problems of pharmaceutical analysis;

- use equipment for physical examinations of medicines;

- perform statistical processing of experimental results;

- model simple biological systems;

- analyze physical processes in the body, using physical laws and phenomena.

8.3. Demonstrate:

PLO G 2. Ability to apply knowledge of general and professional disciplines in professional activities.

PLO G 4. Ability to use the results of independent search, analysis and synthesis of information from various sources to solve typical problems of professional activity;

PLO G 12. To analyze the information received as a result of scientific researches, to generalize, systematize and use it in professional activity

PLO P 14. Ability to determine the main organoleptic, physico-chemical, chemical and pharmaco-technological indicators of drugs, to justify and choose methods for standardization, to carry out statistical processing of results in accordance with the requirements of the State Pharmacopoeia of Ukraine.

9. IINFORMATIONAL SCOPE OF THE DISCIPLINE

Module 1. Fundamentals of general and applied biophysics.

Content module 1. Fundamentals of general and applied biophysics.

Topic 1. Physics of pharmaceutical raw materials processing. Mechanical, hydrodynamic; thermal; refrigeration; diffusion, etc. processes described by physical laws states of matter. Phase transitions.

Topic 2. Deformations. Rheological characteristics of dispersed systems and liquids.

Internal friction, viscosity of liquids. Newton's formula for the force of internal friction. Newtonian and non-Newtonian fluids. Methods and devices for measuring viscosity.

Stationary fluid flow. The continuity equation and the Bernoulli's equation. Linear and volumetric velocities. The basic equation of fluid dynamics. Flow of viscous liquids. Poiseuille's and Gauguin-Poiseuille's formulas. Hydraulic resistance.

Fundamentals of bioreology. Deformation properties of biological tissues. Lame equation. Rheological properties of blood. Laminar and turbulent fluid flow. Reynold's number. Methods of measuring blood pressure and blood flow rate. Pulse waves. The work of the heart. Blood viscosity and its use in the diagnosis of diseases The effect of drugs on blood viscosity.

Topic 3. Thermodynamics of open biological systems. Basic concepts and patterns of thermodynamics. The first and second laws of thermodynamics. The concept of internal energy, entropy, free Helmholtz energy and chemical potential.

Thermodynamic method of studying biological systems.

Thermodynamics of open systems near equilibrium (linear law for flows and thermodynamic forces, cross-transfer processes, Onsager's ratio, entropy production, flow conjugation, steady state, Prigogine's theorem).

Topic 4. Transport phenomena in the cell. The process of drug transfer across the cell membrane.

Structural elements of biological membranes. Physical properties of biomembranes, possibilities of their formation. Liquid crystalline state of the membrane. Dynamic properties of biomembranes. The concept of gradient. Types of gradients. Electrochemical potential and Thiorell's equation. Passive transport of substances through membrane structures. The main mechanisms of passive transport: diffusion, osmosis, filtration. Fick's equation. Membrane permeability coefficients. Nernst – Planck's equation for osmosis and filtration. Active transport. The main types. Molecular organization of active transport on the example of potassium - sodium pump.

The process of drug transfer across the cell membrane.

Topic 5. Biopotential. Propagation of action potential. The effect of drugs on the magnitude of biopotential.

Electric field of a living system. The main characteristics of the electric field. Causes of electric cells, tissues, organs: the presence of a membrane, different phases in the cell and intercellular environment, the phenomenon of diffusion and Donnan equilibrium. Cell resting potential. Bernstein's theory. Nernst's equation.

Action potential. Goldman-Hodgkin-Katz's theory. The concept of reverse ionic processes. The process of spreading the action potential in nerve fibers. Influence of drugs on action potentials.

Topic 6. Biophysics of the sensory system (vision). Features of color perception

Physics of vision. Optical power of the eye. Reduced eye. Aberration of the optical system of eye. The structure of the retina. Biophysics of visual reception processes. Features of color perception to describe the physical characteristics of drugs.

Topic 7. Biophysics of the sensory system (hearing). The effect of sound and infrasound on humans.

