Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

Department of Manufacturing Engineering

Microprocessor technology
Work program of the discipline (Syllabus)

Details of the discipline

Level of higher education	First (bachelor's)
Field of study	13 Mechanical engineering
Speciality	131 Applied mechanics
Educational program	Mechanical engineering technologies
Discipline status	Custom
Form of study	full-time (full-time)/remote/mixed
Year of preparation, semester	3rd year, spring semester
Volume of discipline	4 credits (total total)
Semester control/ control measures	Passed
Schedule of classes	http://rozklad.kpi.ua/
Language of teaching	Ukrainian
Information about thecourse instructors / teachers	Lecturer: Ph.D., assoc. prof, Subin A.A., anatoliy. subin@gmail. com Practical: Ph.D., assoc. prof, Subin A.A., anatoliy. subin@gmail. com Laboratory: Ph.D., Assoc. Prof., Subin A.A., anatoliy. subin@gmail. com
Course placement	https://classroom.google.com/c/MTU5Mjc0NTg1MzI2

The program of the discipline

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

This discipline is applied, studying the basics of digital electronics, microprocessor control systems for technical objects and their diagnostics, in particular in metalworking. In the process of studying this discipline, the student masters the theoretical knowledge and practical skills of building microprocessor systems in mechanical engineering. This allows you to solve quite complex problems of automatic control of real objects in mechanical engineering, programming of cyclic automatic control systems and automatic diagnostic and autodiagnostics systems. Such important concepts as the basics of digital (discrete) electronics, the element base of microprocessor systems, means of pairing real objects with microcomputers, means of reproducing and transmitting information, etc. are considered.

2. Prerequisites and post-requisites of the discipline (place in the structural and logical scheme of training in the relevant educational program)

The study of this discipline is based on the knowledge gained by students in the study of the disciplines of Electrical Engineering and Electronics, Higher Mathematics, Informatics, Physics and others. The knowledge that students will receive when studying this discipline is used later in the study of disciplines Fundamentals of Mechanical Engineering Automation, Technological Foundations of GAV, SAP for CNC machines, Theory of automatic control of technological systems" and other special disciplines.

3. Contents of the course

Section and topic titles	Number of hours				
	Just	including			
		Lecture	Practical (seminar)	Laboratory (computer workshop)	SRS

1	2	3	4	5	6
Topic No1.Introduction. Classification of systems of microprocessor technology.	16	6	4		6
Topic No2.Arithmetic and logical foundations of computers.	24	8	4		12
Modular test work	2				2
Topic No3.Typical elements and nodes of microprocessor technology.	48	12	8	4	24
Topic No4.Basics of programming microprocessors.	44	6	2	14	22
Modular test work	2				2
Topic No5.Microprocessor computing devices in systems of automatic control of technological processes in mechanical engineering.	8	4			4
Passed	0				
Together	**144**	**36**	**18**	**18**	**72**

4. Learning Materials and Resources

Main:

1. Yu.I. Yakymenko, T.O. Tereshchenko, E.I. Sokol and others. Microprocessor technology: Textbook. - 2nd ed., reworked. and additions. – K.: IVC "Publishing House "Polytechnic""; "Condor", 2004. – 440 p.
2. Kostynyuk L.D., Paranchuk Y.S. Microprocessor tools and systems: Textbook. / L.D. Kostynyuk, Y.S. Paranchuk, Lviv: Lviv Polytechnic National University Publishing House, 2001. 200 c.
3. Bolyukh V.F., Danko V.G. Fundamentals of electronics and microprocessor technology: Textbook. manual. – Kharkiv: NTU "KhPI", 2011. – 257 p.
4. Boyko V.I. and others. Circuitry of electronic systems. Kn. 2. Digital circuitry: Textbook. – Kyiv: Vyscha shk., 2004. – 423 p.
5. Boyko V.I. and others. Circuitry of electronic systems. Kn. 3. Microprocessors and microcontrollers: Textbook. – Kyiv: Vyscha shk., 2004. – 399 p.
6. Petrakov Yu.V., Subin A.A., Frolov V.K. Laboratory and computer practice in microprocessor technology (with computer programs on CD) Ministry of Education and Science of Ukraine, NTUU "KPI", Kyiv, 2005, 102s.

Additional:

7. Podzharenko V.O., Kucheruk V.Yu., Sevastyanov V.M. Fundamentals of microprocessor technology. Tutorial. - Vinnytsia: VNTU, 2006. - 226 p.
8. Petrakov Yu.V., Melnychuk P.P. Automation of technological processes in mechanical engineering by means of microprocessor technology (Textbook) Ministry of Education and Science of Ukraine, Zhytomyr: ZHITI, 2001.-194s.
9. James Zweighaft, Jay Mendelson. Pressure, Force, Motion, and Humidity Sensors| Coursera [Electronic resource]. URL: https://www.coursera.org/learn/pressure-force-motion-humidity-sensors

Educational content

5. Methods of mastering the discipline (educational component)

5.1. Lectures

No s/n	*Title of the lecture topic and list of main questions (list of didactic means, links to literature and tasks on the SRS)*
1.	Topic No1. Entry. Classification of systems of microprocessor technology.

