National Technical University of Ukraine
"Igor Sikorsky Kyiv Polytechnic Institute"

Department
biomedical engineering

Microprocessor Engineering

Working program of basic discipline (Silabus)

Requisites for basic discipline	
Level of higher education	***First (bachelor's)***
Branch of knowledge	*16 Chemical and Bioengineering*
Specialty	*163 Biomedical Engineering*
Educational program	*Medical Engineering*
Discipline status	*Mandatory discipline*
Form of study	*full-time / day / mixed / remote*
Year of preparation, semester	*4th course, autumn semester*
The scope of discipline	*5 ECTS credits / 150 hours*
Semester control / Control measures	*Exam, Modular Test Work, Calculation and Graphic Work*
Lessons schedule	*According to the schedule on the site http://rozklad.kpi.ua/*
Language of instruction	*English*
Information about course leader / teachers	***Lecturer:*** *Doctor of Technical Sciences, Associate Professor, Head Department of BME Shlykov Vladyslav Valentynovych, e-mail: v.shlykov@kpi.ua, Telegram: https://t.me/vshlykov* ***Practical:*** *Doctor of Technical Sciences, Associate Professor, Head Department of BME Shlykov Vladyslav Valentynovych, e-mail: v.shlykov@kpi.ua, Zoom: 716 114 6823, code 2021*
Course placement	*Platform «Sikorsky» - course «Microprocessor Engineering» (dx34it)*

Distribution of hours

Semester	Lectures	Practical	Laboratory	Independent Work
autumn semester	*28*	*26*	*18*	*78*

Curriculum of the discipline

1. Description of the discipline, its purpose, subject of study and learning outcomes

The main purpose of the discipline "Microprocessor Engineering" is to form students' ability to solve complex specialized problems and practical problems of architecture of computer and microprocessor systems, which involves the use of theories and scientific methods of analog and digital electronics, software and hardware for medical devices and systems.

The discipline "Microprocessor Engineering" studies the application of methods of analog and digital electronics, architecture of computer and microprocessor systems, software and hardware for the design of medical devices and systems to solve problems related to the development and engineering of biological and medical devices and systems that include single-chip microprocessors and microcontrollers.

Skills are required to study the discipline:

1. *Programming tools for Intel 8086 family processors;*
2. *Assembler Software Development Tools (MASM);*
3. *Programming of Arduino family processors in C/C ++;*
4. *Arduino IDE software.*

General competencies *(OPP was put into effect by the Rector's Order NON/ 89/2021 of 19.04.2021):*

GC 1 *- Ability to apply knowledge in practical situations.*
GC 2 *- Knowledge and understanding of the subject area and understanding of professional activity.*
GC 3 *- Ability to communicate in the state language both orally and in writing.*
GC 4 *- Skills in the use of information and communication technologies.*
GC 5 - *Ability to perform research at the appropriate level.*
GC 6 *- Ability to search, process and analyze information from various sources.*
GC 7 *- Ability to generate new ideas (creativity).*
GC 8 *- Ability to make well-grounded decisions.*
GC 9 *- Ability to communicate with representatives of other professional groups of different levels (with experts from other fields of knowledge / types of economic activity).*
GC 10 - *Safe activities skills.*
GC 11 *- Ability to evaluate and ensure the quality of work performed.*

Special (professional) competencies *(OPP was put into effect by the Rector's Order NON/ 89/2021 of 19.04.2021):*

PC 1 *- Ability to use engineering software packages for research, analysis, processing and presentation of results, as well as for automated design of medical devices and systems.*
PC 2 *- Ability to provide engineering expertise in the process of planning, development, evaluation and specification of medical equipment.*
PC 3 *- Ability to study and apply new methods and tools for analysis, modeling, design and optimization of medical devices and systems.*
PC 5 *- Ability to apply physical, chemical, biological and mathematical methods in the analysis, modeling of the functioning of living organisms and biotechnical systems.*
PC 6 *- Ability to effectively use tools and methods for analysis, design, calculation and testing in the development of biomedical products and services.*
PC 7 *- Ability to plan, design, develop, install, operate, exploit, maintain, control and coordinate the repair of devices, equipment and systems for prevention, diagnosis, treatment and rehabilitation used in hospitals and research institutes.*
PC 9 *- Ability to identify, formulate and solve engineering problems related to the interaction between living and non-living systems.*
PC 10 *- Ability to apply the principles of construction of modern automated control systems for the production of medical devices, their technical, algorithmic, informational and software support for solving professional problems.*
PC 11 *- Ability to understand the technical and functional characteristics of systems, methods and procedures used in prevention, diagnosis and therapy.*
PC 14 *- Ability to perfect experiments according to specified technical and medical methods, perform computer processing, analysis and synthesis of the results.*

