CHAIR OF CHEMISTRY AND PHYSICS

GUIDELINES

FOR IMPLEMENTATION OF THE INDEPENDENT

EXTERNAL WORK OF STUDENTS OF 2 COURSE

MEDICAL FACULTY

FOR DIGITAL TECHNOLOGIES IN MEDICINE

Vladikavkaz

Methodical recommendations are drawn up in accordance with:
1. Federal State Educational Standard of Higher Education in the specialty "General Medicine", approved by the Ministry of Education and Science of the Russian Federation on August 12, 2020 No. 988.
2. Curriculum for the specialty "General Medicine", approved by the Academic Council of the Federal State Budgetary Educational Institution of Higher Education SOGMA of the Ministry of Health of Russia.
3. The work program of the academic discipline "Digital technologies in medicine"

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Approved at the meeting of the Central Committee of UMS
" 24 " May 2023г. Protocol № 8

CONTENT:

Topic 1 *"Fundamentals of the digital economy and digital health"*

1. Control questions:

1. Concepts and definitions of the Digital Economy and Digital Health;

2. What is an algorithmic language?

3. How are real numbers represented in MatLAB calculations?

4. How can I change the format of representation of real numbers in the command window?

5. How are variables declared in MatLAB?

6. How to make the result of actions recorded in the next line a) displayed in the command window; b) was not displayed on the screen?

7. What role does the ans system variable play?

8. How to return a previously entered command to the command line?

9. How to enter the value of a complex number, and in what form will it be displayed on the screen?

10. How to provide addition, subtraction, multiplication, division and exponentiation of complex numbers in MatLAB?

11. What functions for working with complex numbers are provided in the MatLAB language?

2. Target tasks:

Student must know:	Literature:
• 1. What is Matlab • 2. Programming mode • 3. Interactive mode - program interface • 4. Calculator mode **The student should be able to:** 1. to develop mind maps on the topic "Fundamentals of the digital economy and digital health"; 2. work in Matlab environment - calculator mode	**1.** Kobrinsky B.A., Zarubina T.V. "Medical informatics", M., Publishing house "Academy", 2009. **2.** Zhizhin K.S. "Medical Statistics", Higher Education, 2007. **3.** Methodical development for 4th year students for a practical lesson on the topic "Analysis of biomedical signals - digital signals and images" **4.** http / science.urfu.ru / ru / publications / analysis-biomedical-signals-in-environment-matlab-tutorial-tutorial

3. Tasks for independent work on the topic under study:

Tasks:

1. Prepare mental maps for basic theoretical concepts;

2. To study the Matlab software environment - interactive mode - calculator mode to complete tasks on laboratory work No. 1.

PRACTICAL TASKS FOR LABORATORY WORK No. 1

Task 1.1. Evaluate the specified arithmetic expression. Specify the keystroke sequence. Compare your result with the answer given.

Answer:

1. $\dfrac{\left(12\dfrac{1}{6}-6\dfrac{1}{27}-5{,}25\right)13{,}5+0{,}111}{0{,}02}.$ 599,3

2. $\dfrac{\left(1\dfrac{1}{12}+2\dfrac{5}{32}+\dfrac{1}{24}\right):9{,}6+2{,}13}{0{,}0004}.$ 6179,5

3. $\dfrac{\left(6{,}6-3\dfrac{3}{14}\right)5\dfrac{5}{6}}{(21-1{,}25):2{,}5}.$ 2,5

4. $\dfrac{2{,}625-\dfrac{2}{3}\cdot2\dfrac{5}{14}}{\left(3\dfrac{1}{12}+4{,}375\right):19\dfrac{8}{9}}.$ 2,8095

5. $\dfrac{0{,}134+0{,}05}{18\dfrac{1}{6}-1\dfrac{11}{14}-\dfrac{2}{15}\cdot2\dfrac{6}{7}}.$ 0,0115

6. $\dfrac{\left(58\dfrac{4}{15}-56\dfrac{7}{24}\right):0{,}8+2\dfrac{1}{9}\cdot0{,}225}{8{,}75\cdot0{,}6}.$ 0,56071

7. $\dfrac{\left(\dfrac{0{,}216}{0{,}15}+0{,}56\right):0{,}5}{\left(7{,}7:24{,}75+\dfrac{2}{15}\right)4{,}5}.$ 2

8. $\dfrac{1\dfrac{4}{11}\cdot0{,}22:0{,}3-0{,}96}{\left(0{,}2-\dfrac{3}{40}\right)1{,}6}.$ 0,2

9. $\dfrac{\left(\dfrac{3}{5}+0{,}425-0{,}005\right):0{,}12}{30{,}5+\dfrac{1}{6}+3\dfrac{1}{3}}.$ 0,25

10. $\dfrac{3\dfrac{1}{3}+2{,}5}{2{,}5-1\dfrac{1}{3}}\cdot\dfrac{4{,}6-2\dfrac{1}{3}}{4{,}6+2\dfrac{1}{3}}:\left(\dfrac{0{,}05}{\dfrac{1}{7}-0{,}125}+5{,}7\right).$ 0,19231

11. $\dfrac{0{,}725+0{,}42(6)}{0{,}128-6{,}25-(0{,}0345:0{,}12)}\cdot0{,}25.$ -0,04492

12. $\dfrac{\left(4{,}5 \cdot 1\dfrac{2}{3} - 6{,}75\right) \cdot 0{,}(6)}{\left(3{,}333 \cdot 0{,}3 + 0{,}222 \cdot \dfrac{4}{9}\right) 2\dfrac{2}{3}}$.   0,17068

13. $\dfrac{\left(5\dfrac{4}{45} - 4\dfrac{1}{6}\right) : 5\dfrac{8}{15}}{\left(4\dfrac{2}{3} + 0{,}75\right) 3\dfrac{9}{13}} \cdot 34\dfrac{2}{7}$.   0,28571

14. $\dfrac{1\dfrac{4}{11} \cdot 0{,}22 : 0{,}3 - 0{,}96}{\left(0{,}2 - \dfrac{3}{40}\right) 1{,}68}$.   0,19048

15. $\dfrac{\left(40\dfrac{7}{30} - 38\dfrac{5}{12}\right) : 10{,}9 + \left(0{,}875 - \dfrac{7}{30}\right) \cdot \dfrac{20}{11}}{0{,}008}$.   166,67

16. $\dfrac{(68{,}023 - 66{,}028) : 6\dfrac{1}{9} + \dfrac{7}{40} \cdot 4{,}5}{0{,}042 + 0{,}086}$.   8,7028

17. $\dfrac{(2{,}1 - 1{,}965) : (1{,}2 \cdot 0{,}045)}{0{,}00325 : 0{,}013} - \dfrac{4}{0{,}2 \cdot 073}$.   -17,397

18. $\dfrac{(1{,}88 + 2{,}127) \cdot 0{,}01875}{0{,}625 - \dfrac{13}{18} : 3{,}13} + 8{,}29$.   8,2441

19. $\dfrac{3 : 0{,}4 - 0{,}009 : (0{,}15 : 2{,}5)}{0{,}32 \cdot 6 + 0{,}033 - (5{,}3 - 3{,}88)}$.   13,79

20. $\dfrac{(34{,}06 - 33{,}81) \cdot 4}{6{,}84 : (28{,}57 - 25{,}15)} + 1{,}33 : \dfrac{4}{21}$.   7,4825

21. $\dfrac{8{,}8077}{20 - (28{,}2 : (13{,}333 \cdot 0{,}3 + 0{,}0125)) 2{,}004}$.   1,4889

22. $\dfrac{\left(1{,}75 : \dfrac{2}{3} - 1{,}75 \cdot 1{,}125\right) : \dfrac{7}{12}}{(0{,}2012 - 0{,}0325) : 400}$.   2667,5

23. $\dfrac{\left(26\dfrac{1}{3} - 18{,}02 \cdot 0{,}75\right) \cdot 2{,}4 : 0{,}88}{1{,}37 - 23\dfrac{2}{3} : 1{,}82}$.   -3,005

24. $26 : \dfrac{3 : (0{,}48 - 0{,}27)}{2{,}52(1{,}38 + 2{,}45)} + 1{,}27$.   18,836

25. $\left(16{,}5 - 13\dfrac{7}{9}\right) \dfrac{6}{11} + 2{,}2 : (0{,}241 - 0{,}91)$.   -1,8036

Task 1.2. Perform calculations using the specified formula for the specified parameter values. Indicate the required sequence of actions. Compare your result with the one shown. the answer.

Indication. In the MatLAB system, the last few commands are stored. Re-calling thesecommands to the command window are carried out by pressing the keys <↓> and <↑>. Use this opportunity to re-invoke the branded function.

1. $3m^2 + \sqrt[3]{2n^2} : m$; а) $m = -\dfrac{14}{5}$, $n = tg\dfrac{\pi}{8}$; б) $m = 2{,}2 \cdot 10^{-2}$, $n = \dfrac{1}{3{,}1}$.

ОТВЕТ: а) 23,27;   б) 26,938.

2. $\dfrac{4}{3}l^3 \sin^2\dfrac{\alpha}{2}\sqrt{\cos\alpha}$; а) $l = 1{,}7 \cdot 10^3$, $\alpha = 18°$; б) $l = \dfrac{16}{21}$, $\alpha = \dfrac{\pi}{5}$.

ОТВЕТ: а) 1. 5633e+008;   б) 5. 0651e-002.

3. $\sqrt{\dfrac{a\sqrt{b}}{\sqrt[3]{tg\alpha}}}$; а) $a = 1{,}5$, $b = 0{,}8$, $\alpha = 61°$; б) $a = 3 \cdot 10^{-2}$, $b = 0{,}71$, $\alpha = \dfrac{3}{7}\pi$.

ОТВЕТ: а) 1. 0498e+000;   б) 1. 2429e-001.