	Lecture 1. Historical background, basics of discrete electronics, basic concepts and definitions, the structure of microcomputers. [1,3,6]
2.	Lecture 2. The main tasks of microprocessor systems in mechanical engineering. Automatic control system, composition and functions of microprocessor systems. [2,3,6]
3.	Lecture 3. Automatic control system, automatic diagnostic system, automatic measuring complexes, composition and functions of microprocessor systems. [2,3]
4.	Topic No2. Arithmetic and logical foundations of a computer. Lecture 4. Computation systems, non-positional and positional systems, conversion of numbers from one system to another. [2,6,7]
5.	Lecture 5. Forms of representation of numbers in a computer, coding of numbers in a computer, direct code, reverse code, additional code. [2,6,7]
6.	Lecture 6. Arithmetic operations in binary computational system. [1,6]
7.	Lecture 7. Basic logical operations, basics of algebra of logic. [1,6]
8.	Topic number 3. Typical elements and nodes of microprocessor technology. Lecture 8. The concept of an electronic element of a computer, logical elements "NO", "I", "OR", "I-NO", "OR-NO". "Excluding OR" and others. [1,4,5]
9.	Lecture 9. Triggers: "RS trigger", "T-trigger", "D-trigger", "JK trigger", synchronized and unsynchronized. [1,4,5]
10.	Lecture 10. Registers: registers for receiving and transmitting information, shift registers. [4,5]
11.	Lecture 11. Counters, reverse counters. [4,5]
12.	Lecture 12. Encryptors. Decoders. [1,2,7]
13.	Lecture 13. Memory elements, permanent storage devices, programmable storage devices. [1,2,7]
14.	Topic No4. Basics of programming microprocessors. Lecture 14. Construction and organization of programs, methods of program development. Algorithms. Recording input data, computational operations, organization of calculation cycles, elements of comparison, organization of the transfer of calculated information and its storage.[3,6,8]
15.	Lecture 15. Basic programming languages. Elements of the Assembler programming language, machine codes. [6,8]
16.	Lecture 16. Description of data manipulation commands, verification and transition commands, data transfer commands between battery and memory. Communication commands with subroutines and procedures, data loading and sending commands. [6,8]
17.	Topic No5. Microprocessor computing devices in systems of automatic control of technological processes in mechanical engineering. Lecture 17. Means of pairing microcomputers with objects, primary information sensors, interfaces, digital-analog and analog-to-digital converters, element base of means of communication. [4,5,6,9]
18.	Lecture 18. Principles of construction of microprocessor control systems for discrete processes in metalworking. Principles of construction of controlling microprocessor systems, architecture of information and control computing systems. [4,5,6,9]

5.2. Practical work:

Practical classes cover the main topics of the lecture material and consider the practical application of the knowledge gained.

No s/n	*Name of laboratory work (computer workshop)*	*Number of rooms. Hours*
1	Entry. Classification of microprocessor systems	4

2	Arithmetic and logical foundations of a computer.	4
3	Typical elements and nodes of microprocessor technology.	8
4	Basics of programming microprocessors.	2

5.3. Laboratory classes

The main tasks of the cycle of laboratory classes are practical testing and consolidation of knowledge that was received in lectures.

No s/n	*Name of laboratory work (computer workshop)*	*Number of rooms. Hours*
1	Study of the microlaboratory KR580IK80	*4*
2	Organization of programs, assembler teams	*4*
3	Methods of developing programs of cyclic systems automatic control	*4*
4	Development of programs of cyclic automatic control systems with diagnostic elements	*6*

5.4. Individual tasks

Not provided.

5.5. Tests

MKR under sections 1, 2, 3, 4.

6. Independent work of a student / graduate student

No s/n	*The name of the topic, in preparation for classroom classes*	*Number of hours of SRS*
1.	Topic No1.Introduction. Classification of systems of microprocessor technology.	6
2.	Topic No2.Arithmetic and logical foundations of computers.	12
3.	Modular test work	2
4.	Topic No3.Typical elements and nodes of microprocessor technology.	24
5.	Topic No4.Basics of programming microprocessors.	22
6.	Modular test work	2
7.	Topic No5.Microprocessor computing devices in systems of automatic control of technological processes in mechanical engineering.	4

Politics and control

7. Policy of the discipline (educational component)

- *The rules for attending classes (both lectures and practical / laboratory) are regulated: "Regulations on the organization of the educational process in the KPI them. