



**Департамент за езиково и
специализирано обучение**

4002 Пловдив, бул. „В. Априлов“ №15А
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**Department of Languages and
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NATURAL SCIENCES SECTION

PROGRAM

Physics for preparing year foreign students in Medicine, Dental Medicine and Pharmacy

**Approved by the Departmental Council on 14 January, 2021/
Proceedings № 1**



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Section of Natural Sciences - Physics

Name of course

Physics for foreign students in preparatory course for Medicine, Dental Medicine and Pharmacy in English

Type of course according to the Uniform State Requirements:

Mandatory

Level of education:

Preparatory course

Forms of training:

Exercises, seminars, project preparation, tests, colloquia

Duration of training:

Two semesters

Attendance:

118 h

Teaching aids:

Multimedia presentations, tests, exercises

Forms of assessment:

Exam, colloquium, tests, current assessment of the work in class

Formation evaluation:

Written Examination - test and verbal exam with a score

Aspects for this evaluation:

- Ability to understand the text of the English language
- Understanding of basic concepts and equations in physical phenomena
- Development of physical theses topics

Semester examination:

Annual exam



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State Examination:

No

Leading teacher:

Senior Lecturer of Section of Natural Sciences

Department of Languages and Specialized Training

Section of Natural Sciences

ANNOTATION

The course of Physics for foreign students in preparatory course enables the acquisition of knowledge and skills in physics for the first course - medicine, dentistry, and pharmacy. The training covers basic concepts, terminology and specific physical basic knowledge of medical physics and biophysics.

The following teaching methods:

- Methods for building speech-based on expression and use of physical terminology
- Methods for understanding the physical texts
- Methods for evaluation and control of knowledge

MAIN TASKS OF CURRICULUM

Acquiring knowledge and skills to implement all modern forms, methods and means of facilitating the study of physics and biophysics in the first course in medicine, dentistry, pharmacy through:

- Personal preparation of students
- Professionally focused training
- Vocabulary of physical terms in the English language
- Basic physical knowledge – definitions, physical values, formulas, laws, principles, charts, theories
- Practical application of the physical knowledge
- Reading and understanding of the physical text of the English language
- Control tests and colloquium
- Final test



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EXPECTED RESULTS

Upon completion of the course, students must have the following knowledge and skills:

- To know basic concepts, terms, physical values, principles, laws, graphs, charts, and theories relating to Medical Physics
- To read and understand physical texts in English
- Listen and understand lectures on physics in the first year
- To build proper self-assessment of their knowledge of physics
- Be able to independently develop theses in physics related to the curriculum

CURRICULUM

Discipline	Hours				
	Exercise duration	Weekly	I semester	II semester	Total
Exercises and Seminars	2/ 2 or 3	4 or 5	40	78	118

PROGRAM

Physics Course Syllabus 2019/20		
TOPICS		Hours
I. Introduction to Mechanics		
1.	Mechanics. Basic physical concepts. Physical quantities. Determining the position of a material point, coordinate system, distance, displacement, trajectory, path, velocity, acceleration	2
2.	Movement and rest, common characteristics	2



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3.	Motion of a material point on a circle	2
4.	Forces in mechanics. Newton's laws	2
5.	Mechanical work, energy, power	2
6.	Test No1 preparation	2
7.	Test No 1- Introduction to Mechanics	2
	II. Main course. Exam Topics	
	Part I	
1.	Mechanical vibration. Basic physical concepts. Natural and forced vibration, resonance	2
2.	Mechanical waves. Definition. Physical characteristics	2
3.	Sound. Physical characteristics of sound. Perception of sound. Psychophysical characteristics	2
4.	Sound methods for diagnosis	2
5.	Ultrasound and Infrasound. Medical application	2
6.	Test No 2: Preparation	2
7.	Test No 2	2
8.	Fluids. Basic physical concepts. Types of fluids. Fluid motions. Ideal fluids. Pascal's law. Archimedes' principle. Bernoulli's equation	2
9.	Real fluids. Viscosity. Newton's law of viscosity. Poiseuille's law. Reynolds number	2
10.	Thermodynamics. Basic physical concepts . Thermodynamic parameters. Internal energy. Heat, temperature and temperature scales	2
11.	Transport processes. Energy transport, heat transfer	2
12.	Principles of thermodynamics. Entropy. Prigogine equation	2
13.	Molecular phenomena in liquids. Cohesive and adhesive forces. Surface tension. Capillarity	2
14.	Preparation for a colloquium	2
15.	Colloquium: topics 1-12	2
16.	Electrostatics. Electric charges and interaction between them. Coulomb's Law	2
17.	Electrical field. Characteristics. Intensity and potential. Electric fields line and potential surfaces	2
18.	Types of materials according to their electrical properties. Conductors and dielectrics in the electric field. Dipoles	2
19.	Direct electrical current. Definition and characteristics. Physical quantities	2



