PROGRAM

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

Accepted by a Section Council – 21.10.2019
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

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

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

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<tr>
<th>Discipline</th>
<th>Hours</th>
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<tr>
<td></td>
<td>Exercise duration</td>
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<tr>
<td>Exercises and Seminars</td>
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Physics Course Syllabus 2019/20

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<th>TOPICS</th>
<th>Hours</th>
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<td>I. Introduction to Mechanics</td>
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<tr>
<td>1. Mechanics. Basic physical concepts. Physical quantities. Determining the position of a material point, coordinate system, distance, displacement, trajectory, path, velocity, acceleration</td>
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<tr>
<td>2. Movement and rest, common characteristics</td>
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<tr>
<td>3. Motion of a material point on a circle</td>
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<tr>
<td>4. Forces in mechanics. Newton's laws</td>
<td>2</td>
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<tr>
<td>5. Mechanical work, energy, power</td>
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<td>6. Test No1 preparation</td>
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<td>7. Test No 1- Introduction to Mechanics</td>
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<td>II. Main course. Exam Topics Part I</td>
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<tr>
<td>1. Mechanical vibration. Basic physical concepts. Natural and forced vibration, resonance</td>
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<tr>
<td>2. Mechanical waves. Definition. Physical characteristics</td>
<td>2</td>
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<tr>
<td>4. Sound methods for diagnosis</td>
<td>2</td>
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<td>5. Ultrasound and Infrasound. Medical application</td>
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<td>6. Test No 2: Preparation</td>
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<td>7. Test No 2</td>
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<td>14. Preparation for a colloquium</td>
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<td>15. Colloquium: topics 1-12</td>
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<td>17. Electrical field. Characteristics. Intensity and potential. Electric fields line and potential surfaces</td>
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<td>18. Types of materials according to their electrical properties. Conductors and</td>
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<td>No.</td>
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<td>19.</td>
<td>Dielectrics in the electric field. Dipoles</td>
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<tr>
<td>20.</td>
<td>Direct electrical current. Definition and characteristics. Physical quantities</td>
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<td>21.</td>
<td>Ohm’s Law. Work and power</td>
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<td>22.</td>
<td>Semiconductors. Band theory. Diodes and triodes</td>
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<td>23.</td>
<td>Electrolytes. Electrical current in electrolytes. Electrophoresis. Electrical current through the living tissue</td>
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<td>25.</td>
<td>Test No 3</td>
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<tr>
<td>27.</td>
<td>Magnetism in matter. Diamagnetism, paramagnetism, ferromagnetism</td>
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<td>Seminar</td>
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<td>30.</td>
<td>Test No 4:</td>
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<td>32.</td>
<td>Optical lenses. Elements. Converging and diverging lenses</td>
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<tr>
<td>33.</td>
<td>A magnifier and a microscope</td>
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<tr>
<td>34.</td>
<td>The interaction of light with matter. Dispersion and absorption of light. Laws</td>
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<tr>
<td>35.</td>
<td>Eye. Optical system of the eye. Formation of images. Optical defects of the eye</td>
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<tr>
<td>36.</td>
<td>IR and UV rays. Bands (zones). Basic properties. Effects on biological objects. Medical application</td>
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<tr>
<td>37.</td>
<td>Test No 5</td>
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<tr>
<td>38.</td>
<td>Quantum transitions. Spontaneous and stimulated emission</td>
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<tr>
<td>39.</td>
<td>Luminescence. Fluorescence and phosphorescence</td>
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<tr>
<td>41.</td>
<td>X-rays. Production and types. Interaction of photons with matter</td>
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<td>43.</td>
<td>Radioactivity. Decay constants and half-lives of the nuclides. Nuclear decay laws. Activity of a radioactive source</td>
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<td>44.</td>
<td>Main types of radioactivity. Alpha, beta and gamma decay</td>
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Exam Topics
2019/2020

1. Mechanical vibration. Basic physical concepts. Free and forced vibration, resonance
2. Mechanical waves. Definition. Physical 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
15. Electrostatics. Electric charges and interaction between them. Coulomb's Law
18. Types of materials according to their electrical properties. Conductors and dielectrics in the electric field. Dipoles
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
26. Electromagnetic waves or particles. Electromagnetic spectrum. Quanta
27. The interaction of light with matter. Dispersion and absorption of light. Laws
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
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
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

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
Sound methods for diagnosis

Task № 12 - 2 hours
Ultrasound and Infrasound. 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

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

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

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

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

**Task № 48 - 3 hours**
X-rays. Production and types. Interaction of photons with matter

**Task № 49 - 2 hours**

**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
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 $\Delta f = f - f_0$?
   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 $\Delta f$ 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 Cos (Θ).
   a. Θ = 45° (cos 45 = 0.7)
   b. Θ = 90°(cos 90= 0)
   c. Θ = 60°(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 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?
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
   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