The program learning outcomes after studying the discipline "Microprocessor Engineering" are *(OPP was put into effect by the Rector's Order NON/ 89/2021 of 19.04.2021):*

PLO 1 - *Understanding of fundamental-applied, medical-physical and bioengineering bases of technologies and equipment for research of processes of a human body.*
PLO 2 - *Possession of engineering methods for calculation of elements of devices and systems of medical use and a choice of classical and newest constructional materials.*
PLO 4 - *Knowledge of methods of designing digital and microprocessor systems for medical purposes.*
PLO 5 - *Knowledge of research methods and techniques used in the design of medical equipment.*
PLO 7 - *Understanding of scientific and technical principles that underlie the latest advances in biomedical engineering.*

PLO 8 - *Knowledge of a foreign language to the extent sufficient for general and professional communication.*
PLO 16 - *Application of modern programming technologies and tools that support their use.*
PLO 17 - *Knowledge of general information about the human body and its functions from the standpoint of a systems approach and their use in biomedical engineering.*
PLO 24 - *Apply knowledge of the basics of mathematics, physics and biophysics, bioengineering, chemistry, engineering graphics, mechanics, resistance and strength of materials, properties of gases and liquids, electronics, computer science, obtaining and analyzing signals and images, automatic control, systems analysis and decision making methods at the level required to solve the problems of biomedical engineering.*
PLO 25 - *Formulation of logical conclusions and substantiation of recommendations for evaluation, operation and implementation of biotechnical, medical-technical and bioengineering means and methods.*
PLO 26 - *Management of complex actions or projects that require engineering decisions in unpredictable conditions.*
PLO 29 - *Professional communication with healthcare professionals in the state and foreign languages (English or one of the other official EU languages) and understanding of their requirements for biomedical products and services.*
PLO 30 - *Engineering support, service and maintenance in the operation of laboratory analytical equipment, medical diagnostic and therapeutic complexes and systems, as well as the preparation of standard documentation for the types of work in accordance with the Technical Regulations for medical devices.*
PLO 31 - *Understanding of theoretical and practical approaches to the creation and management of medical equipment and medical technic.*
PLO 33 - *Planning, organization and control of medical-technical and bioengineering systems and processes.*
PLO 37 - *Ability to analyze the level of compliance with modern world standards, as well as evaluate solutions and set tasks for the development of automated control systems, taking into account the capabilities of modern hardware and software for automation of medical equipment.*
PLO 38 - *Ability to set tasks for the development of automated control systems taking into account the capabilities of modern hardware and software for automation of medical equipment.*
PLO 39 - *Recommendation and technical support of appropriate medical equipment and biomaterials for equipping medical institutions and support the main stages of the technological process of diagnosis, prevention and treatment.*
PLO 40 - *Use of computer-aided design systems for development of technological and hardware scheme of medical devices and systems.*
PLO 42 - *Development and implementation of modern diagnostic and therapeutic methods related to the use of biotechnology, computer and nanotechnology.*
PLO 45 - *Improving the technical elements of medical devices and systems and medical products in the process of professional activity.*

2. Prerequisites and postrequisites of the discipline (place in the structural and logical scheme of education according to the relevant educational program)

The discipline "Microprocessor Engineering" belongs to the cycle of professional training and has an interdisciplinary nature. It integrates according to its subject knowledge from other disciplines: analog and digital circuitry, object-oriented programming and more. According to the structural and logical scheme of the training program, the discipline "Microprocessor Engineering" is closely related to other disciplines of general and professional training: "Fundamentals of Informatics", "Electrical Engineering and Electronic Devices", "Digital Circuitry", "Object-Oriented Programming". It is immediately preceded by the discipline "Digital Circuitry".