4. $\dfrac{3a^2\sqrt{6{,}8 \cdot (a-b)}}{4(a+b)^3}$; а) $a = 4{,}13 \cdot 10^{-1}$, $b = \dfrac{1}{261}$;

   б) $a = \sin\dfrac{5\pi}{8}$, $b = -tg12°$.

ОТВЕТ: а) 2. 9464e+000;   б) 4. 9445e+000.

5. $\dfrac{c^3}{6}\cos\dfrac{\alpha}{2}\sqrt{\sin\alpha}$; а) $c = \lg 2{,}38$, $\alpha = \dfrac{\pi}{5}$; б) $c = e^{-0{,}3}$, $\alpha = 65°$.

ОТВЕТ: а) 3. 4657e-004;   б) 2. 2120e-002.

6. $\sqrt{\dfrac{n^3}{16{,}3\sin\alpha\sin 2\alpha}}$; а) $n = 3{,}1516 \cdot 10^{-2}$, $\alpha = 5°$; б) $n = e^{3{,}5}$, $\alpha = \dfrac{2\pi}{13}$.

ОТВЕТ: а) 1. 1265e-002;   б) 7. 6324e+001.

7. $5\sin 35° \sqrt{\dfrac{S^3 \cos 36°}{\pi^3 tg\alpha}}$; а) $S = \ln 3$, $\alpha = 44°$; б) $S = \dfrac{18}{25}$, $\alpha = \dfrac{7}{12}\pi$.

ОТВЕТ: а) 5. 4283e-001; б) 8. 9703e-018+ 1. 4650e-001i.

8. $\left| \lg(1+\sin\alpha) + \ln(1-\sin\beta) \right|$; а) $\alpha = \dfrac{3\pi}{7}$, $\beta = 83°$; б) $\alpha = \dfrac{2}{3}\pi$, $\beta = 16°$.

ОТВЕТ: а) 4. 6035e+000;   б) 5. 1546e-002.

9. $\sqrt[3]{\sin^2(\alpha+\beta)-\sin^2(\alpha-\beta)}$; а) $\alpha=\frac{5}{7}\pi$, $\beta=0,3\pi$; б) $\alpha=12°$, $\beta=220°$

ОТВЕТ: а) 4. 8756e-001+ 8. 4448e-001i;   б) 7. 3715e-001.

10. $\left(\log_a(b+1,4)\right)^{-3/4}$; а) $a=3,56$, $b=e^{0,316}$; б) $a=2$, $b=2,1649\cdot10^{-2}$.

ОТВЕТ: а) 1. 1790e+000;   б) 1. 6630e+000.

11. $3\left(p^{-2/3}+q^{-1/2}\right)\sqrt[3]{pq}$; а) $p=\ln3$, $q=\lg3$; б) $p=0,013$, $q=1,4\cdot10^2$.

ОТВЕТ: а) 5. 7737e+000;   б) 6. 6559e+001.

12. $\frac{2}{3}m\sqrt{m\sqrt[3]{m\sqrt[4]{m}}}$; а) $m=3,6485\cdot10^2$; б) $m=\frac{24}{37}$.

ОТВЕТ: а) 1. 5880e+004;   б) 5. 4516e-001.

13. $\frac{8}{3}S\sqrt{\frac{S}{\pi}}\sin^6\frac{\alpha}{2}$; а) $S=e^{1,11}$, $\alpha=\frac{7}{11}\pi$; б) $S=5,403$, $\alpha=28°$.

ОТВЕТ: а) 2. 8187e+000;   б) 3. 7879e-003.

14. $2\sqrt{\frac{F}{\pi}}tg\alpha\sin^2\frac{\alpha}{2}$; а) $F=\frac{1}{0,03}$, $\alpha=\frac{5}{7}\pi$; б) $F=\ln7$, $\alpha=1,34°$.

ОТВЕТ: а) -6. 6313e+000;   б) 5. 0346e-006.

15. $\frac{1}{12}\cdot\frac{m^3\cos\alpha}{(\sin\alpha+\cos\alpha)^3}$; а) $m=-20,1$, $\alpha=20°$; б) $m=\lg13,6$, $\alpha=1,48$.

ОТВЕТ: а) -3. 0201e+002;   б) 8. 5792e-003.

16. $\frac{\sqrt{3h^3}}{\cos^2\alpha}\sin(\alpha+30°)\sin(\alpha-30°)$;

    а) $h=0,28$, $\alpha=41°$; б) $h=e^{0,415}$, $\alpha=237.°$

ОТВЕТ: а) 8. 1284e-002;   б) 4. 9334e+000.

17. $\frac{\alpha}{3}\left(\lg(d+2)-tg\alpha\right)^2$;

    а) $d=6,178$, $\alpha=20°$; б) $d=-2,2461\cdot10^{-2}$, $\alpha=1,146$.

ОТВЕТ: а) 3. 5028e-002;   б) 1. 4003e+000.

18. $d^3ctg\alpha\sqrt{\sin^4\alpha-\cos^4\alpha}$; а) $d=10,6$, $\alpha=50°$; б) $d=e^{2,3}$, $\alpha=1$.

ОТВЕТ: а) 4. 1645e+002;   б) 4. 1101e+002.

19. $\frac{a^2\sqrt{3}}{4}\left(\sec\alpha+\cos ec\alpha\right)^4$;

    а) $a=5,08$, $\alpha=25°$; б) $a=\ln1,37$, $\alpha=\frac{12}{25}\pi$

ОТВЕТ: а) 1. 6193e+003;   б) 3. 5238e+003.

20. $\dfrac{\sqrt{\pi}}{3} \cdot \dfrac{1}{\left(ctgA + ctgB\right)^2}$; a) $A = 51°$, B $= 39°$; б) $A = 0{,}643$, B $= \dfrac{\pi}{7}$.

ОТВЕТ: a) 1. 4132e-001;   б) 5. 0772e-002.

21. $\lg\left(3^{x^2 - x - 9} + \dfrac{8}{27}\right)$; a) $x = e^{1{,}648}$; б) $x = tg1{,}21$.

ОТВЕТ: a) 6. 1109e+000;   б) -5. 1927e-001.

22. $\dfrac{\sqrt[5]{5e^{4a}\left(a + 12{,}36\right)^2}}{\ln\left(a + 7\right)}$; a) $a = 2{,}1754 \cdot 10^2$; б) $a = \cos17°$.

ОТВЕТ: a) 8. 5511e+075 ;   б) 4. 0272e+000;

23. $\lg^2 x - \left(\dfrac{27}{8}\right)^{x-1} \sin\sqrt{x}$; a) $x = e^{2{,}145}$; б) $x = 2{,}468 \cdot 10^{-1}$.

ОТВЕТ: a) -2. 0936e+003;   б) 1. 7858e-001.

24. $\sqrt[5]{\left(x - y\right)^2 \sqrt[3]{1\big/_{y - x}}}$; a) $x = e^{-0{,}37}$, $y = \ln2{,}1517$; б) $x = 37°$, $y = \cos\dfrac{7}{24}\pi$.

ОТВЕТ: a) 3. 4445e-001;   б) 2. 6745e-001.

25. $\dfrac{\sin A + tgB}{\sqrt[5]{\left(A - 3B\right)^2}}$; a) $A = 5{,}6$, $B = \lg25$; б) A $= \dfrac{8}{9}\pi$, $B = \dfrac{\pi}{10}$.

ОТВЕТ: a) 4. 4466e+000;   б) 5. 2145e-001.

Task 1.3. Follow these steps (see table 1.1):

a) the number z_1, given in algebraic (exponential) form, go to exponential

(algebraic), check and write down the result

б) the number z_2, given in exponential (algebraic) form, go to the algebraic

(exponential), check and write down the result

c) calculate the given expression; write the result in exponential form, with the argument

result in the range between (-π) and + π

Вари ант	Комплексное число				Выражение
	z_1	z_2	z_3	z_4	
1	$4 + 3i$	$2{,}71e^{i\pi/12}$	$1{,}82e^{-1{,}2i}$	$\sqrt{3} - 2i$	$z_1^2 \cdot z_2 : z_3 + z_4$
2	$0{,}8 - 2i$	$3{,}08e^{i7\pi/12}$	$8{,}01e^{2i}$	$-5 + \sqrt{2}i$	$z_1^2 : z_2 + z_3 - z_4$
3	$-0{,}7 + 4i$	$1{,}74e^{i0{,}3\pi}$	$3 + 4i$	$2{,}1e^{-2{,}3i}$	$\sqrt{z_1 : z_2} \cdot z_3 + z_4$
4	$-3 - 2i$	$3{,}21e^{15°i}$	$1{,}2 + 3i$	$2{,}71e^{-78°i}$	$\sqrt{z_1 \cdot z_2} : z_3 + z_4$
5	$2{,}71e^{i\pi/12}$	$-0{,}7 + 4i$	$1{,}31e^{-i5\pi/12}$	$-8 - 3i$	$\sqrt{z_1 : z_2} \cdot z_3 - z_4$

6	$3{,}08e^{i7\pi/12}$	$-3-2i$	$2{,}03e^{i14/13}$	$\sqrt{3}+\sqrt{2}i$	$\left(z_1+z_2\right)^4\cdot z_3:z_4$
7	$1{,}74e^{0{,}3\pi i}$	$0{,}8-2i$	$3{,}28e^{-1{,}2i}$	$\sqrt{3}-\sqrt{2}i$	$\left(\sqrt{z_1}+z_2\right)\cdot z_3:z_4$
8	$3{,}21e^{15i}$	$4+3i$	$\sqrt{3}-4i$	$1{,}23e^{111°i}$	$\left(z_1-z_2\right)^3\cdot z_3+z_4$
9	$1+i\frac{\pi}{2}$	$1{,}2e^{107°i}$	$0{,}8-2i$	$2{,}5e^{14°i}$	$\left(z_1:z_2+z_3\right)^3\cdot z_4$
10	$\sqrt{5}-i$	$0{,}7e^{1{,}7i}$	$1{,}2e^{0{,}9i}$	$-3-2i$	$\left(z_1:z_2+z_3\right)^2-z_4$
11	$0{,}187-3{,}94i$	$0{,}3e^{-107°i}$	$-0{,}7+4i$	$1{,}5e^{23°i}$	$\sqrt[3]{z_1+z_2-z_3}\cdot z_4$
12	$-1+\sqrt{5}i$	$2{,}1e^{211°i}$	$0{,}4e^{32°i}$	$4+3i$	$\sqrt[3]{z_1}\cdot z_2:z_3+z_4$
13	$-\sqrt{3}-4i$	$1{,}25e^{-0{,}8i}$	$-3-2i$	$0{,}75e^{0{,}7i}$	$\left(\sqrt[3]{z_1\cdot z_2}+z_3\right):z_4$
14	$1{,}2e^{1{,}7i}$	$0{,}18-3{,}9i$	$0{,}71e^{4i}$	$0{,}8-2i$	$\left(\sqrt[3]{z_1:z_2}+z_3\right)\cdot z_4$
15	$0{,}3e^{-97°i}$	$-1+\sqrt{5}i$	$-0{,}7+4i$	$5{,}2e^{71°i}$	$\left(\sqrt{z_1\cdot z_2}-z_3\right):z_4$
16	$1{,}25e^{0{,}6i}$	$-\sqrt{3}-4i$	$4+3i$	$2{,}5e^{3{,}8i}$	$\left(\sqrt{z_1:z_2}-z_3\right)\cdot z_4$
17	$1{,}05e^{-0{,}4i}$	$\sqrt{5}-i$	$2{,}7e^{0{,}8i}$	$-0{,}7+4i$	$\sqrt{\left(z_1:z_2+z_3\right)\cdot z_4}$
18	$2{,}1e^{73°i}$	$1+i\frac{\pi}{2}$	$\sqrt{2}+\sqrt{3}i$	$1{,}93e^{192°i}$	$\sqrt{\left(z_1\cdot z_2-z_3\right):z_4}$
19	$2{,}7+0{,}8i$	$2e^{-\sqrt{3}i}$	$0{,}81e^{i\pi/7}$	$-\sqrt{2}-\sqrt{3}i$	$\sqrt{\left(z_1+z_2\right):z_3\cdot z_4}$
20	$-0{,}8+2{,}7i$	$-2e^{\sqrt{3}i}$	$0{,}9e^{i5\pi/7}$	$3{,}1-2{,}1i$	$\sqrt{\left(z_1+z_2\right)\cdot z_3:z_4}$
21	$-1{,}1-3{,}2i$	$0{,}33e^{-1{,}9i}$	$2e^{\sqrt{2}i}$	$2{,}08+i$	$\sqrt{z_1-z_2}\cdot z_3:z_4$
22	$2{,}1-3{,}2i$	$0{,}68e^{148°i}$	$\sqrt{5}+\sqrt{2}i$	$2{,}73e^{23°i}$	$\sqrt{z_1-z_2}:z_3\cdot z_4$
23	$1{,}1e^{-0{,}8i}$	$\sqrt{5}-2i$	$-1{,}7+i$	$0{,}97e^{\sqrt{2}i}$	$\left(\left(z_1+z_2\right)^2-z_3\right):z_4$
24	$2{,}1e^{0{,}8i}$	$-\sqrt{5}+2i$	$1{,}7e^{\sqrt{3}i}$	$0{,}8e^{2{,}5i}$	$\left(\left(z_1-z_2\right)^2+z_3\right):z_4$
25	$1{,}1e^{-2{,}1i}$	$\frac{\pi}{8}-2{,}1i$	$2{,}71+0{,}4i$	$1{,}71e^{-\sqrt{3}i}$	$\left(z_1-z_2\right)^3:z_3+z_4$

Task 1.4. Find the Roots of the Quadratic Equation

$$a\text{-}x^2 + b*x + c = 0$$

for given values of the coefficients a, b and c (see table 1.2).

Вариант	a	b	c
1	0.56	1.2e-4	4.08
2	1	0.1	100

3	4. 2e-3	8. 03e-4	1.06
4	7. 1e3	9. 4e4	8. 3e10
5	5.09	4.32	256
6	8.3	5.34	693
7	27	27	1276
8	3.08	0.2	30
9	5.3	10.6	876
10	0.45	0. 034	121
11	4.3	10.7	3. 4e3
12	13	0.8	287
13	6. 035	5.2	875
14	2.3	7.9	324
15	1	0.02	16.57
16	1.3	0.56	18.8
17	0.13	0. 056	18.8
18	17	12	956
19	0. 085	1	1. 3e3
20	1.2	0.32	15
21	7.1	6.4	256
22	0.2	0. 002	2.9
23	1. 4e-3	3.9	2. 6e2
24	0.86	3.2	5. 4e2
25	7. 3e3	8. 2e2	3. 5e8

Self-check tests:

1. The Matlab system is
   a. Universal mathematical system
   b. text editor
   c. algorithmic programming language
   d. system of work with databases

2. Does not apply to analogs of the Matlab system
   a. Basic
   b. Mathematica
   c. Maple

3. The Mathematics panel contains
   a. 1.buttons with palettes of commonly used mathematical notation
   b. 2.math buttons
   c. 3.lists of math functions
   d. 4.buttons for programming functions

4. Symbol: = in Matlab denotes
   a. assignment
   b. equality
   c. approximation
   d. description

5. The assignment operation in the Matlab document looks like this:
   a. a: = 5
   b. a = 5
   c. a; 5
   d. a: 5

6. When entering an assignment character from the keyboard, enter
   a. 1.colon
   b. 2.semicolon
   c. 3.space
   d. 4.equal sign

7. To change the format of the result, you need
   a. 1.changing the number of characters in the Result Format window
   b. 2.add zero to the result
   c. 3.change the precision of calculations
   d. enter the initial data with greater accuracy

8. Before entering the subscript of the vector element, press the key
   a. one. [
   b. Shift
   c. Alt

9. A discrete variable allows
   a. 1.set a variable to a series of numbers arranged in ascending order with equal steps
   b. 2.Set the variable the change interval
   c. 3.change the value of the variable by one
   d. 4.there is no correct answer in the list

10. Built-in functions located on the Calculator palette are entered into the document
   a. 1.clicking on the function name
   b. 2.only by entering the function name from the keyboard
   c. 3.selecting the function name on the Calculator palette
   d. 4.there is no correct answer in the list

11. If, when specifying a discrete variable, the step is omitted, then
   a. 1.step is considered equal to 1
   b. 2.step is considered equal to 0
   c. 3.step is considered equal to 0.5
   d. Error message

12. Numeric constant TOL is intended for
   a. 1.setting the accuracy for approximate calculations *
   b. 2.setting the number of characters when displaying the result
   c. 3.setting the accuracy of the initial data
   d. 4.setting the number of displayed results

13. To get a table of values of the function f (x) in a given discrete variable range, enter
   a. 1.f (x) =
   b. 2.f (x): =
   c. 3.f (x) and press the Tab key
   d. 4.f (x)?

14. User function
   a. 1.must be described before first use *
   b. 2.can be described anywhere in the document
   c. can not be described
   d. 4.there is no correct answer in the list

Topic 2: Medical Image Recognition Algorithms

1. Control questions:

1. What is Spectral Analysis?
2. The role of the computer in biomedical research 4. Give the concept of medical imaging
3. Give the concept of radiography
4. Give the concept of radiography, magnetic resonance imaging (MRI)
5. Give the concept of nuclear medicine
6. Give the concept of ultrasound
7. Give the concept of elastography
8. Give the concept of tactile visualization
9. Дать понятие фотоакустического изображения
10. Дать понятие термографии
11. Дать понятие эхокардиографии
12. Как создать свой личный файл в пакетеMatlab?
13. Для чего служит стартовое окно пакета?
14. Какую структуру имеет пакетMatlab?
15. Особенности пакета Matlab
16. Как вводятся данные в файл пакета Matlab?
17. Как вводятся векторы в языке MatLAB? Какими функциями можно формировать векторы в языке MatLAB?
18. Какие функции MatLAB разрешают преобразовывать вектор поэлементно?
19. С помощью каких средств в MatLAB осуществляются основные операции с векторами?
20. Как вводятся матрицы в системе MatLAB?
21. What functions are available in MatLAB for the formation of matrices of a certain type?
22. How to form a matrix: a) by the given vectors of its rows? b) given vectors of its columns? c) given vectors of its diagonals?
23. What functions of element-by-element matrix transformation are there in MatLAB?
24. How are the usual matrix operations carried out in MatLAB?
25. How to solve a system of linear algebraic equations in MatLAB?

Student must know:	Literature:
• 1. Why does a medical professional need spectral research skills in their work? • 2. The main structure of the Matlab package • 3. Interactive mode of operation **The student should be able to:** 1. Own basic tools for creating, editing, formatting images in the Matlab package. 2. Effectively use the Matlab package for working with vectors and matrices.	**5.** Kobrinsky B.A., Zarubina T.V. "Medical informatics", M., Publishing house "Academy", 2009. **6.** Zhizhin K.S. "Medical Statistics", Higher Education, 2007. **7.** Methodical development for 4th year students for a practical lesson on the topic "Analysis of biomedical signals - digital signals and images" **8.** http / science.urfu.ru / ru / publications / analysis-biomedical-signals-in-environment-matlab-tutorial-tutorial

3. Tasks for independent work on the topic under study:

1. Prepare mental maps for basic theoretical concepts;
2. To study the Matlab software environment - interactive mode - Operations with vectors and matrices to complete tasks in laboratory work No. 2.
3. According to the theoretical part of Chapter 2 of the guidelines for CT in medicine, study "Algorithms for recognizing medical images";

PRACTICAL TASKS FOR LABORATORY WORK No. 2

Task 1.5. Calculate the values of the function f (x) on the segment [a; B] with step h.

Table 1.3

Вариант	$f(x)$	a	b	h
1	$\dfrac{x^2}{1+0{,}25\sqrt{x}}$	1,1	3,1	0,2
2	$\dfrac{x^3 - 0{,}3x}{\sqrt{1+2x}}$	2,05	3,05	0,1
3	$\dfrac{2e^{-x}}{2\pi + x^3}$	0	1,6	0,16
4	$\dfrac{\cos \pi x^2}{\sqrt{1-3x}}$	-1	0	0,1
5	$\sqrt{1+4x}\,\sin \pi x$	0,1	0,8	0,07
6	$\dfrac{e^{x/3}}{1+x^2}$	1,4	2,4	0,1
7	$e^{-2x} + x^2 - 1$	0,25	2,25	0,2
8	$(e+x)\sin\left(\pi\sqrt{x-1}\right)$	1,8	2,8	0,1
9	$\sqrt{3+2x}\cdot tg\dfrac{\pi x^3}{2}$	0,1	0,9	0,08

10	$\sqrt{2+3x}\cdot\ln\left(1+3x^2\right)$	-0,1	0,9	0,1
11	$\sqrt[3]{x^2+3}\cdot\cos\dfrac{\pi x}{2}$	1	2,5	0,15
12	$(4+7x)\sin\left(\pi\sqrt[3]{1+x}\right)$	0	7	0,7
13	$e^{-x^2}\left(1+3x-x^2\right)$	0	2	0,2
14	$x^3-3x+\dfrac{8}{\sqrt{1+x^2}}$	0	1,7	0,17
15	$\sqrt{sh\sqrt{2\pi x}}\ ,\ \left(sh\,x=\dfrac{e^x-e^{-x}}{2}\right)$	0	1,2	0,12
16	$\sqrt{ch\dfrac{x}{\sqrt{2\pi}}}\ ,\ \left(ch\,x=\dfrac{e^x+e^{-x}}{2}\right)$	0,5	1,5	0,1
17	$\dfrac{x^3+2x}{\sqrt{1+e^x}}$	-0,2	0,8	0,1
18	$\sqrt{1+2x^2}\cdot\sin\dfrac{3x}{2}$	2	4	0,2
19	$\sqrt{3x^2+5}\cdot\cos\dfrac{\pi x}{2}$	0,5	1,5	0,1
20	$\arccos e^{-\sqrt[3]{3x}}$	0,2	0,5	0,03
21	$\arcsin e^{-x^2/5}$	8	13	0,5
22	$x+\ln\left(x+\sqrt{1+x^2}\right)$	-0,5	0,5	0,1
23	$\dfrac{1+e^{-x/2}}{\sqrt{3x^2+1}}$	3	5	0,2
24	$3x^3+\dfrac{1}{x}+e^{-2x^2}$	1,2	2,2	0,1
25	$x^{2x+1}+x^3-2x$	1	5	0,4

Self-check tests:

A discrete variable allows

1.set a variable to a series of numbers arranged in ascending order with equal steps

2.Set the variable the change interval

3.change the value of the variable by one

4.there is no correct answer in the list

Built-in functions located on the Calculator palette are introduced into the document

1.clicking on the function name

2.only by entering the function name from the keyboard

3.selecting the function name on the Calculator palette

4.there is no correct answer in the list

If, when specifying a discrete variable, the step is omitted, then

1.step is considered equal to 1

2.step is considered equal to 0

3.step is considered equal to 0.5

4. Error message

The numeric constant TOL is for

1.setting the accuracy for approximate calculations *

2.setting the number of characters when displaying the result

3.setting the accuracy of the initial data

4.setting the number of displayed results

To get a table of values of the function f (x) in a given discrete variable range, enter
    1.f (x) =
    2.f (x): =
    3.f (x) and press the Tab key
    4.f (x)?

User function
    1.must be described before first use *
    2.can be described anywhere in the document
    3. can not be described
    4.there is no correct answer in the list

The input cursor is marked with red cross
    1.Horizontal red line
    2.Red vertical line
    3.there is no correct answer in the list

The character placeholder is
    1.black rectangle in which the character should be entered according to the format
    2.black rectangular frame into which it is fashionable to enter the formula
    3.red rectangle in which the error message is displayed
    4.there is no correct answer in the list

You can use the key to navigate from one placeholder to another.
    1. TAB
    2. HOME
    3. END
    4.there is no correct answer in the list

To remove a part of the formula, you need
    1.select this part and press the Del key
    2.press the Del key
    3.press the Backspace key
    4. There is no correct answer in the list.

To start entering text directly into the computational area, enter
    1. symbol "
    2.symbol /
    3.symbol \
    4.symbol?

At the location marked with the cursor, the graph template appears by
    1.clicking on the appropriate template in the Graph panel
    2. dragging and dropping the chart template
    3. double click on the location marked with the cursor
    4.there is no correct answer in the list

If the function argument is not described when plotting the graph, then
    1.By default, the graph will be built in the range from -10 to 10 with a step of 1
    2.By default, the graph will be built in the range from -1 to 1 with a step of 0.1
    3.An error message will appear
    4.there is no correct answer in the list

When plotting 2 or more graphs in one template, the names of the functions are entered
    1.separated by commas
    2.separated by a colon
    3. through a space
    4.there is no correct answer in the list

To delete a schedule, you need
    1.activate it by clicking the mouse and press the Del key
    2.press the Del key
    3.select the graph with the mouse
    4.there is no correct answer in the list

To change the graphic color, symbol or line thickness in the Format chart window, use the tab

1. Traces
2. X-Y Axes
3. Labels
4. Defaults

The symbol "->" (arrow) is intended for

1. to carry out symbolic calculus
2. to enter a comment
3. for the analytic transformation of the function
4. to calculate the function

Topic 3: "Virtual and Augmented Reality in Medicine"

1. Control questions:

1. What is virtual reality (VR)
2. Types of virtual reality
3. Pros and cons of virtual reality
4. Perspectives of virtual reality
5. Examples of VR in medical practice
6. What functions of MatLAB carry out the display of graphs on the screen?
7. What functions provide the supply of the graph with coordinate lines and labels?
8. What is a "vector graph" and how to build it?
9. How to display a graph in the form of a bar chart?
10. How to build a histogram?
11. Is it possible to build several graphs in the same coordinate system and in the same graphics window?
12. How to display several separate charts in different graphic windows? 13. How to draw several separate charts in one graphic window in different graphic fields?

Student must know:	Literature:
- Why does the medical professional need spectral skills in their work? - Basic structure of Matlab package - Interactive and software mode of operation **The student should be able to:** - Own basic tools for creating, editing, formatting images in the Matlab package. - Effectively use the Matlab package to work with the simplest graphs.	**9.** Kobrinsky B.A., Zarubina T.V. "Medical informatics", M., Publishing house "Academy", 2009. **10.** Zhizhin K.S. "Medical Statistics", Higher Education, 2007. **11.** Methodical development for 4th year students for a practical lesson on the topic "Analysis of biomedical signals - digital signals and images" **12.** http / science.urfu.ru / ru / publications / analysis-biomedical-signals-in-environment-matlab-tutorial-tutorial

3. Tasks for independent work on the topic under study:

1. Prepare mental maps for basic theoretical concepts;
2. To study the Matlab software environment - interactive mode - Building the simplest graphs - to complete the tasks in laboratory work No. 4.
3. According to the theoretical part of Chapter 3 of the guidelines for CT in medicine, study "Virtual and Augmented Reality in Medicine";

PRACTICAL TASKS FOR LABORATORY WORK No. 4

Task 1.9. Plot in the MatLA graphics window the function from
tasks 1.5. Print this graph on a piece of paper.

Self-check tests:

MATLAB is short for words
1. Mathematical Laboratory
2. Matrix Laboratory
3. Materialized Labor

MatLab extension packages are called
1. Toolkits
2. Tools
3. Toolboxes

Of the listed devices, it is optional when working with MatLab.
1. monitor
2. processor
3. printer

Is MatLab capable of performing operations on complex numbers
1. yes
2. no

In addition to calling programs written in the MatLab language, work in the MatLab environment
can be performed
1. "in automatic mode"
2. "in data entry mode"
3. "in calculator mode"

Most of the commands and functions of the system are stored as text files with enlargement
1. g
2. .m
3. .p

Which menu in the menu bar of the main MatLab window contains commands to display and hiding internal program windows
1. Window
2. Help
3. Desktop

What window of the MatLab system is intended for entering numbers, variables, expressions and commands to view calculation results and display program texts
1. Command History
2. Command Window
3. Workspace

The keys <↓> and <↑> in MatLab serve
1. to move the cursor down or up on the screen
2. to move the cursor left or right on the screen
3. to display commands and expressions previously entered from the keyboard in the input line

If the result of evaluating the expression has not been assigned to any other variable, then MatLab always stores it in a variable
1. inf
2. ans
3. NaN

To separate the integer part of a number from the fractional part in MatLab, use
1. point
2. comma
3. semicolon

What format of presentation of calculation results is used in MatLab by default
1. hex
2. long

3.short

**To denote the imaginary unit in complex numbers in MatLab is reserved
two characters**
1.i and j
2.i n k
3.j and k

**Does MatLab, like other programming languages, require in advance
declare variable types**
1.yes
2. no
3.to display commands and expressions previously entered from the keyboard in the input line

**If the result of evaluating the expression has not been assigned to any other variable,
then MatLab always stores it in a variable**
1.inf
2.ans
3. NaN

To separate the integer part of a number from the fractional part in MatLab, use
1.point
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**What format of presentation of calculation results is used in MatLab by
Default**
1.hex
2.long
3.short

**To denote the imaginary unit in complex numbers in MatLab is reserved
two characters**
1.i and j
2.i n k
3.j and k

**Does MatLab, like other programming languages, require in advance
declare variable types**
1.yes
2. no

Topic 4: "Big Data and Artificial Intelligence in Health Care"

1. Test questions:

1. History of artificial intelligence
2. Current trends
3. What is artificial intelligence
4. Neural networks and machine learning
5. What object is called a polynomial in MatLAB?
6. How is multiplication and division of polynomials carried out in MatLAB?
7. What functions can be used to find the roots of a given polynomial, the value of the polynomial by the known value of the argument?
8. What functions allow you to find the derivative of a polynomial?
9. How to find the characteristic polynomial of a matrix?

2. Target tasks:

Student must know:	Literature:
• Why does the medical professional need spectral skills in their work? • Basic structure of Matlab package • Interactive and software mode of operation **The student should be able to:** • Own basic tools for creating, editing, formatting images in the Matlab package. • Effectively use the Matlab package to work with the simplest graphs.	**13.** Kobrinsky B.A., Zarubina T.V. "Medical informatics", M., Publishing house "Academy", 2009. **14.** Zhizhin K.S. "Medical Statistics", Higher Education, 2007. **15.** Methodical development for 4th year students for a practical lesson on the topic "Analysis of biomedical signals - digital signals and images" **16.** http / science.urfu.ru / ru / publications / analysis-biomedical-signals-in-environment-matlab-tutorial-tutorial

3. Tasks for independent work on the topic under study:

Prepare mental maps for basic theoretical concepts;
2. To study the software environment Matlab - interactive mode - Functions of applied numerical mathematics - to complete tasks for laboratory work No. 4.
3. For the theoretical part of Topic 4 guidelines for CT in medicine, study "Big data and artificial intelligence in health care";

PRACTICAL TASK ON LABORATORY WORK No. 4

Task 1.6.

1. Enter an arbitrary matrix of size (4 * 6). Find the sum of its largest elements lines.

2. Enter a square matrix (5 * 5) with one smallest element. Find the amount elements of the row in which the element with the lowest value is located.
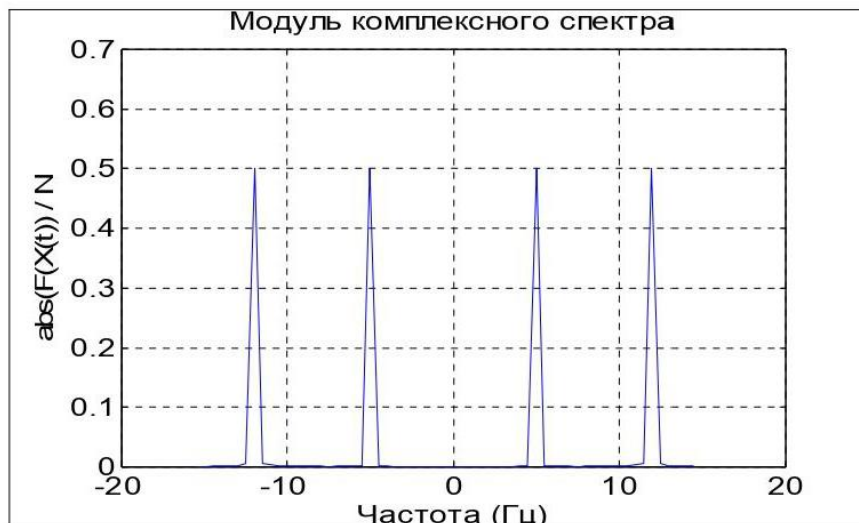
Рис. 1.26

3. Enter the matrix (6 * 9), which has the only largest and smallest elements and they are located on separate lines. Swap the line with the largest element and the line with the smallest element.

4. Enter a matrix (5 * 6) with different element values. In each line, select an element with the smallest value, from the received numbers select the largest. Find the indices receivedelements.

5. Enter the matrix (5 * 6). Find the vector whose elements are the largest elements the corresponding row of the matrix.

6. Enter the matrix (5 * 6). Construct a vector whose elements are the sums of the greatest and the smallest element of the corresponding row of the matrix.

7. Enter the matrix (5 * 6). Construct a vector whose elements are the average values of the elements of the corresponding row of the matrix.

8. Enter the matrix (5 * 6). Construct a vector whose elements are rms the deviation of the elements of the corresponding row of the matrix from their average value.

9. Enter the matrix (5 * 6). Construct a vector whose elements are the arithmetic means the largest and smallest elements of the corresponding row of the matrix.

10. Enter the matrix (6 * 5). Construct a vector whose elements are sums of squares elements of the corresponding column of the matrix.

11. Enter the matrix (5 * 5). Construct vectors whose elements are the sums elements of columns of a matrix, products of elements of columns and the smallest values of elements columns.

12. Enter the matrix (5 * 6). Find the arithmetic mean of its largest and smallest elements.

13. Enter the matrix (5 * 5). Construct a vector whose elements are elements of the main diagonals of the matrix. Find the footprint of the matrix.

14. Enter two matrices (4 * 4). Construct a new (4 * 8) matrix including the first 4 columns of the row of the first matrix, and in the others - the columns of the second matrix.

15. Find the sum of all elements of the matrix of size (4 * 3).

Task 1. 7. Calculate the vectors:

a) the module of the frequency transfer function (FPF);

6) the CPF argument;

c) the real part of the NPF; d) the imaginary part of the PPF

according to the given numerator and denominator of the transfer function (table 1.4). Find the roots of the denominator of the transfer function in advance, determine the largest natural frequency COmax of the system. Provide calculation of lffiF at 100 values of frequency with in range from 0 to 5comax.

Ва-ри-ант	Числитель	Знаменатель
1	$1.82p+67.56$	$p^4+2.65p^3+3.09p^2+7.04p+34.05$
2	$4.61p^2+1.82p+67.56$	$p^4+3.65p^3+45p^2+7.04p+125$
3	$p^2+4p+23$	$p^4+2p^3+39p^2+2p+45$
4	$3p^2+1.82p+67.56$	$p^2+7.04p+34.05$
5	$p+6$	$p^2+0.7p+48$
6	$p^3+4.61p^2+1.82p$	$2.65p^3+3p^2+4p+87$
7	$p^3+4.61p^2+1.82p+67.56$	$p^4+2.65p^3+68p^2+5p+34$
8	$4.61p^2+68$	$p^4+2.65p^3+3.09p^2+7.04p+34.05$
9	7.56	$p^4+2.65p^3+3.09p^2+7.04p+34.05$
10	$p^3+1.8p+7$	$p^4+6.5p^3+39p^2+7p+45$
11	$p^3+4.61p^2+1.82p+67.56$	$p^3+3.09p^2+70p+34$
12	$p^2+1.8p+78$	$2.65p^3+3.09p^2+7.04p+34.05$
13	$p^3+1.82p+67.56$	$p^4+2.6p^3+3p^2+4p+34$
14	$p^3+4.61p^2+1.82p+67.56$	$7p^2+7p+34$
15	$4.61p^2+1.82p+67.56$	$p^2+7.04p+560$
16	$1.82p+67.56$	$3.09p^2+7.04p+34.05$
17	p^3	$3.09p^2+7.8p+125$
18	$1.82p$	$p^3+3.09p^2+7.04p+34.05$
19	$4.61p^2$	$p^2+7.04p+34.05$
20	$p^3+67.56$	$p^4+2.65p^3+3.09p^2+7.04p+34.05$
21	p^3	$p^4+2p^3+3p^2+12p+100$
22	$p^3+4.61p^{2+}1.82p+67.56$	$p^4+5p^3+30p^2+7p+305$
23	$p^2+1.82p+67.56$	$p^4+2p^3+9p^2+4p+35$
24	$p^{3+}61p^2+182p+67$	$p^4+3p^3+9p^2+0.04p+39$

Indication. The frequency transfer function is called the transfer function of the system at values of n argument (p = j · dj).

The natural frequencies of the system are the values of the moduli of the imaginary parts of the roots characteristic equation of the system (which is obtained by equating.; 11.the denominator of the transfer function).

Task 1.8. Enter an arbitrary matrix of size (5 * 5). Find:

1) the determinant of the matrix; in case the determinant turns out to be equal to zero, or too small, change some elements of the matrix and repeat the calculations;

2) inverse matrix; check correctness by inverting the inverse matrix;

3) the characteristic polynomial of the matrix;

4) the roots of the characteristic polynomial of the matrix; sort the roots by complex conjugate pairs and in ascending order of values;

5) eigenvalues of the matrix; compare with the previously found roots of the characteristic polynomial;

6) LU-decomposition of a matrix; check if it is correct;

7) QR-decomposition of a matrix; check if it is correct;

8) singular values of the matrix; compare them with svd-decomposition;

9) the trace of the matrix;

10) the conditionality number of the matrix;

11) exponential from the matrix;

12) the logarithm of the exponent of the matrix; compare with the original matrix.

Self-check tests:

What extension do m-files have in MatLab

    1.mat extension

    2. extension. T

    3.extension. f

What type of M-files can take input data as a set of input parameters and produce results as a set of output values

    1.program file

    2.file functions

Is it correct to say that the variables defined in the file function, after its execution, become available in the workspace and can be used in other file functions?

    1.yes

    2. no

The created m-file can be saved

    1.only in the current working directory

    2.in any directory for which the search path is set in MatLab

    3.in any directory, regardless of whether it is in the search path

Choose which of the following statements is true

    1.the name of the m-file in which the file-function is stored can be the same as the name of any variable or MatLab command, since all the variables specified in the file-function are local

    2.the name of the m-file in which the function file is stored must be unique and must not be the same as the function name

    3.the name of the m-file in which the file-function is stored must be unique and must necessarily match the name of the function

Whether it is allowed to call the created file-function from other file-programs or file-functions

    1.yes

    2. no

What command should be entered into the command window to call the m-file editor of the MatLab system

1.edit command

2.cd command

3.pwd command

What command should be entered into the command window to call the m-file editor of the MatLab system

1.edit command

2.cd command

3.pwd command

What color the m-file editor uses by default to highlight syntax errors in the program code

    1.blue

    2.red

    3.green

What symbol allows you to designate a program block as a separate fragment

    1.% symbol

    2. %% symbol

    3. %%% symbol

How to bring up the dialog used to set search paths

    1.using the FilePreferences command

    2.via the FileSet Path command

    3.the FileImport Data command

To get the maximum possible value in MatLab, presented in single precision format, you need to enter the command in the command line

1.realmax ('double')

2.realmin ('single')

3.realmax ('single')

How many bytes is required to store each element of a boolean array

1.1 byte

2.2 bytes

3.4 bytes

For storing a matrix with zero elements in sparse format

1.requires more memory than storing a matrix in normal form (including all zero and non-zero elements)

2.requires less memory than storing a matrix in its usual form (including all zero and non-zero elements)

Which array element is the element k (2, 2) = {'magic'}

1.cell array

2.array structures

3.character array

If information can be presented in the form of a table with fields containing data of the same type, then to store such information, use

    1.cell arrays

    2.arrays of structures

    3.numeric arrays

To remove an unnecessary field in an array of structures, use the function

    1.fieldnames

    2. getfield

    3.RMF ield

Which of the following ways of setting a symbolic variable is erroneous in MatLab

    1.setting the numeric character code as an argument to the char function

    2.enter the desired character in apostrophes

    3.type the required character in curly braces

What function allows you to execute a command formed as a string of characters

    1.eval

    2.feval

Topic 5: Strategy for creating a new model of medical institutions based on digitalization

1. Control questions:

1. What is the transformation in health care for?
2. Digital transformation in healthcare - what is it?
3. Health transformation and value-based treatment comment on.
4. What means of control over the course of the computational process are provided in the MatLAB language?
5. How can you organize calculations in a loop in MatLAB?
6. How to organize the output of the table of calculation results in the MatLAB command window?
7. How to carry out complex (multi-operator) calculations in the calculator mode?

2. Target tasks:

Student must know:	Literature:
- Why does the medical professional need spectral skills in their work? - Basic structure of Matlab package - Interactive and software mode of operation **The student should be able to:** - Own basic tools for creating, editing, formatting images in the Matlab package. - Effectively use the Matlab package to work with the simplest graphs.	1. Kobrinsky B.A., Zarubina T.V. "Medical informatics", M., Publishing house "Academy", 2009. 2. Zhizhin K.S. "Medical Statistics", Higher Education, 2007. 3. Methodical development for 4th year students for a practical lesson on the topic "Analysis of biomedical signals - digital signals and images" **4.** http / science.urfu.ru / ru / publications / analysis-biomedical-signals-in-environment-matlab-tutorial-tutorial

1. Tasks for independent work on the topic under study:

Tasks: (preliminarily study [3,4] again.)

1. Explore general issues of digital imaging.
2. Create a phantom head.
3. Compute synthesized projections using parallel rays.
4. Compute synthesized projections using parallel rays
5. Perform head phantom reconstruction based on projection data obtained using fan beams.
6. Compute synthesized projections using fan beams

> Prepare a report:
> - debug programs for restoring scenes from projections;
> - debug programs of results of studies of MRI images
> Prepare the intelligence of the card according to the basic concepts

Self-check tests:

When substituting a variable value in an expression, after the substitute keyword in the placeholder, type

1. boolean expression
2. variable
3. formula
4. constant

To carry out analytical differentiation, the symbol is used

one.
2. =
3. ≈
4. ÷

Instead of the differentiation operator placeholder, you need to enter

1. function depending on the argument and the name of the argument

2.function name and argument name

3.the name of the derived function and the name of the argument

4.there is no correct answer in the list

Instead of placeholders for the integration operator, it is required to enter

1.function depending on the argument, the name of the argument and the limits of integration

2.function name, argument name and integration limits

3.the name of the derived function and the name of the argument

4.there is no correct answer in the list

To carry out analytical differentiation, the symbol is used

1. =

2. ≈

3.there is no correct answer in the list

If the integral diverges, then

1.the error message is issued

2.the divergent integral is calculated

3.integral is replaced by convergent

4.there is no correct answer in the list

To move a document design element, you need it

1.select and drag using mouse

2.copy and paste to the desired location

3.remove and paste in the desired location

4.there is no correct answer in the list

To resize a document element you need

1.select and stretch (or shrink) by pulling the black rectangles on the borders of the selection area

2.Draw the mouse several times within the element area

3. transfer the document element to Word and resize there

4.there is no correct answer in the list

Color highlighting is done using

1.Part Item Properties of the Format menu

2.Formatting pane

3.The Refresh item of the View menu

4.there is no correct answer in the list

To create a text region, you need to enter the symbol

1. double quote

2.colon

3.opening square bracket

4. apostrophe

To format text in Matlab use

1.formatting panel

2.Standard panel

3.Format item of the main menu

4.there is no correct answer in the list

To set a paragraph, use

1.markers on the ruler

2.Format item of the main menu

3.formatting panel

4.there is no correct answer in the list

The number of copies when the document is sad is set in the window

1.in the document print window

2.in the setup page options window

3.Command Print

4.there is no correct answer in the list

To get the maximum possible value in MatLab, presented in single precision format, you need to enter the command in the command line

1.realmax ('double')

2.realmin ('single')

3.realmax ('single')

How many bytes is required to store each element of a boolean array

1 byte

2 bytes

4 bytes

For storing a matrix with zero elements in sparse format

1.requires more memory than storing a matrix in normal form (including all zero and non-zero elements)

2.requires less memory than storing a matrix in its usual form (including all zero and non-zero elements)

Which function allows you to create a template of a cell array (an array of a given size with empty cells)

1.cellldisp function

2.cell function

3.struct

If information can be presented in the form of a table with fields containing data of the same type, then to store such information, use

1.cell arrays

2.arrays of structures

3.numeric arrays

To remove an unnecessary field in an array of structures, use the function

1.fieldnames

2. getfield

3.RMF ield

Which of the following ways of setting a symbolic variable is erroneous in MatLab

1.setting the numeric character code as an argument to the char function

2.enter the desired character in apostrophes

3.type the required character in curly braces

What function allows you to execute a command formed as a string of characters

1.eval

2.feval

Topic 6: "Biomedical Signal Analysis - Digital Signals and Images"

1. Control questions:

Signals - Definition and classification of mathematical signals.

List known biomedical signals.

List the main informational characteristics of the ECG signal.

Explain why the R wave of the electrocardiogram is used to form the HRV time series.

How the HRV signal is formed from the electrocardiogram recording.

What is the essence of the used algorithm for clearing signals from artifacts.

What type of interpolation is recommended for HRV signals.

Under what conditions the mathematical expectation and the mode are slightly different.

What types of HRV distribution histograms are known.

Block diagram of heart rate variability

Physiological nature of the ECG signal

Mathematical methods for the analysis of biomedical signals

Matlab - interface and programming mode.

Understanding math expression

Real and complex numbers

Number formats

Constants and System Variables

Text comments in programs

Variables and Assigning Values to Them

Destroying variable definitions

MATLAB Operators and Built-in Functions

Application of the operator: (colon)

User functions

Bug reporting and bug fixes

2. Target tasks:

Student must know:	Literature:
• What is Matlab • 2. Programming mode • 3. Interactive mode - program interface • 4. Interpolation commands **The student should be able to:** • work in Matlab environment • be able to form a signal for its processing	5. Kobrinsky B.A., Zarubina T.V. "Medical informatics", M., Publishing house "Academy", 2009. 6. Zhizhin K.S. "Medical Statistics", Higher Education, 2007. 7. Methodical development for 4th year students for a practical lesson on the topic "Analysis of biomedical signals - digital signals and images" **8.** http / science.urfu.ru / ru / publications / analysis-biomedical-signals-in-environment-matlab-tutorial-tutorial

3. Tasks for independent work on the topic under study:

Prepare mental maps on the basic theoretical concepts of the topic "Strategy for creating a new model of medical institutions based on digitalization";

To study the Matlab software environment - interactive mode - Operators of control of computational processes to complete tasks in laboratory work No. 5.

PRACTICAL EXERCISE ON LABORATORY WORK No. 5

Task 1.11.

1. In accordance with table 1.5 perform:

- calculation of exact (using standard MatLAB functions) values of the corresponding function in the range of variation of the argument from x1 to x2 at m equidistant points of this range, including its boundaries;

- calculation by the specified power series of approximate values functions at the same points, limited by the r first terms of the series;
- calculation of the error in the approximate determination of the function at each point, comparing the approximate value with exact, and plotting the dependence of the error on the argument;
 - calculation of approximate values of the function at the same points with rel an absolute error not more than $\& = 0.001$; plotting the obtained relative errors.

Вар.	x1	x2	m	r	f(x)	Приближенная формула
1	0.2	5	20	4	sin(x)	$\sum (-1)^k \dfrac{x^{2k-1}}{(2k-1)!}$
2	1	10	30	5	cos(x)	$1 - \sum (-1)^k \dfrac{x^{2k}}{(2k)!}$
3	0.3	3	40	5	exp(x)	$1 + \sum \dfrac{x^k}{k!}$
4	0.4	4	50	4	ln(1+x)	$\sum (-1)^{k-1} \dfrac{x^k}{k}$
5	0.5	5	30	3	ln(x)	$\sum \dfrac{a^k}{k}$, где $a = \dfrac{x-1}{x}$
6	0.6	6	40	4	ln(x)	$\sum (-1)^k \dfrac{a^k}{k}$, где $a = x - 1$
7	0.7	7	50	5	ln(x)	$2 \sum \dfrac{a^{2k-1}}{2k-1}$, где $a = \dfrac{x-1}{x+1}$
8	0.8	8	45	6	ln(x+a)	$\ln(a) + 2 \sum \dfrac{b^{2k-1}}{2k-1}$, где $b = \dfrac{x}{2a+x}$
9	1.1	11	40	3	ctg(x)	$\dfrac{1}{x} + 2x \sum \dfrac{1}{x^2 - k^2 \pi^2}$
10	1.2	12	50	4	cosec(x)	$\sum \dfrac{1}{(x - k\pi)^2}$
11	1.3	13	50	5	cosec(x)	$\dfrac{1}{x} + 2x \sum \dfrac{(-1)^k}{x^2 + k^2 \pi^2}$
12	1.4	14	60	6	arctg(x)	$\sum (-1)^{k-1} \dfrac{x^{2k-1}}{2k-1}$
13	1.5	15	45	5	arctg(x)	$\dfrac{\pi}{2} + \sum (-1)^k \dfrac{1}{(2k-1)x^{2k-1}}$
14	1.6	16	40	4	ln(x)	$\sum (-1)^{k-1} \dfrac{a^k}{r}$, где $a = x - 1$
15	0.9	9	50	6	sin(x)	$x \prod (1 - \dfrac{x^2}{(k\pi)^2})$
16	1	10	50	4	cos(x)	$\prod (1 - \dfrac{x^2}{(2k-1)^2 \pi^2})$
17	0.6	5	50	3	ln(x)	$\sum \dfrac{a^k}{k}$, где $a = (x-1)/x$

18	-0.9	0.9	45	4	arcctg(x)	$\dfrac{\pi}{2} - \sum (-1)^k \dfrac{x^{2k-1}}{(2k-1)}$
19	1	20	50	5	sh(x)	$\sum \dfrac{x^{2k-1}}{(2k-1)!}$
20	1	20	50	5	ch(x)	$1 + \sum \dfrac{x^{2k}}{(2k)!}$
21	-0.9	0.9	50	5	arcth(x)	$\sum \dfrac{x^{2k-1}}{2k-1}$
22	1	20	50	5	arcth(x)	$\sum \dfrac{1}{(2k-1)x^{2k-1}}$
23	-0.8	0.8	50	4	arcsin(x0	$x + \sum \dfrac{1\cdot 3\cdot 5...(2k-1)\cdot x^{2k+1}}{2\cdot 4\cdot 6....(2k)\cdot(2k-1)}$
24	-0.8	0.8	50	4	arccos(x 0	$\dfrac{\pi}{2} - \left\{ x + \sum \dfrac{1\cdot 3\cdot 5...(2k-1)\cdot x^{2k+1}}{2\cdot 4\cdot 6....(2k)\cdot(2k-1)} \right\}$
25	-5	5	50	6	exp(x)	$1 + \sum \dfrac{x^k}{k!}$

Task 1.12. Calculate the values of the function from problem 1.5 with the values of the argument in the range from 0.1 to 100, forming a geometric progression with a denominator equal to the square root from 10, and display the table of calculation results in the command window.

Task 1.13. Calculate the values of the modulus lПIФ and its argument (in degrees) from problem 1.7 for values of the argument in the range from 0.1 to 100, forming a geometric progression with denominator equal to the square root of 10, and print the result table to the command window calculations.

Self-check tests:

The Matlab system is

1. Universal mathematical system
2. text editor
3. algorithmic programming language
4. system of work with databases

Does not apply to analogs of the Matlab system

1. Basic
2. Mathematica
3. Maple

The Mathematics panel contains

1. buttons with palettes of commonly used mathematical notation
2. math buttons
3. lists of math functions
4. buttons for programming functions

Symbol: = in Matlab denotes

1. assignment
2. equality
3. approximation
4. description

The assignment operation in the Matlab document looks like this:

1. a: = 5

2. a = 5

3.a; 5

4.a: 5

When entering an assignment character from the keyboard, enter

1.colon

2.semicolon

3.space

4.equal sign

To change the format of the result, you need

    1.changing the number of characters in the Result Format window

    2.add zero to the result

    3.change the precision of calculations

    4. enter the initial data with greater accuracy

Before entering the subscript of the vector element, press the key

one. [

2. Shift

3. Alt

4.

A discrete variable allows

1.set a variable to a series of numbers arranged in ascending order with equal steps

2.Set the variable the change interval

3.change the value of the variable by one

4.there is no correct answer in the list

Built-in functions located on the Calculator palette are entered into the document

1.clicking on the function name

2.only by entering the function name from the keyboard

3.selecting the function name on the Calculator palette

4.there is no correct answer in the list

If, when specifying a discrete variable, the step is omitted, then

1.step is considered equal to 1

2.

3.step is considered equal to 0

4.step is considered equal to 0.5

5. Error message

Numeric constant TOL is intended for

1.setting the accuracy for approximate calculations *

2.setting the number of characters when displaying the result

3.setting the accuracy of the initial data

4.setting the number of displayed results

To obtain a table of values of the function f (x) in a given discrete variable range, enter

1.f (x) =

2.f (x): =

3.f (x) and press the Tab key

4.f (x)?

Topic 7 "Digital images in MATLAB and their application in medical research"

1. Control questions:

1. What is Spectral Analysis?
2. The role of the computer in biomedical research
3. How do I create my own personal file in the Matlab package?
4. What is the package start window used for?
5. What is the structure of the Matlab package?
6. Features of the Matlab package
7. How is data entered into a Matlab package file?
8. Mathematical methods for the analysis of biomedical signals
9. Research program and importing results into MATLAB
10. Source signal interpolation - methods in MATLAB
11. Fundamentals of spectral analysis in the HAARA bases
12. Windowed Fourier transforms, a method of using them in medical research
13. What is the result of the direct Fourier transform.
14. Three main spectral components of short records of HRV signals.
15. What parameters are included in the equation of continuous wavelet analysis.
16. How is the scaling parameter of the wavelet transform and the investigated frequency related?
17. List the known basic functions of the wavelet transform.
18. What shape does the scatterogram of the HRV signal usually have?
19. How correlation rhythmography is formed.
20. Estimates of what methods are used to obtain a complex indicator of PARS.
21. List the contents of the original files of HRV signals.
22. What methods are used for interpolation of initial signals to obtain estimates.
23. How many electrodes are used to register HRV signals.
24. Name the file format of MATLAB environment functions.
25. What command in MATLAB environment is used to implement fast Fourier transform. List the main arguments for this command.
26. Describe an algorithm for constructing an attractor in phase space.

2. Objectives:

Student must know:	Literature:
- Why does the medical professional need spectral skills in their work? - The main structure of the Matlab package - Interactive mode of operation **The student should be able to:** - Own basic tools for creating, editing, formatting images in the Matlab package.be able to form a signal for its processing - Effectively use Matlab package for deeper medical research.	9. Kobrinsky B.A., Zarubina T.V. "Medical informatics", M., Publishing house "Academy", 2009. 10. Zhizhin K.S. "Medical Statistics", Higher Education, 2007. 11. Methodical development for 4th year students for a practical lesson on the topic "Analysis of biomedical signals - digital signals and images" **12.** http / science.urfu.ru / ru / publications / analysis-biomedical-signals-in-environment-matlab-tutorial-tutorial

3. Tasks for independent work on the topic under study:

Based on the experiment done with the installation available at the department - the department of physics, which provides registration and processing of the ECG in the first lead, receive the following signals for further processing:

· Electroencephalogram;
· Rheogram;
· Electrocardiogram;
· Electromyogram;
· Skin-galvanic reaction;

· Breathing recursion;
· Photoplethysmogram;
· Cutaneous potential.
Using the program included in this installation, import the data into the Matlab environment.
Tasks: (preliminarily study [3,4] again.)
1. Conduct a study of heart rate variability (HRV) with hyperventilation functional stress test.
2. Perform data processing.
3. To form a multifactorial image of the functional state of the autonomic nervous system (ANS).
4. Investigate the nonlinear characteristics of the time series (VR) of the HRV signal.
5. Evaluate the research results.
6. Draw conclusions.
7. Prepare a report
8. Prepare the intelligence of the card according to the basic concepts

Self-check tests:

A discrete variable allows
set a variable to a series of numbers arranged in ascending order with equal steps
set variable to change interval
change the value of a variable by one
there is no correct answer in the list

Built-in functions located on the Calculator palette are introduced into the document
by clicking on the function name
only by entering the function name from the keyboard
by highlighting the function name in the Calculator palette
there is no correct answer in the list

If, when specifying a discrete variable, the step is omitted, then
step is considered equal to 1
step is considered equal to 0
the step is considered equal to 0.5
Error message

The numeric constant TOL is for
setting the accuracy for approximate calculations *
setting the number of characters when displaying the result
setting the accuracy of the source data
setting the number of displayed results

To get a table of values of the function f (x) in a given discrete variable range, enter
f (x) =
f (x): =
f (x) and press the Tab key
f (x)?

User function
must be described before first use *
can be described anywhere in the document
need not describe
there is no correct answer in the list

The input cursor is marked with
red cross
horizontal red line
red vertical line
there is no correct answer in the list

The character placeholder is
black rectangle in which the character should be entered according to the format
black rectangular frame into which it is fashionable to enter a formula
red rectangle in which the error message is displayed

there is no correct answer in the list

You can use the key to navigate from one placeholder to another.

TAB

HOME

END

there is no correct answer in the list

To remove a part of the formula, you need

select this part and press the Del key

press the Del key

press the Backspace key

There is no correct answer in the list.

To start entering text directly into the computational area, enter

symbol "

symbol /

symbol \

symbol ?

At the location marked with the cursor, the chart template appears by

clicking on the appropriate template in the Graph panel

drag-and-drop chart template

double-click on the location marked with the cursor

there is no correct answer in the list

If the function argument is not described when plotting the graph, then

by default, the graph will be built in the range from -10 to 10 with a step of 1

by default, the graph will be built in the range from -1 to 1 with a step of 0.1

an error message will appear

there is no correct answer in the list

When plotting 2 or more graphs in one template, the names of the functions are entered

comma separated

colon separated

through a space

there is no correct answer in the list

To delete a schedule, you need

activate it by clicking the mouse and press the Del key

press the Del key

select the graph with the mouse

there is no correct answer in the list

To change the graphic color, symbol or line thickness in the Format chart window, use the tab

Traces

X-Y Axes

Labels

Defaults

The symbol "->" (arrow) is intended for

to carry out symbolic calculations

to enter a comment

for analytic function transformation

to calculate the function

Тема 8: Программные средства реализации информационных процессов в медицине.
Базовые технологии дискретных ортогональных и вейвлет - преобразований информации.

   1.Контрольные вопросы:

1. Что такое спектральный анализ?
2. Роль компьютера в медико-биологическом исследовании
3. Основы спектрального анализа в базисах ХААРА
4. Определение вейвлет преобразований, методика использования их в медицинских исследованиях
5. Оконные преобразования Фурье, методика использования их в медицинских исследованиях
6. Что является результатом прямого фурье-преобразования.
7. Три главных спектральных компоненты коротких записей сигналов ВСР

8. What parameters are included in the equation of continuous wavelet analysis.
9. How is the scaling parameter of the wavelet transform and the investigated frequency related?
10. List the known basic functions of the wavelet transform.
11. What shape does the scatterogram of the HRV signal usually have?
12. How correlation rhythmography is formed.

   2. Target tasks:

Student must know:	Literature:
• Why does a medical professional need the skills of conducting spectral, wavelet research in their work? • Basic concepts of wavelet theory • Basic research methods. **The student should be able to:** • Own basic tools for creating, editing, formatting images in the Matlab package.Effectively use Matlab package for deeper medical research. • Be able to understand the theoretical description of orthogonal transformations.	13. Kobrinsky B.A., Zarubina T.V. "Medical informatics", M., Publishing house "Academy", 2009. 14. Zhizhin K.S. "Medical Statistics", Higher Education, 2007. 15. Methodical development for 4th year students for a practical lesson on the topic "Analysis of biomedical signals - digital signals and images" **16.** http / science.urfu.ru / ru / publications / analysis-biomedical-signals-in-environment-matlab-tutorial-tutorial

3. Tasks for independent work on the topic under study:

Based on the experiment done with the installation available at the department - the department of physics, which provides registration and processing of the ECG in the first lead, receive the following signals for further processing:
   · Electroencephalogram;
   · Rheogram;
   · Electrocardiogram;
   · Electromyogram;
   · Skin-galvanic reaction;
   · Breathing recursion;
   · Photoplethysmogram;
   · Cutaneous potential.
   Using the program included in this installation, import the data into the Matlab environment.
   Tasks: (preliminarily study [3,4] again.)
1. Conduct a study of heart rate variability (HRV) with hyperventilation functional stress test.
2. Perform data processing.
3. Apply the method of maxima of the moduli of the wavelet transform coefficients
4. Evaluate the research results.
5. Draw conclusions.

6. Prepare a report
7. Prepare the intelligence of the card according to the basic concepts
Practical task: Type and debug a program in the Matlab environment.

```
&& Wavelet analysis of HRV signals:
T1=NN (1,1); T2=NN (end,1); signal (:,1)= (T1:100: T2);
signal (:,2)=interp1 (NN (:,1), NN (:,2), signal (:,1),'spline');
f1=0.4; f2=0.15; f3=0.04; f4=0.003;
D=0.1; w='morl'; fc=centfrq (w);
a1= (fc)/(D* (f4)); a4= (fc)/(D* (f1));
lna1=log (a1); lna4=log (a4);
lna=linspace (lna1, lna4,300);
A=exp (lna); F=fc./(D.*A); dA=zeros (size (A));
for i=2: length (A)-1
dA (i)=A (i+1)-A (i=1);
end;
dA (1)=2* (A (2)-A (1)); dA (end)=2* (A (end)-A (end=1)); dA=abs (dA);
W=cwt (detrend (signal (:,2)), A, w); sW=size (W);
for j=1: sW (2)
shf (:, j)=W (F>f2&F<f1, j).* (dA (F>f2&F<f1)')...
./(A (F>f2&F<f1)'.^ (3/2));
slf (:, j)=W (F>f3&F<f2, j).* (dA (F>f3&F<f2)')...
./(A (F>f3&F<f2)'.^ (3/2));
svlf (:, j)=W (F>f4&F<f3, j).* (dA (F>f4&F<f3)')...
./(A (F>f4&F<f3)'.^ (3/2));
end;
cnorm=max (abs ((detrend (signal (:,2)))))...
/max (abs (sum (shf)+sum (slf)+sum (svlf)));
u_hf=sum (cnorm*shf).^2; u_lf=sum (cnorm*slf).^2;
u_vlf=sum (cnorm*svlf).^2;
u_tp=u_hf+u_lf+u_vlf;
HF=sum (u_hf); LF=sum (u_lf); VLF=sum (u_vlf);
TP=sum (u_tp);
lfkhf=zeros (1, sW (2));
lfkhf (1)=0;
for i=2: sW (2)
if u_hf (i)>0.01*max (u_hf)
lfkhf (i)=u_lf (i)/u_hf (i);
else
lfkhf (i)=lfkhf (i=1);
end;
end;
Aintense=sum (lfkhf (lfkhf>10));
figure; plot (signal (:,1), lfkhf);
hold on; plot (signal (:,1),10*ones (size (signal (:,1))))
title ('отношение LF k HF'); xlabel ('время, мс');
```

Self-check tests:

The simplify keyword is used
- ☐ when simplifying expressions
- ☐ when factoring an expression
- ☐ when reducing similar terms
- ☐ there is no correct answer in the list

The factor keyword is used
- ☐ when factoring an expression
- ☐ when simplifying expressions
- ☐ when reducing similar terms
- ☐ there is no correct answer in the list

The parfrac keyword is used
- ☐ when determining the polynomial coefficients
- ☐ when simplifying expressions
- ☐ when reducing similar terms
- ☐ there is no correct answer in the list

The collect keyword is used
- ☐ when reducing similar terms
- ☐ when determining the polynomial coefficients
- ☐ when simplifying expressions
- ☐ there is no correct answer in the list

For the analytical solution of problems of mathematical analysis, the panel is designed
- ☐ Mathematics
- ☐ Formatting
- ☐ Standard
- ☐ Calculator

To perform the operation of substituting the value of a variable into an expression, use the keyword
- ☐ substitute
- ☐ complex
- ☐ solve
- ☐ laplace

Topic 9: "Object recognition when decoding medical images"
1. Control questions:

1. What is Spectral Analysis?
2. The role of the computer in biomedical research
3. What are the principles of obtaining projections of a tomographic image?
4. How is the head phantom reconstructed based on projection data?
5. What are the features of the synthesis of projections when using parallel rays?
6. What are the features of the synthesis of projections when using fan rays?
7. Definition of wavelet transforms, methods of using them in medical research
8. Windowed Fourier transforms, a technique for using them in medical research
9. Methods of object recognition in medical images using MATLAB

2. Objectives:

Student must know:	Literature:
• Why does a medical professional need the skills of conducting spectral, wavelet research in their work? • Basic concepts of wavelet theory • Basic research methods. **The student should be able to:** • Own basic tools for creating, editing, formatting images in the Matlab package. Effectively use Matlab package for deeper medical research. • Be able to understand the theoretical description of orthogonal transformations.	17. Kobrinsky B.A., Zarubina T.V. "Medical informatics", M., Publishing house "Academy", 2009. 18. Zhizhin K.S. "Medical Statistics", Higher Education, 2007. 19. Methodical development for 4th year students for a practical lesson on the topic "Analysis of biomedical signals - digital signals and images" 20. http / science.urfu.ru / ru / publications / analysis-biomedical-signals-in-environment-matlab-tutorial-tutorial

3. Tasks for independent work on the topic under study:
Tasks: (preliminarily study [3,4] again.)

1. Explore general issues of digital imaging.
2. Create a phantom head.
3. Compute synthesized projections using parallel rays.
4. Compute synthesized projections using parallel rays
5. Perform head phantom reconstruction based on projection data obtained using fan beams.
6. Compute synthesized projections using fan beams

Prepare a report:
- debug programs for restoring scenes from projections;
- debug programs of results of studies of MRI images
Prepare the intelligence of the card according to the basic concepts

Self-check tests:

When substituting a variable value in an expression, after the substitute keyword in the placeholder, type

☐ boolean expression
☐ variable
☐ formula
☐ constant

2. To carry out analytical differentiation, use the symbol

☐
☐ =
☐ ≈
☐ ÷

3. Instead of a placeholder for the differentiation operator, you need to enter

☐ function depending on argument and argument name
☐ function name and argument name

☐ derived function name and argument name
☐ there is no correct answer in the list

4. Instead of placeholders for the integration operator, it is required to enter
☐ function depending on the argument, the name of the argument and the range of integration
☐ function name, argument name and limits of integration
☐ derived function name and argument name
☐ there is no correct answer in the list

5. To carry out analytical differentiation, the symbol is used
☐ =
☐ ≈
☐ there is no correct answer in the list

6. If the integral diverges, then
☐ an error message is displayed
☐ the divergent integral is calculated
☐ the integral is replaced by the convergent
☐ there is no correct answer in the list

7. To move a document design element, you need to
☐ select and drag using mouse
☐ copy and paste to the desired location
☐ remove and paste at the desired location
☐ there is no correct answer in the list

8. To resize a document element you need
☐ select and stretch (or shrink) by pulling the black rectangles on the borders of the selection area
☐ drag the mouse several times within the element area
☐ transfer a document element to Word and resize there
☐ there is no correct answer in the list

9. Color selection is made using
☐ Item Properties item of the Format menu
☐ Formatting pane
☐ of the Refresh item of the View menu item
☐ there is no correct answer in the list

10. To create a text region, you need to enter the symbol
☐ double quote
☐ colon
☐ open square bracket
☐ apostrophe

11. To format text in Matlab, use
☐ Formatting panel
☐ Standard panel
☐ Format item of the main menu
☐ there is no correct answer in the list

12. To set a paragraph, use
☐ markers on the ruler
☐ Format item of the main menu
☐ Formatting panel
☐ there is no correct answer in the list

13. The number of copies when the document is sad is set in the window
☐ in the document print window
☐ in the page options setup window
☐ with the Print command
☐ there is no correct answer in the list