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	Ohm's Law. Work and power	
20.	Semiconductors. Band theory. Diodes and triodes	2
21.	Electrolytes. Electrical current in electrolytes. Electrophoresis. Electrical current through the living tissue	
22.	Test No 3: Preparation	2
23.	Test No 3	2
24.	Magnetism. Permanent magnetic field. Characteristics. Amper`s and Lorentz`s laws	2
25.	Magnetism in matter. Diamagnetism, paramagnetism, ferromagnetism	2
26.	Electromagnetic waves or particles. Electromagnetic spectrum. Quanta	2
27.	Alternating current. Phase difference between current and voltage. Resistance R, capacitance C and inductance L. Electrical impedance Z	2
28.	Seminar	3
29.	Test No 4:	2
30.	Light. Development of ideas about the nature of light. Properties of light	3
31.	Optical lenses. Elements. Converging and diverging lenses	2
32.	A magnifier and a microscope	3
33.	Eye. Optical system of the eye. Formation of images. Optical defects of the eye	2
34.	The interaction of light with matter. Dispersion and absorption of light. Laws	3
35.	IR and UV rays. Bands (zones). Basic properties. Effects on biological objects. Medical application	2
36.	Seminar	3
37.	Test No 5	2
38.	Quantum transitions. Spontaneous and stimulated emission	2
39.	Luminescence. Fluorescence and phosphorescence	3
40.	Laser. Laser`s action diagram. Elements of a laser. Characteristics of laser light. Types of lasers	2
41.	X-rays. Production and types. Interaction of photons with matter	3
42.	Atomic and nuclear physics. Atomic structure. Structure of the atomic nucleus. Forces acting in a nucleus. Mass defect. Binding energy	2
43.	Radioactivity. Decay constants and half-lives of the nuclides. Nuclear decay laws. Activity of a radioactive source	3
44.	Main types of radioactivity. Alpha, beta and gamma decay	2



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45.	Seminar	3
46.	Test No 6: Preparation	2
47.	Test No 6	3

Exam Topics 2019/2020

1. Mechanical vibration. Basic physical concepts. Free and forced vibration, resonance
2. Mechanical waves. Definition. Physical characteristics
3. Sound. Physical characteristics of sound. Perception of sound. Psychophysical characteristics
4. Sound methods for diagnosis
5. Ultrasound and Infrasound. Medical application
6. Fluids. Basic physical concepts. Types of fluids. Fluid motions
7. Ideal fluids. Pascal's law. Archimedes' principle. Bernoulli's equation
8. Real fluids. Viscosity. Newton's law of viscosity. Poiseuille's law. Reynolds number
9. Hemodynamics. Hydrodynamic vessels resistance. Blood pressure
10. Molecular phenomena in liquids. Cohesive and adhesive forces. Surface tension. Capillarity
11. Thermodynamics. Basic physical concepts . Thermodynamic parameters. Internal energy. Heat, temperature and temperature scales
12. Principles of thermodynamics. Entropy. Prigogine equation
13. Transport processes. Energy transport, heat transfer
14. Transport processes. Mass transport, diffusion, osmosis
15. Electrostatics. Electric charges and interaction between them. Coulomb's Law
16. Electrical field. Characteristics. Intensity and potential. Electric fields line and potential surfaces
17. Membrane potential. Cell membrane – structure. Resting membrane potential
18. Types of materials according to their electrical properties. Conductors and dielectrics in the electric field. Dipoles
19. Direct electrical current. Definition and characteristics. Physical quantities. Ohm's Law. Work and power
20. Alternating current. Phase difference between current and voltage. Resistance R, capacitance C and inductance L. Electrical impedance Z



