



МЕДИЦИНСКИ УНИВЕРСИТЕТ – СОФИЯ
Medical University - Sofia
МЕДИЦИНСКИ ФАКУЛТЕТ
Faculty of Medicine – Dean’s Office

PHYSICS AND BIOPHYSICS CURRICULUM

The curriculum has been adopted at the meeting of the Faculty Council № 41/08.07.2020

Annotation of the academic discipline

The program “**Medical Physics and Biophysics**” for students in **Pharmacy** is subdivided into two structural and temporal different parts - “Medical Physics” and “Biophysics. The teaching on the first discipline is placed in the first semester, on the second – in the second semester.

Studying the discipline "**Medical Physics**" helps to acquire theoretical knowledge of physical phenomena, principles and laws and their application in medical diagnostics and therapy. Students acquire skills to apply their knowledge in explaining the physical basics of electrodiagnostics and electrotherapy, the physical principles of ultrasound imaging, the biological effects of laser radiation, the nature of magnetic resonance imaging, X-ray computed tomography, the mechanism of apparatus for radionuclide diagnostics, etc.

Subject of the **Biophysics** are the physical principles founding all processes in the living systems. It is precise interdisciplinary science between physics and biology. It is fundamental experimental and theoretical discipline closely related to mathematics, biochemistry and physiology. It is crossing the areas of physics, chemistry and physical chemistry. Learning biophysics helps students in pharmacy in the formation of problem based thinking, just because of the need to use knowledge from many scientific areas for the explanation of the mechanism of functioning of the living matter at a particular level of organization. In the lecture course in biophysics are included the topics “Biothermodynamics”, “Biomembranes”, “Free radicals and oxidative stress”, “Membrane transport”, “Electrical properties of cells and tissues” and “Nanotechnology in medicine”. Acquiring the knowledge offered in these topics is necessary for the understanding of the phenomena concerning the interactions of drugs with membranes and cells. It will help the students in pharmacy in the development of new strategies for drug therapy and optimization of newly designed medicaments. For the practical exercises the students are required to obtain by self-study the knowledge needed for finding solution for formulated experimental problem. The practical education consists of 4 experimental practices, one seminar and an exam on the learned material.

Lectures

A “Medical Physics”

1. Structure of solids
2. Structure of liquids
3. Hydrostatics.
4. Hydrodynamics
5. Phase separation in liquid heterogeneous systems
6. Sound
7. Psychophysical characteristics of sound
8. Ultrasound
9. Temperature and heat
10. Thermal exchange, laws
11. Electric field

12. Electrical conductivity of liquids
13. Magnetic field. Lorentz force
14. Magnetic properties of substances
15. Physical basis of electrodiagnostics
16. Physical basis of electrotherapy
17. Reflection and refraction of light
18. Dispersion and absorption of light
19. Scattering of light
20. Polarization of light
21. Optical lenses
22. Human eye as an optical system
23. Optical microscope
24. Electron microscope
25. Optical atomic spectra
26. Molecular spectra
27. Luminescence
28. Lasers
29. Radioactivity
30. Activity of radioactive sources
31. X-ray (Roentgen ray) radiation
32. Interaction of photon ionizing radiation with matter
33. Interaction of charged particles with matter
34. Effect of ionizing radiation on human organism. Dosimetry quantities

B Biophysics

35. Basics of thermodynamics
36. Basics of non-equilibrium thermodynamics
37. Thermodynamics of living systems. Bioenergetics
38. Thermodynamics of biopolymers
39. Biomembranes – functions, types, composition. Membrane lipids
40. Biomembranes – role of membrane proteins. Fluid-mosaic model
41. Model membranes
42. Molecular mobility in membranes. Phase transitions
43. Free radicals in living systems
44. Oxidative stress and antioxidant protection
45. Basics of membrane transport
46. Free diffusion of ions and hindered diffusion
47. Osmosis and filtration
48. Facilitated passive transport
49. Active transport
50. Main types of biopotentials
51. Resting potential
52. Action potential
53. Surface electric charge of cells. Electrophoresis
54. Passive electrical properties of cells and tissues
55. Nanotechnologies in medicine – drug nanocarriers
56. Nanotechnologies in medicine – diagnostic methods, biomaterials

Seminars

A “Medical Physics”

1. Determination of dynamic viscosity of liquids.
2. Determination of surface tension of liquids.

3. Photometric values and measurements.
4. Determining the threshold of hearing with pure-tone audiometry.
5. Electrical modeling of the biological objects.
6. Determination index of refraction of liquids by refractometer.
7. Measuring the activity of a radioactive source by relative method. Determination of half-life of a radionuclide.
8. Photocolorimetric determination of the concentration of solutions.
9. Test. Seminar: Atomic and molecular spectra.

B “Biophysics”

1. Iontophoretic permeability determination of the human skin in vivo
2. Investigation on the diffusion potential in model system
3. Electrophoretic estimation of the surface electric charge of red blood cells
4. Transport through artificial membrane
5. Semianar “Biopotentials”
6. Exam on the practical exercises and seminars – final test

Ongoing assessment – oral testing and middle tests during the semester.

Syllabus for theoretical semester exam

1. Structure of solids
2. Structure of liquids
3. Hydrostatics.
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9. Temperature and heat
10. Thermal exchange, laws
11. Electric field
12. Electrical conductivity of liquids
13. Magnetic field. Lorentz force
14. Magnetic properties of substances
15. Physical basis of electrodiagnostics
16. Physical basis of electrotherapy
17. Ultraviolet, visible and infrared radiation
18. Reflection and refraction of light
19. Scattering and absorption of light
20. Polarization of light
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Academic literature:

A “Medical Physics”

1. Lecture notes.
2. Medical Physics –Exercise book, ISBN 978-954-9566-73-4, Издателство ТЕМТО, 2018 г.

B “Biophysics”

1. B. Tenchov, R. Koynova, L. Traikov, Lecture notes in biophysics, Simelpress, Sofia 2019
2. R. Glaser, Biophysics. An Introduction, 2012, Sringer-Verlag, Berlin Heidelberg New York, ISBN 978-3-642-25212-9
3. Weiss, T. F., Cellular Biophysics - Two Volume Set, MIT Press, 1996, 1318 pp., 758 illus, ISBN-10: 9780262529570
4. Texts for the practical exercises and seminars