The acquired practical skills and acquired theoretical knowledge during the study of the discipline "Microprocessor Engineering" can be used in the future during the acquisition of academic disciplines:

- from the cycle of professional training (educational-professional program "Medical Engineering"): "Biomedical devices, apparatus and complexes";

- from elective disciplines (educational-professional program "Medical Engineering"): "Medical Equipment", "Development and operation of physiotherapeutic medical devices", "Medical-diagnostic complexes based on biophotonic converters", "Design of medical information systems".

3. The content of the discipline

The main sections and topics that will be considered in the process of studying the course:

Section 1. General provisions for the construction of microprocessors.

Subject 1.1. Intel 8086 microprocessor. Coprocessor and arithmetic extension of the processor.

Subject 1.2. Program synchronization and timer control.

Section 2. Hardware of microprocessor systems.

Subject 2.1. Organization of memory and registers. Direct memory access.

Subject 2.2. Clock generator. Timers. Bus address and data.

Subject 2.3. Organization of I/O ports.

Subject 2.4. Interfaces of external devices for interaction with technological equipment.

Section 3. Software for microprocessor systems.

Subject 3.1. Interrupt controller. Organization of the mechanism of breaks.

Subject 3.2. Means of organization of exchange with external devices. The scheme of conclusions.

Subject 3.3. Application of microprocessor engineering in medicine.

Subject 3.4. Intel 8086 command system. Interrupt system. Memory addressing.

Subject 3.5. MASM tools for software development.

Section 4. Arduino processors architecture.

Subject 4.1. Memory and register organization for Arduino UNO.

Subject 4.2. Organization of I/O ports.

Subject 4.3. Selection and connection of sensors and sensors.

Section 5. Arduino processors software.

Subject 5.1. Arduino processor programming in C/C ++.

Subject 5.2. Arduino IDE software.

Subject 5.3. NI VISA components in LabVIEW 2010 for serial data I/O.

4. Training materials and resources

Basic literature:

1. *Шликов, В. В. Мікропроцесорна техніка. Практикум [Електронний ресурс]: навчальний посібник для студентів спеціальності 163 «Біомедична інженерія» та 152 «Метрологія та інформаційно-вимірювальна техніка» / В. В. Шликов ; КПІ ім. Ігоря Сікорського. – Київ : КПІ ім. Ігоря Сікорського, 2018. – 145 с.*
2. *Якименко Ю. І., Терещенко Т.О., Сокол Є.І., Жуйков В.Я., Петергеря Ю.С. Мікропроцесорна техніка: підручник для студ. вищ. техн. закл. освіти / за ред. Т.О. Терещенко / Міністерство освіти і науки України, НТУУ "КПІ". - Київ: Політехніка; Кондор, 2008. - 594 с.*
3. *Кирик В. В. Мікропроцесорна техніка: навч. посіб. / М-во освіти і науки України, НТУУ "КПІ" Київ: НТУУ "КПІ", 2014. - 183 с.*

4. *Терещенко Т.О., Петергеря Ю.С., Жуйков В.Я., Хохлов Ю.В., Мороз А.В. Електронний підручник «Мікропроцесори та мікроконтролери» для студентів напряму підготовки "Електроніка", "Електротехніка" та інших бакалаврат ів. Київ: НТУУ "КПІ", 2009.*
5. *Шликов В.В., Кисельова О.Г., Матвійчук А.О. Мікропроцесорна техника: Методичні вказівки до виконання лабораторних робіт для студентів напрямів підготовки 6.051402 «Біомедична інженерія», 6.051003 «Приладобудування» – К.: НТУУ «КПІ», 2014. – 123 с.*
6. *Shlykov, V. V. Microprocessor technics [Electronic resource] : workshop on discipline for students of specialties 163 «Biomedical Engineering» and 152 «Metrology and information-measuring technique» / V. V. Shlykov, Y. P. Stasyuk ; Igor Sikorsky Kyiv Polytechnic Institute. – Kyiv : Igor Sikorsky Kyiv Polytechnic Institute, 2020. – 148 p.*

Additional literature:

1. *Бунтов В.Д., Макаров С.Б. Микропроцессорные системы Часть II. Микропроцессоры. Учебное пособие. СПб.: Изд-во политехнического университета, 2008. –199 с.*
2. *Майк Предко. Руководство по микроконтролерам. Том 1. - Москва: Постмаркет, 2001г. – 416 с.*
3. *Магда Ю.С. Ассемблер для процессоров Intel Pentium. – СПб.: Питер, 2006 г. – 410 с.*
4. *Юров В. И. Assembler. Учебник для вузов. 2-е изд.— СПб.: Питер, 2003. – 637 с.*
5. *Абашев А.А., Жуков И.Ю., Бурдаев О.В. Ассемблер в задачах защиты информации. – М.: Кудиц-Образ, 2004 г. – 544 с.*
6. *Анкудинов И.Г. Микропроцессорные системы. Архитектура и проектирование. Учебное пособие. СПб.: СЗТУ, 2003 г. – 109 с.*
7. *Эрни Каспер. Программирование на языке Ассемблера для микроконтроллеров семейства i8051. – М.: Телеком, 2004 г. – 191 с.*

Educational content

5. Methods of mastering the discipline (educational component)

№ s/n	Subject	Program learning outcomes	The main tasks	
			Control measure	Deadline
1.	Intel 8086 microprocessor. Coprocessor and arithmetic extension of the processor.	PLO 2 PLO 4	Practical work 1 Laboratory work 1	1-2nd week
2.	Program synchronization and timer control.	PLO 4 PLO 16	Practical work 2	3rd week
3.	Organization of memory and registers. Direct memory access.	PLO 4 PLO 16	Practical work 3	4th week
4.	Clock generator. Timers. Bus address and data.	PLO 4 PLO 16	Practical work 4	5th week
5.	Organization of I/O ports.	PLO 4 PLO 16 PLO 37	Practical work 5 Laboratory work 2	6-7th week
6.	Interfaces of external devices for interaction with technological equipment.	PLO 2 PLO 4	Practical work 6 Laboratory work 3	8th week
7.	Interrupt controller. Organization of the mechanism of breaks.	PLO 4 PLO 16	Practical work 7	9th week
8.	Means of organization of exchange with external devices. The scheme of conclusions.	PLO 2 PLO 4 PLO 16	Laboratory work 4	
9.	Application of microprocessor engineering in medicine.	PLO 1 PLO 5 PLO 7	Practical work 8	10th week

		PLO 17 PLO 30 PLO 31 PLO 33 PLO 38 PLO 40 PLO 42		
10.	Intel 8086 command system. Interrupt system. Memory addressing.	PLO 2 PLO 4 PLO 5 PLO 16	Practical work 9 Laboratory work 5	11th week
11.	MASM tools for software development.	PLO 4 PLO 5	Laboratory work 6	12th week
12.	Memory and register organization for Arduino UNO.	PLO 16 PLO 40 PLO 45	Practical work 10	
13.	Organization of I/O ports.	PLO 4 PLO 16 PLO 37	Laboratory work 7	13th week
14.	Selection and connection of sensors and sensors.	PLO 2 PLO 4 PLO 25	Practical work 11	
15.	Arduino processor programming in C/C ++.	PLO 2 PLO 4 PLO 16	Laboratory work 8	14th week
16.	Arduino IDE software.	PLO 16 PLO 24 PLO 30	Practical work 12	
17.	NI VISA components in LabVIEW 2010 for serial data I/O.	PLO 4 PLO 24 PLO 31	Laboratory work 9	15th week
18.	Modular control work		Practical work 13	
19.	Calculation and graphic work	PLO 4 PLO 8 PLO 26 PLO 29 PLO 39 PLO 45	Registration and submission of work	16th week

6. Independent student work

One of the main types of semester control during the mastering of the discipline "Microprocessor Engineering" is the implementation of calculation and graphic work. Calculation and graphic work is performed in accordance with the requirements, within the period specified by the teacher.

The main purpose of computational and graphic work is to solve a practical problem using the material learned in lectures and independently, and practical skills acquired in practical work. The student can write calculation and graphic work only on the subject agreed with the teacher.

Approximate subject of calculation and graphic work:

№1 Modern microprocessors from Intel. Basic microprocessor 8086/8088.
№2 Microprocessor system architecture. Computer design features.
№3 General principles of building multiprocessor computers.
№4 Computer system resources. General characteristics.

№5 Organization of modern computer memory. General principles and composition of basic memory devices.
№6 Microprocessor interfaces. Basic principles of control of external devices.
№7 Pentium class microprocessors. Features of architecture.
№8 AMD microprocessors. Features of architecture.
№9 Mathematical coprocessors. Purpose and features of architecture.

The title page of the calculation and graphic work should have the following content: the name of the university; name of the faculty; name of department; name of specialty, name of educational-professional program, name of academic discipline; theme of calculation and graphic work; surname and name of the student, course, number of the academic group, year.

The title page is followed by a detailed plan (content) of the calculation and graphic work, which should highlight the introduction, sections of the main content (main topics studied), their subdivisions (if necessary), conclusion, list of sources used. The table of contents on the right indicates the page numbers at the beginning of each question. Each section begins on a new page.

The total amount of calculation and graphic work, depending on the chosen topic can vary from 25 to 40 pages of the main text (in consultation with the teacher). The amount of computational and graphic work is determined by the student's ability to briefly and at the same time comprehensively explain and analyze the program code in the Code Composer Studio environment.

Mandatory requirement: clear reference to sources of information. All figures, facts, opinions of scientists, quotations, formulas should have a reference in the form [2, p. 54] (the first digit means the number of the source in the list of references given at the end of the creative work, and the second digit - the page number in this source). It is desirable to use tables, diagrams, graphs, charts, etc. The list of used sources (not less than 10 sources) is made out according to operating rules. If the information is taken from the Internet, you need, as for ordinary literature, specify the author, the title of the article, and then provide the address of the site on the Internet.

Calculation and graphic work is evaluated by the following criteria: logic of the plan; completeness and depth of topic disclosure; reliability of the received data; reflection of practical materials and results of calculations; correctness of formulation of conclusions of the received results and conclusions; design; substantiation of the student's own opinion on this issue in the form of a conclusion.

Deadline for submission of calculation and graphic work for verification: 15-16th week of study.

Calculation and graphic work is not tested for plagiarism, but must meet the requirements of academic integrity. In case of academic dishonesty, the work is canceled and not checked.

Policy and control

7. Policy of academic discipline (educational component)

Attending classes

Attendance at lectures is optional. Attending practical classes is desirable, as they are used to write express tests / tests, as well as to defend practical work.

The grading system is focused on obtaining points for student activity, as well as performing tasks that are able to develop practical skills and abilities.

Control measures missed

Missed control measures (defense of practical work) must be practiced in the next classes, provided that the task is scheduled for the current lesson, or in consultations.

Omissions of writing a module test and express test are not fulfilled.

Calculation and graphic work, which is submitted for inspection in violation of the deadline is evaluated with a decrease in the number of weight points.

Violation of deadlines and incentive points

Encouragement points		*Penalty points **	
Criterion	*Weight points*	*Criterion*	*Weight points*
Improving practical work	*1 points (for each practical work)*	*Untimely implementation and test of practical work*	*From -0.5 points to -5 points (depending on the delivery date)*
Passing distance courses on topics that are agreed with teachers	*5 points*	*Untimely execution and test of calculation and graphic work*	*From -2 points to -20 points (depending on the construction period)*
Registration of scientific work for participation in the competition of student scientific works	*10 points*		
Writing abstracts, articles, participation in international, national and / or other events or competitions on the subject of the discipline	*5 points*		

** if the control measure was missed for a good reason (illness, which is confirmed by a certificate of the established sample) - penalty points are not accrued.*

Academic integrity

The policy and principles of academic integrity are defined in Section 3 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". Read more: https://kpi.ua/code*.*

Norms of ethical behavior

Normative principles of behavior of students and employees, defined in sections 2 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". Read more: https://kpi.ua/code.

Procedure for appealing the results of control measures

Students have the opportunity to raise any issue related to the control procedure and expect it to be addressed according to predefined procedures.

The student has the right to appeal the results of the control measure according to the approved provision on appeals in the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (approved by the order №NON/128/2021 from 20.05.2021) - https://osvita.kpi.ua/index.php/node/182

Inclusive education

The discipline "Medical Microprocessor Systems" can be taught to most students with special educational needs, except for students with severe visual impairments who do not allow to perform tasks using personal computers, laptops and / or other technical means.

Distance learning

Distance learning takes place through the Sikorsky Distance learning Platform «Sikorsky».

Distance learning through additional online courses on certain topics is allowed subject to agreement with students. If a small number of students wish to take an online course on a specific topic,

studying the material with such courses is allowed, but students must complete all the tasks provided in the discipline.

The list of courses is offered by the teacher after the students have expressed a desire (because the bank of available courses is updated almost every month).

The student provides a document confirming the completion of the distance course (in the case of a full course) or provides practical tasks from the distance course and subject to an oral interview with the teacher on the topics can receive grades for control measures provided for the studied topics (express control / test tasks, practical work).

Performance of practical works, and also performance of settlement and graphic work, is carried out during independent work of students in a remote mode (with a possibility of consultation with the teacher through e-mail, social networks).

Learning a foreign language

Teaching in English is carried out only for foreign students.

At the request of students, it is allowed to study the material with the help of English-language online courses on topics that correspond to the topics of specific classes.

8. Monitor and evaluate the system of evaluation of learning outcomes (Rating System of Evaluation)

Evaluation system (current control):

№ s/n	Control measure	%	Weight points	Number	Total
1.	Express control works / test tasks	10	2	5	10
2.	Execution and test of practical works	24	2	12	24
3.	Execution and test of laboratory works	36	4	9	36
4.	Modular control work (MCW)	15	15	1	15
5.	Calculation and graphic work (CGW)	15	15	1	15
6.	Test work[1]	80	80	1	80
	Total				100

Calendar control *(CC) - is performed twice a semester as monitoring of the current state of compliance with syllabus requirements.*

The purpose of calendar control is to improve the quality of student learning and monitor the implementation of the schedule of the educational process by students.

Criterion			The first CC	The second CC
Deadline of calendar controls			8th week	14th week
Conditions for obtaining a positive result from the calendar control	Current rating		≥ 24 points	≥ 42 points
	Execution practical work	PW № 1- 5	+	+
		PW № 6-12	-	+
	Execution of laboratory works	LW № 1- 4	+	+
		LW № 5- 9	-	+
	Express control works / test tasks	At least 4 of any lectures	+	-
		At least 8 of any lectures	-	+
	Modular control work	Estimated MCW	-	+
	Calculation and graphic work	Estimated CGW	-	-

[1] *Taken into account in the amount of the rating together with the grade for CGW in case the student has not scored 60 points per semester or he wants to improve his grade.*

In case of detection of academic poor quality during training - the control measure is not credited.

Semester certification of students

	Mandatory condition for admission to the test	*Criterion*
1	*Current rating*	*RD ≥ 42*
2	*Obtaining a positive assessment for the performed calculation and graphic work*	*More than 8 points*
3	*All practical works are tested*	*More than 14 points*
3	*All laboratory works are tested*	*More than 14 points*
4	*Writing at least 6 express tests / tests*	*More than 6 points*

The results are announced to each student separately in the presence or remotely (by e-mail). Also recorded in the system "Electronic Campus".

Optional conditions for admission to closure:

1. *Activity in practical classes.*
2. *Activity in laboratory classes.*
3. *Positive result of the first attestation and the second attestation.*
4. *Attending 50% of lectures.*

Table of translation of rating points to grades on a university scale:

Number points	*Assessment on the university scale*
100-95	*Perfectly / Відмінно*
94-85	*Very good / Дуже добре*
84-75	*Good / Добре*
74-65	*Satisfactorily / Задовільно*
64-60	*Enough / Достатньо*
Less 60	*Unsatisfactorily / Незадовільно*
Admission conditions are not met	*Not allowed / Не допущено*

9. Additional information on the discipline (educational component)

The list of questions for preparation for modular control work, and also for preparation for credit is given in appendix 1.

Distance learning through additional online courses on certain topics is allowed subject to agreement with students. If a small number of students wish to take an online course on a specific topic, studying the material with such courses is allowed, but students must complete all the tasks provided in the discipline.

The list of courses is offered by the teacher after the students have expressed a desire (because the bank of available courses is updated almost every month).

The student provides a document confirming the completion of the distance course (in the case of a full course) or provides practical tasks from the distance course and subject to an oral interview with the teacher on the topics can receive grades for control measures provided for the studied topics (express control / test tasks, practical work).