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21. Electrolytes. Electrical current in electrolytes. Electrophoresis. Electrical current through the living tissue
22. Semiconductors. Band theory. Diodes and triodes
23. Magnetism. Permanent magnetic field. Characteristics. Amper`s and Lorentz`s laws
24. Magnetism in matter. Diamagnetism, paramagnetism, ferromagnetism
25. Light. Development of ideas about the nature of light. Properties of light
26. Electromagnetic waves or particles. Electromagnetic spectrum. Quanta
27. The interaction of light with matter. Dispersion and absorption of light. Laws
28. Quantum transitions. Spontaneous and stimulated emission. Luminescence. Fluorescence and phosphorescence.
29. Laser. Laser`s action diagram. Elements of a laser. Characteristics of laser light. Types of lasers
30. Geometrical optics. Optical density of a medium. Index of refraction. Refraction and reflection. Snell's Law. Specular and diffuse reflection. Total internal reflection
31. Optical lenses. Elements. Converging and diverging lenses
32. A magnifier and a microscope
33. Eye. Optical system of the eye. Formation of images. Optical defects of the eye
34. IR and UV rays. Bands (zones). Basic properties. Effects on biological objects. Medical application
35. Atomic and nuclear physics. Atomic structure. Structure of the atomic nucleus. Forces acting in a nucleus. Mass defect. Binding energy
36. X-rays. Production and types
37. Interaction of photons with matter
38. Radioactivity. Decay constants and half-lives of the nuclides. Nuclear decay laws. Activity of a radioactive source
39. Main types of radioactivity. Alpha, beta and gamma decay

**EXERCISES
2019/2020**

**FIRST SEMESTER
10 weeks x 5 hours**

Task № 1 - 2 hours



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Mechanics. Basic physical concepts. Physical quantities. Determining the position of a material point, coordinate system, distance, displacement, trajectory, path, velocity, acceleration.

Task № 2 - 2 hours

Movement and rest, common characteristics.

Task № 3 - 2 hours

Motion of a material point on a circle. Physical quantities that characterize circular motion: period, frequency, velocity, angular velocity, centripetal acceleration.

Task № 4 - 2 hours

Forces in Mechanics. Newton's laws. Concept of forces. Types of forces. Gravity, force of normal pressure, weight of the body, friction force, force of elasticity, centripetal force. Pressure.

Task № 5 - 2 hours

Mechanical work, power and energy. Conservative and non-conservative forces. Potential, kinetic and full mechanical energy. Mechanical systems and types of mechanical systems.

Task № 6 - 2 hours

Preparation

Task № 7 - 2 hours

Test № 1

Task № 8 - 2 hours

Mechanical vibration. Basic physical concepts. Natural and forced vibration, resonance

Task № 9 - 2 hours

Mechanical waves. Definition. Physical characteristics

Task № 10 - 2 hours

Sound. Physical characteristics of sound. Perception of sound. Psychophysical characteristics

Task № 11- 2 hours



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Sound methods for diagnosis

Task № 12 - 2 hours

Ultrasound and Infrasonud. Medical application

Task № 13 - 2 hours

Test No 2: Preparation

Task № 14 - 2 hours

Test No 2

Task № 15 - 2 hours

Fluids. Basic physical concepts. Types of fluids. Fluid motions. Ideal fluids. Pascal's law. Archimedes' principle. Bernoulli's equation

Task № 16 - 2 hours

Real fluids. Viscosity. Newton's law of viscosity. Poiseuille's law. Reynolds number

Task № 17 - 2 hours

Thermodynamics. Basic physical concepts . Thermodynamic parameters. Internal energy. Heat, temperature and temperature scales

Task № 18 - 2 hours

Transport processes. Energy transport, heat transfer

Task № 19 - 2 hours

Principles of thermodynamics. Entropy. Prigogine equation

Task № 19 - 2 hours

Molecular phenomena in liquids. Cohesive and adhesive forces. Surface tension. Capillarity

SECOND SEMESTER

7 weeks x 4 h

10 weeks x 5 x



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Task № 21 - 2 hours

Preparation for a colloquium

Task № 22 - 2 hours

Colloquium: topics 1-12

Task № 23 - 2 hours

Electrostatics. Electric charges and interaction between them. Coulomb's Law

Task № 24 - 2 hours

Electrical field. Characteristics. Intensity and potential. Electric fields line and potential surfaces

Task № 25 - 2 hours

Types of materials according to their electrical properties. Conductors and dielectrics in the electric field. Dipoles

Task № 26 - 2 hours

Direct electrical current. Definition and characteristics. Physical quantities Ohm's Law. Work and power

Task № 27 - 2 hours

Semiconductors. Band theory. Diodes and triodes

Task № 28 - 2 hours

Electrolytes. Electrical current in electrolytes. Electrophoresis. Electrical current through the living tissue

Task № 29 - 2 hours

Test No 3: Preparation

Task № 30 - 2 hours

Test No 3

Task № 31 - 2 hours

Magnetism. Permanent magnetic field. Characteristics. Amper`s and Lorentz`s laws



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Task № 32 - 2 hours

Magnetism in matter. Diamagnetism, paramagnetism, ferromagnetism

Task № 33 - 2 hours

Electromagnetic waves or particles. Electromagnetic spectrum. Quanta

Task № 34 - 2 hours

Alternating current. Phase difference between current and voltage. Resistance R , capacitance C and inductance L . Electrical impedance Z

Task № 35 - 3 hours

Seminar

Task № 36 - 2 hours

Test No 4

Task № 37 - 3 hours

Light. Development of ideas about the nature of light. Properties of light

Task № 38 - 2 hours

Optical lenses. Elements. Converging and diverging lenses

Task № 39 - 3 hours

A magnifier and a microscope

Task № 40 - 2 hours

Eye. Optical system of the eye. Formation of images. Optical defects of the eye

Task № 41 - 3 hours

The interaction of light with matter. Dispersion and absorption of light. Laws

Task № 42 - 2 hours

IR and UV rays. Bands (zones). Basic properties. Effects on biological objects. Medical application

Task № 43 - 3 hours

Seminar



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Task № 44 - 2 hours

Test No 5

Task № 45 - 2 hours

Quantum transitions. Spontaneous and stimulated emission

Task № 46 - 3 hours

Luminescence. Fluorescence and phosphorescence

Task № 47 - 2 hours

Laser. Laser's action diagram. Elements of a laser. Characteristics of laser light. Types of lasers

Task № 48 - 3 hours

X-rays. Production and types. Interaction of photons with matter

Task № 49 - 2 hours

Atomic and nuclear physics. Atomic structure. Structure of the atomic nucleus. Forces acting in a nucleus. Mass defect. Binding energy

Task № 50 - 3 hours

Radioactivity. Decay constants and half-lives of the nuclides. Nuclear decay laws. Activity of a radioactive source

Task № 51 - 2 hours

Main types of radioactivity. Alpha, beta and gamma decay

Task № 52 - 3 hours

Seminar

Task № 53 - 2 hours

Test No 6: Preparation

Task № 54 - 3 hours

Test No 6



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TESTS

- 1. Sound amplification in the outer ear (auditory canal) is affected by:**
 - a. Sound speed
 - b. Sound pressure (sound frequency?)
 - c. Sound amplitude

- 2. Prolonged exposure to loud noise can cause permanent damage to:**
 - a. The air conductivity (of the ear)
 - b. The structure of the eardrum (tympanic membrane)
 - c. Inner ear

