

PUBLIC HEALTH MINISTRY OF UKRAINE
KHARKIV NATIONAL MEDICAL UNIVERSITY

DEPARTMENT OF MEDICAL AND BIOLOGICAL PHYSICS AND
MEDICAL INFORMATICS

MEDICAL & BIOLOGICAL PHYSICS

WORKBOOK

Part 1

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Part 1

FACULTY _____

GROUP # _____

STUDENT'S NAME _____

TEACHER'S NAME _____

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Medical and Biological Physics. Workbook: workbook for students studying the subject in English. in 2 parts/ Vladimir G. Knigavko, Olga V. Zaytseva, Marina A. Bondarenko.- Kharkiv: Kh.N.M.U., 2012.- Part 1.- 116 p.

The Workbook covers topics in medical and biological physics and presents key concepts in higher mathematics, the theory of probability and mathematical statistics in compliance with the new typical program for the subject "Medical and Biological Physics" for students of medical universities approved by the Ukrainian Ministry of Public Health and CMC for higher medical education. The Workbook as a book for practical and laboratory works is an integral part of the "Medical and biological physics. Textbook". For convenience of students and teachers it has been arranged by subjects in almost the same order as the Textbook. The course "Medical and biological physics" is scheduled for two semesters, and in accordance with credit-module system of organization of educational process it is composed of three Modules. That is why the Workbook consists of two parts: Part 1 includes material of the first and second modules, this part is intended for the first semester; Part 2 is dedicated to material of the third module, this part is intended for the second semester.

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INTRODUCTION

This Workbook covers the core of the medical and biological physics, as well presents key concepts in higher mathematics, theory of probability, and mathematical statistics for students of the medical universities. The Workbook represents all methodological base of practical and laboratory classes' activity.

It was worked out in compliance with Standard program for subject "Medical and biological physics" approved by Ukrainian Ministry of Public Health for higher medical education, and meets the requirements of the credit-module system of organization of educational process.

The Workbook as a book for practical and laboratory works is an integral part of the Textbook "Medical and biological physics". For convenience of students and teachers it has been arranged by subjects in almost the same order as the Textbook. There are examples of the test questions at the end of each unit; it helps student to check his level of knowledge mastering. Therefore material represented in the Workbook promotes a better understanding of subject and a systematization of students' knowledge. The Workbook makes possible for student to prepare for the class qualitatively, to work actively in the class, to do homework, to make self-checking of his/her knowledge, and, as a result, to prepare for the final module assessment properly.

The course "Medical and biological physics" is scheduled for two semesters, and in accordance with credit-module system of organization of educational process it is composed of three Modules:

Module 1 "Mathematical processing of medical and biological data" (11 units),

Module 2 "Fundamentals of biological physics" (9 units),

Module 3 "Fundamentals of Medical Physics" (20 units).

That is why the Workbook consists of two parts: Part 1 includes material of the first and second modules, this part is intended for the first semester; Part 2 is dedicated to material of the third module, this part is intended for the second semester.

MODULE 1

Mathematical processing of medical and biological data

Contents

1. Differential Calculus (seminar)
2. Integral Calculus (seminar)
3. Some Differential Equations (seminar)
4. Elements of the Theory of Probability (Part 1) (seminar)
5. Elements of the Theory of Probability (Part 2) (seminar)
6. Random Variables (Part 1) (seminar)
7. Random Variables (Part 2) (seminar)
8. Elements of Mathematical Statistics (seminar)
9. Study of Correlation Dependence between Random Variables (lab. work)
10. Methods of Data Processing (seminar)
11. **Control of acquirements in the Module 1** "Mathematical processing of medical and biological data"

Subject 1: Basic of Differential Calculus

Task 1. Let y be some function of variable x : $y = f(x)$. An increment of this function $\Delta y = f(x + \Delta x) - f(x)$ corresponds to an increment of its argument Δx . Record formula for the *derivative* of the function y with respect to the argument x

Give the *physical meaning* of the derivative _____

Give the *geometrical meaning* of the derivative _____

Task 2. Make a careful study of the table "Derivatives of Basic Elementary Functions", and then fill in the blanks in the table below.

Function	Derivative of function
$y = x^n$ (Power function)	
$y = a^x$ (Exponential function)	
$y = e^x$ (Exponential function, $a = e \approx 2,7$)	
$y = \log_a x$ (Logarithmic function)	
$y = \ln x$ (Function of the natural logarithm)	
$y = \log x$ (Function of the decimal logarithm)	
Trigonometric functions:	
$y = \sin x$ (Sine)	
$y = \cos x$ (Cosine)	
$y = \tan x$ (Tangent)	
$y = \cot x$ (Cotangent)	
Inverse Trigonometric functions:	
$y = \arcsin x$ (Arc Sine)	
$y = \arccos x$ (Arc Cosine)	

$y = \arctan x$ (Arc Tangent)	
$y = \operatorname{arccot} x$ (Arc Cotangent)	

Task 3. Study *basic properties of derivatives*. Complete the sentences.

1. The derivative of a constant is equal to _____

Let $y = 356$ then $y' =$ _____

2. Let function $y = c \cdot u(x)$ then $y' =$ _____

Let $y = 78 \sin x$ then $y' =$ _____

3. Let function $y = u(x) + v(x)$ then $y' =$ _____

Let $y = e^x - \cos x$ then $y' =$ _____

Let $y = \ln x + \tan x$ then $y' =$ _____

Let $y = 15x^2 - 6x + 8$ then $y' =$ _____

4. Let function $y = u(x) \cdot v(x)$ then $y' =$ _____

Let $y = (3x + 5) \cdot \sin x$ then $y' =$ _____

Let $y = (e^x - \cos x) \cdot (6x - 1)$ then $y' =$ _____

Let $y = \cos x \cdot (\ln x - 5)$ then $y' =$ _____

5. Let function $y = \frac{u(x)}{v(x)}$ then $y' =$ _____

Let $y = \frac{6x}{\sin x}$ then $y' =$ _____

Let $y = \frac{e^x + 8}{3x^2}$ then $y' =$ _____

Let $y = \frac{\cos x - \sin x}{5x^2 + 1}$ then $y' =$ _____

Task 4. Give the definition of a *composite function* _____

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