Work program of the discipline (syllabus):

Compiled by *Associate Professor of Biomedical Engineering, Doctor of Technical Sciences, Shlykov Vladyslav Valentynovych, Head of the Department of Biomedical Engineering.*

Approved by *the Department of Biomedical Engineering (protocol № ___ to _____)*

Approved by *the Methodical Commission of the Faculty of Biomedical Engineering (protocol № __ to _____)*

Appendix 1 to the syllabus of the discipline

"Microprocessor Engineering"

The list of questions for preparation for modular control work,

And also for preparation for test

1. To analyse the Harvard architecture of microprocessors.
2. To analyse the bus assignment: address bus, data bus, control bus.
3. Compare the RISC and CISC architectures. Definition and specialization.
4. To analyse the structure of the built-in microcontroller.
5. To give the analysis of modularity of microprocessor system. System bus.
6. Give examples of adding integers. Command syntax.
7. Give examples of subtraction of integers. Command syntax.
8. Give examples of multiplication of integers. Command syntax.
9. Give examples of division of integers. Command syntax.
10. Give examples of arithmetic shift to the left and right. Command syntax.
11. Give examples of unconditional transition and comparison of operands. Command syntax.
12. Give examples of using the conditional transition command. Conditions of transition.
13. Give examples of logical operations. Command syntax.
14. Give examples of the command cyclic shift to the left.
15. Give examples of the command cyclic shift to the right.
16. Give examples of the team organization of cycles. Command syntax.
17. Give examples of the use of prefix repetition of data transfer commands.
18. Give examples of commands to set and reset flags.
19. Give examples of the command to move along the line.
20. Give examples of loading the address of a variable in memory.
21. Give examples of basic addressing. Segment address.
22. The use of index addressing with a shift. Effective operand address.
23. Application of base-index addressing. Forming an address in memory.
24. Give examples of using an effective address when working with arrays.
25. Give examples of the use of routines. Command syntax.
26. Use of general purpose registers. The composition of the operating device.
27. The use of segment registers. The composition of the bus interface.
28. Use of index registers. Register of flags.
29. Give the functions of the ALU. Assignment of ALU address inputs.
30. Assign buffer address and command buffer.
31. Provide a scheme of direct addressing of I/O to the port.
32. Provide a scheme of indirect addressing of I/O to the port.
33. Give examples of I / O commands in / out port. Command syntax.
34. To analyse the I/O procedure in / from the file. Example.
35. To analyse the compatibility of the interface of the i8086 processor with the system bus.
36. Turn on the i8086 processor in the minimum mode.
37. Provide the scheme of inclusion of the i8086 processor in the maximum mode.
38. To analyse the organization of memory. Address space.
39. To analyse the structure of the i8086 processor. Executive module.
40. To analyse the structure of the i8086 processor. Bus interface.
41. To analyse the structure of the i8086 processor. Management and timing.
42. Provide a diagram of the module of the dynamic memory controller.
43. To analyse the functions of the I/O interface.
44. To analyse the increase in memory of the microcontroller.

45. Give examples of the break command by vector type. Command syntax.
46. Give examples of the overflow break command. Command syntax.
47. To analyse returns from breaks and routines.
48. To analyse the segmental organization of memory.
49. To analyse the formation of the physical address of the byte in memory.
50. To analyse the formation of a logical address.
51. Give examples of programming the I/O mode in the port.
52. Give an example of a break call. Addresses of break functions.
53. To analyse data exchange management. Software exchange.
54. To analyse data exchange management. Exchange on a break.
55. To analyse the functions and purpose of the coprocessor.
56. To analyse the purpose of arithmetic expansion of the processor.
57. To analyse the functions and purpose of the timer.
58. Give examples of timing of timer signals.
59. Give examples of addressing I/O ports.
60. Give the structure of the parallel I/O interface.
61. Give the structure of the serial I/O interface.
62. Give the wiring diagram of the clock generator.
63. To analyse the block diagram of the programmable timer.
64. Specify the operating modes of the programmable timer.
65. To analyse the work of the break controller. Source of interruptions.
66. Give examples of interrupt requests. Types of break vectors.
67. Give the circuit diagram of the microprocessor i8086.
68. To analyse the addressing of an 8-bit device organization of the exchange.