Physics of hearing. Objective and subjective characteristics of sound. Intensity, volume, their units. Thresholds of audibility and pain. Weber's, Weber-Fechner's laws. Biophysical bases of auditory sensation. Basic sound techniques in diagnostics. Impact of noise on health in the production process.

Topic 8. Ultrasound in medicine and pharmacy

Ultrasound and infrasound sources and receivers. Peculiarities of propagation and biophysical bases of ultrasound and infrasound action on biological tissues. Use of ultrasound in medicine and pharmacy.

Topic 9. Direct electric current in medicine and pharmacy.

Electrical conductivity of biological tissues and fluids. Polarization of electrodes and ways of its elimination. Direct current, and its use in medicine. Galvanization, electrophoresis. The main characteristics of the methods. Advantages of drug administration by electrophoresis. Features of drugs for electrophoresis.

Topic 10. Alternating and pulsed electric currents in medicine and pharmacy.

The concept of impedance, impedance variance coefficient. Rheography as a method of diagnosis.

Basic characteristics and methods of obtaining pulse currents. The effect of pulsed current on the human body. Application of pulse currents in diagnosis and treatment. Pulse current electrophoresis.

Topic 11. Magnetic field and its application in medicine and pharmacy

Magnetic properties of substances. Physical basis of magnetobiology. The effects of magnetic field on biological objects and the primary processes that occur in them.

Delivery of medicines. Nanopharmacy. Methods of studying the structure of matter using a magnetic field (Mass spectroscopy, NMR, MRI)

Topic 12. Physical basis of high-frequency methods in medicine and pharmacy.

Basic physiotherapeutic methods of high-frequency therapy, their characteristics and primary mechanisms of action. Combination of methods with other methods of pharmacological therapy

Topic 13. Biophysics of interaction of electromagnetic waves of the optical range with a living system. Photobiology.

The concept of photobiological processes and their classification. Electromagnetic waves of the optical range. Methods of obtaining radiation of optical range. Specific effects on the human body. Use in medicine and pharmacy.

Topic 14. Lasers in medicine and pharmacy

Physical principles of light amplification. Spontaneous and induced radiation. Equilibrium and inverse population of energy levels. Principles of laser operation. Laser radiation: its properties and applications in medicine and pharmaceutical production.

Topic 15. Radioactivity. Radiopharmaceuticals.

Radioactivity. The phenomenon of radioactivity, types of radioactive decay, basic characteristics and properties. Law of radioactive decay. Half-life. Activity, units of activity. Physical foundations of nuclear pharmacy. Radiopharmaceuticals.

MODULE 2. Physical methods of analysis.

Content module 2. Physical methods of analysis.

Topic 1. Weighing methods, determination of fluid density. Calculation of errors of direct and indirect measurements.

Direct and indirect measurements. Measurement errors and their calculation. Weighing methods, determination of liquid density.

Topic 2. Physical bases of sensors functions.

General characteristics and classification of sensors. Electrical measurements of nonelectrical quantities. The main types of sensors and their characteristics. Requirements for sensors. Sensors in the pharmaceutical industry.

Topic 3. Surface tension as a parameter for assessing the state of biological and pharmaceutical liquids. Surface tension of liquids. Surface tension coefficient. Methods of its definition. Surface tension as a parameter for assessing the state of biological and pharmaceutical fluids

Topic 4. Conductometric method of analysis.

Classification of conductometric methods of analysis. Direct conductometry. Conductometric titration. High-frequency conductometric titration.

Topic 5. Potentiometric method of analysis

Electrodes for potentiometric analysis. Measurement of EMF of electrochemical circuits. Direct potentiometry (ionometry). Potentiometric titration.

Topic 6. Coulometric method of analysis

Direct coulometry. Coulometric titration.

Topic 7. Refractometric method of analysis.

Refraction of light. Determination of solution concentration.

Topic 8. Polarimetric method of analysis

Polarization of light. Natural and polarized light. Methods of obtaining polarized light. Polarization of light during reflection and refraction at the boundary of two dielectrics. Brewster's law. Double refraction. Nicol's prism. Malus's law. Optically active substances. Bio Law. Polarimetry. Determination of the concentration of optically active solutions.

Topic 9. Photocolorimetric and spectrophotometric methods of analysis

Light absorption. Bouguer's law. Absorption of light by solutions. Ber's law. Bouguer-Lambert-Beer's law. Transmittance, optical density. Concentration colorimetry. Spectrophotometric method of analysis.

Topic 10. Luminescent and chemiluminescent methods of analysis

Luminescence. Types of luminescence. Photoluminescence. Basic concepts and patterns. Stokes and Vavilov's laws. Application of luminescence in medicine and pharmacy.

Topic 11. Methods of optical microscopy.

Elements of geometric optics. Aberrations of optical systems. Optical microscopy. The main characteristics of a light microscope. Methods of microscopy.

Topic 12. X-ray structural and X-ray spectral analyzes

X-rays. Inhibitory and characteristic X-rays: spectrum, characteristics and properties. Changing the stiffness and intensity of X-rays. Interaction of X-rays with matter, primary mechanisms. The law of X-ray attenuation and protection against it. Physical basis of radiography and radioscopy. X-ray structural and X-ray spectral analyzes

Topic 13. Elements of quantum mechanics. Electron microscopy

The concept of the basic physical principles of electron microscopy (electron transmission microscope, electron scanning microscope, atomic force microscope).

Topic 14. Biophysics of ionizing radiation. Radiometry.

Ionizing radiation: properties and basic mechanisms of interaction with the environment. Effects of ionizing radiation on humans and methods of protection. The concept of somatic (indirect) and genetic (direct) action. The use of ionizing radiation in medicine. Dosimetry of ionizing radiation. The concept of absorbed and exposure dose. Equivalent biological dose. Doses units.

Radiological control of herbal pharmaceutical raw materials.

Topic 15. Physical methods of sterilization of pharmaceutical raw materials and finished dosage forms. Physical methods of drug delivery.

	Amount of hours				
Names of content modules and		including			
topics	T-4 1	Clas	sroom Independent		T. 1 1 1
1	Total		D 1	students'	Individual
		Lections	Practicals	work	work
1	2	3	4	5	6
Module 1. Fun	damentals	of general a	nd applied bio	ophysics.	
Content module 1.	Fundamen	tals of gener	ral and applie	d biophysics.	
Topic 1 . Physics of processing	5	2	2	1	
of pharmaceutical raw					
materials. State of matter.					
Topic 2 . Deformations. The	5	2	2	1	
rheological properties of					
disperse systems and liquids.					
Thermodynamics of open	4	2		2	
biological systems.					
Topic 4 . Transport	4	1	2	1	
phenomena in the cell. The					
process of drug transfer across					
the cell membrane.					
Topic 5. Biopotential.	4	1	2	1	
Propagation of action		_	_	_	
potential. Influence of					
medicinal substances on the					
magnitude of biopotential.					
Topic 6. Biophysics of the	4	1	2	1	
sensory system (vision).		-	_	-	
Features of color perception					
Topic 7. Biophysics of the	4	1	2	1	
sensory system (hearing). The					
effect of sound and infrasound					
on humans					
Topic 8. Ultrasound in	3	-	2	1	
medicine and pharmacy	_				
Topic 9. Direct electric current	3	_	2	1	
in medicine and pharmacy	_				
Topic 10. Alternating and	3	_	2	1	
pulsed electric currents in	C .		_	-	
medicine and pharmacy					
Topic 11. Magnetic field and	5	2	2	1	
its application in medicine and	_				
pharmacy					
Topic 12. Physical basis of	3	_	2	1	
high-frequency methods in	_				
medicine and pharmacy.					
Topic 13. Biophysics of	3	_	2	1	
interaction of electromagnetic			_	_	
waves of the optical range with					
a living system. Photobiology.					
Topic 14. Lasers in medicine	3	-	2	1	
and pharmacy				_	
Topic 15. Radioactivity	5	2	2	1	
Radiopharmaceuticals.	Ĩ	_	_	· ·	
Individual work	4				4
Module control 1	8		2	6	

10. STRUCTURE OF EDUCATIONAL DISCIPLINE

Total on the content module 1	70	14	30	22	4
Content m	nodule 2. P	hysical met	hods of anal	ysis.	
Topic 1. Weighing methods,	3		2	1	
determination of fluid density.					
Calculation of errors of direct					
and indirect measurements					
Topic 2 . Physical bases of	3		2	1	
sensors functions.					
Topic 3 . Surface tension as a	3		2	1	
parameter for assessing the					
state of biological and					
pharmaceutical liquids					
Topic 4. Conductometric	3,5	0,5	2	1	
method of analysis					
Topic 5. Potentiometric	3,5	0,5	2	1	
method of analysis					
Topic 6 . Coulometric method	4	1	2	1	
Topic 7. Refractometric	3,5	0,5	2	1	
method of analysis					
Topic 8. Polarimetric method	3,5	0,5	2	1	
of analysis					
Topic 9 . Photocolorimetric and	3,5	0,5	2	1	
spectrophotometric methods of					
analysis					
Topic 10. Luminescent and	3,5	0,5	2	1	
chemiluminescent methods of					
analysis					
Topic 11 . Methods of optical	3		2	1	
microscopy.					
Topic 12 . X-ray structural and	4		2	2	
X-ray spectral analyzes					
Topic 13. Elements of	4		2	2	
quantum mechanics. Electron					
microscopy					
Topic 14 . Biophysics of	4		2	2	
ionizing radiation. Radiometry					
Topic 15 . Physical methods of	4	2		2	
sterilization of pharmaceutical					
raw materials and finished					
dosage forms. Physical					
methods of drug delivery.					
Individual work	4				4
Module control 2	7		2	5	
Total on the content module 2	65	6	30	25	4
TOTAL HOURS	135	20	60	47	8

11. THEMATIC PLAN OF LECTURES

No		Amount
.,175	Name of topic	of
		hours
1	The states of matter. Phase transitions.	2
2	Biophysics of blood circulation. Elements of hydro and hemodynamics.	2
3	Thermodynamics of biological processes	2
4	Biophysics of cellular processes. Biomembranes. Biopotentials	2
5	Biophysics of the senses (smell, taste, touch, hearing, vision)	2

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6	Magnetic field. Mass spectroscopy, NMR, MRI	2
7	Physical Principles of Nuclear Pharmacy	2
8	Physical bases of electrochemical methods of analysis	2
9	Physical bases of optical methods of analysis	2
10	Physical methods of sterilization of pharmaceutical raw materials and	2
	finished dosage forms. Physical methods of drug delivery.	
	Total	20

12. THEMATIC PLAN OF PRACTICAL CLASSES

N⁰	Name of tonic	
		of hours
	Content module 1. Fundamentals of general and applied biophysics	
1	Physics of mechanical processing of pharmaceutical raw materials	2
2	Deformations. Rheological characteristics of dispersed systems and liquids	2
3	Phenomena of transport in a cell. The process of drug transfer across the cell membrane.	2
4	Biopotential. Propagation of action potential. The effect of drugs on the biopotentia magnitude.	2
5	Biophysics of the sense organ (vision). Features of color perception	2
6	Biophysics of the senses (hearing). The effect of sound on humans	2
7	Ultrasound in medicine and pharmacy	2
8	Direct electric current in medicine and pharmacy.	
9	Alternating and pulsed electric currents in medicine and pharmacy.	2
10	Magnetic field and its application in medicine and pharmacy	2
11	Physical bases of high-frequency methods in medicine and pharmacy.	2
10	Biophysics of interaction of electromagnetic waves of the optical range	0
12	with a living system. Photobiology.	2
13	Lasers in medicine and pharmacy	2
14	Radioactivity. Radiopharmaceuticals.	2
15	Module control 1	2
	Content module 2. Physical methods of analysis.	
16	Weighing methods, determination of fluid density. Calculation of errors of	2
	direct and indirect measurements.	Z
17	Physical bases of sensors functioning.	2
18	Surface tension as a parameter for assessing the state of biological and	C
	pharmaceutical fluids	Z
19	Conductometric method of analysis.	2
20	Potentiometric method of analysis	2
21	Coulometric method of analysis	2
22	Refractometric method of analysis.	2
23	Polarimetric method of analysis	
24	Photocolorimetric and spectrophotometric methods of analysis	2
25	Luminescent and chemiluminescent methods of analysis	2
26	Methods of optical microscopy	2
27	X-ray structural and X-ray spectral analyzes	2
28	Elements of quantum mechanics. Electron microscopy	2
29	Biophysics of ionizing radiation. Radiometry.	2
30	Module control 2	2
	Total	60

13. THEMATIC PLAN OF INDIVIDUAL WORK

№	Name f topic				
Content module 1. Fundamentals of general and applied biophysics					
1	The physical methods of processing pharmaceutical raw materials	1			

2	Method of viscosity measurement					
3	Thermodynamic parameters of biological systems					
4	Biophysical aspects of membrane processes					
5	Calculus of the value of biopotential and explaination of changes under the					
	influence of drugs	1				
6	Color perception importance for describing the physical characteristics of					
	pharmaceutical raw materials					
7	Noise control in the pharmaceutical industry.	1				
8	Processes caused by ultrasound in different substances	1				
9	Techniques that use direct currents					
10	Techniques that use alternating and pulsed currents					
11	Magnetic field for targeted drug delivery					
12	2 Electromagnetic radiation of the optical range in the pharmaceutical					
	industry	1				
13	Methods of high-frequency methods of therapy					
14	Lasers function	1				
15	Obtaining of radiopharmaceuticals	1				
16	Individual work					
17	Preparation for module control	6				
	Total content module 1	26				
	Content module 2. Physical methods of analysis.					
18	Method of errors calculus of direct and indirect measurements	1				
19	Characteristics of the sensors	1				
20	Measuring of the coefficient of surface tension					
21	Possibilities of the conductometric method of analysis					
22	Possibilities of the potentiometric method of analysis					
23	Possibilities of the coulometric method of analysis					
24	Method of determining the concentration by refractometric method	1				
25	Method of determining the concentration of optically active substances	1				
26	Method of determining the concentration of translucent solutions	1				
27	Methods of qualitative and quantitative luminescent analysis.	1				
28	Techniques of microscopy	1				
29	Possibilities of X-ray structural and X-ray spectral analyzes	2				
30	Methods of electron microscopy and features of sample preparation for it	2				
31	Radiometric methods	2				
32	Possibilities of physical methods of drug delivery.	2				
33	Individual work	4				
34	Preparation for module control	6				
	Total	29				
	In all	55				

14. LIST OF INDIVIDUAL TASKS

- preparation of presentation materials (tables, experimental or model demonstrations)
- review of scientific literature
- participation in scientific conferences
- publications in scientific journals

15. LIST OF THEORETICAL TASKS TO THE FINAL MODULE CONTROL

The full list of test tasks is presented and available to students in the resources of the MOODLE environment for each topic.

16. LIST OF PRACTICAL SKILLS AND TASKS TO THE FINAL MODULE CONTROL

Not provided.

17. METHODS AND FORMS OF IMPLEMENTATION OF THE CONTROL

The grade in the discipline is determined taking into account the results of the current educational activities of the student and assessments of his mastery of individual modules

Current control is carried out at each lesson through the test of theoretical knowledge and practical skills and abilities.

Forms of current control:

1. Oral interview (individual, frontal, combined, written).

2. Practical check of the formed skills.

3. Test control

4. Analysis of the student's results.

The student's independent work is assessed in practical classes and is part of the final assessment of the student.

The student's individual work is the preparation of presentation materials (table, experimental or model demonstration, reviews of scientific literature) on the topics proposed by the curriculum.

Points for individual tasks are accrued to the student for current success only if they are successfully completed and defended.

The final control of mastering of modules 1 and 2 takes place in writing after completion of studying of the block of the corresponding semantic modules by performance of test tasks. The time of the modular task is 2 academic hours.

In case of the introduction of quarantine measures, modular control in the form of test control is carried out by means of MOODLE.

18. EVALUATION OF THE LEVEL OF STUDENT TRAINING IN THE DISCIPLINE

Assessment for module is defined as the sum of assessments of current educational activities and assessment of final module control (in points), which is set when assessing theoretical knowledge and practical skills according to the program ..

The maximum number of points that a student can score when studying each module is 200, including for current learning activities - 120 points, according to the results of the final module control - 80 points. Thus, the ratio between the results of the assessment of current educational activities and the final modular control of 60% to 40% is chosen.

When assessing the mastery of each topic of the module, the student is graded on a 4point (traditional) scale using the evaluation criteria adopted by the university for the relevant discipline. This takes into account all types of work provided by the methodological development for the study of the topic.

e rs / TTS	umbers	Number of practical classes	Conversion into point of the traditional scale					
odulo ' hou ts EC			Traditional scale				(L	ore *
Number of mo number of study number of credit	Number of co modules, their n		"5"	"4"	"3"	"2"	Scores for individual task(l	Minimum scc
Module 1 70 hours	1`	14	8	6,5	5	0	8	70
Module 2 65 hours	1	14	8	6,5	5	0	8	70

Minimal amount of points:

 1^{st} module: 5 points x 14 = 70

 2^{nd} module: 5 points x 14 = 70

Maximal amount of points:

 1^{st} module: 8 points x 14 = 112+ 8(IT)=120

 2^{nd} module: 8 points x 14 = 112 + 8(IT)=120

19. RECOMMENDED LITERATURE

19.1 Basic

1. Medical and biological physics (Part I) / V.I. Fediv, O.I.Olar, V.V. Kulchynsky, G.Yu. Rudko – Chernivtsi, Bukovinian State Medical University, 2017. – 342p.

2. Medical and biological physics. Optical phenomena for medical diagnostics/ V.I. Fediv, V.V. Kulchynsky, O.I.Olar, G.Yu. Rudko – Chernivtsi, Bukovinian State Medical University, 2019. – 156p.

3. Medical and biological physics. Fundamentals of atomic and nuclear physics in medicine. / V.I. Fediv, V.V. Kulchynsky, O.I.Olar, G.Yu. Rudko – Chernivtsi, Bukovinian State Medical University, 2019. – 13p.

4. Medical and Biological Physics. MODULE 1. Mathematical processing of medical and biological data. Basic of regularities of biomechanics and electricity and their use for diagnosis and treatment. Educational and methodical textbook / ed. by V.I. Fediv // Chernivtsi, Bukovinian State Medical University, 2019. - 146 pp.

5. Medical and Biological Physics. MODULE 2. Basic regularities of electromagnetism, optical, atomic and nuclear physics. Educational and methodical textbook / ed. by V.I. Fediv // Chernivtsi, Bukovinian State Medical University, 2019. - 186 pp.

19.2. Auxillary

- 1. V.I. Fediv, O.I.Olar Medical and biological physics (Vol.1: Mathematical processing of medical and biological data).– Chernivtsi: BSMU, 2010. 147 p.
- 2. V.I. Fediv, O.I.Olar Medical and biological physics (Vol.2: Biomechanical and electrical principles in medicine).– Chernivtsi: BSMU, 2011.–266 p.
- 3. V.I. Fediv, O.I.Olar Medical and biological physics (Vol.3: Electromagnetism and optics in medicine).– Chernivtsi: BSMU, 2013. 194 p.
- 4. V.I. Fediv, O.I.Olar Medical and biological physics (Vol.4: Quantum mechanics and elements of nuclear physics in medicine).– Chernivtsi:BSMU, 2014. 191 p.

19.3 Information resources

1. www.bsmu.edu.ua

20. COMPILERS OF THE STUDENT HANDBOOK (SYLLABUS)

- 1. Fediv Volodymyr chief of the department, professor, Dr of Physical science
- 2. Olar Olena Associate professor, PhD