- 3. The loss of elasticity (stiffening) of the tympanic membrane will result in:**
 - a. Increase of air conductivity
 - b. Decrease of hearing threshold
 - c. Decrease in the binaural effect

- 4. Doppler frequency (shift) is:**
 - a. The infrared spectrum of light, studied by Doppler
 - b. The frequency generated by ultrasonic transducer
 - c. The difference between emitted and reflected (received) frequency between to objects in relative motion

- 5. For which of the following numerical Doppler frequency shifts is the blood speed the highest?**
 - a. 1210 Hz
 - b. 800 Hz
 - c. 1530 Hz

- 6. Is it possible to tell the direction of motion of erythrocytes from the sign of the Doppler shift $\Delta f = f - f_0$?**



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- a. Yes, when $\Delta f > 0$ erythrocytes move towards the transducer
 - b. Yes, when $\Delta f > 0$ erythrocytes move away from the transducer
 - c. No, the sign of Δf does not tell the direction of motion
- 7. If shorter wavelengths of ultrasound are less penetrating in human tissue, then which of the following frequencies is most appropriate for DEEP tissue and organ imaging?**
- a. 8 MHz
 - b. 3 MHz
 - c. 20 MHz
- 8. Doppler shift is defined as:**
- a. The frequency difference between emitted and received signals for observers at relative motion
 - b. The difference in acoustic impedance between two transmitting mediums
 - c. The intensity difference between emitted and reflected waves
- 9. At what angle (Θ) to the surface of the body should the ultrasonic probe be applied in order to gain a maximum Doppler shift? Consider that Doppler shift is proportional to $\text{Cos}(\Theta)$.**
- a. $\Theta = 45^0$ ($\text{cos } 45 = 0.7$)
 - b. $\Theta = 90^0$ ($\text{cos } 90 = 0$)
 - c. $\Theta = 60^0$ ($\text{cos } 60 = 0.5$)
- 10. What units are used to measure blood pressure with aneroid manometer?**
- a. mmHg, kPa
 - b. mmHg, atm
 - c. N.m^{-2} , Torr
- 11. What is the predominant type of blood flow in the arteries of a healthy person?**
- a. Turbulent
 - b. Laminar
 - c. Transitional
- 12. Blood pressure on the walls of blood vessels is compensated (counterbalanced) by the elasticity of blood vessels, and by the air pressure. If the reading of the**



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sphygmomanometer during a systole is 120 mmHg and air pressure is 760 mmHg, what is the actual pressure that blood exerts on the walls of arteries?

- a. 90 mm Hg
- b. 640 mm Hg
- c. 880 mm Hg

13. Pulse pressure is defined as:

- a. The difference between systolic and diastolic pressures
- b. The difference between systolic and atmospheric pressures
- c. The average of diastolic and systolic pressures

14. What is the most precise definition of blood pressure?

- a. The pressure in the cardio-vascular system
- b. The pressure exerted by blood on the walls of blood vessels
- c. The pressure in the arteries

15. What is the variation of blood pressure across the cardio-vascular system:

- a. It decrease linearly from arteries to veins
- b. It oscillates between diastolic and systolic but stays mostly the same
- c. It decreases non-linearly with the greatest drop at the capillaries

16. When blood pressure is measured with a stethoscope, at what point is the systolic pressure detected?

- a. At the loudest sound
- b. At the first sound
- c. When the sound disappears

17. When blood pressure is measured with a stethoscope, at what point is the diastolic pressure detected?

- a. At the loudest sound
- b. At the first sound
- c. When sounds disappear

18. What property of blood is characterized by the Reynolds number?

- a. Blood viscosity
- b. Blood speed



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c. Type of blood flow: laminar or turbulent

19. Hemodialysis is a method for:

- a. Determination of serum proteins by blood dialysis
- b. Removing toxins from patient's blood
- c. investigating brain hemodynamics

20. Does speed of dialysis depend on the conductance of the membrane?

- a. Yes, high conductance relates to faster dialysis
- b. Yes, high conductance relates to slower dialysis
- c. There is no correlation between membrane conductance and the rate of dialysis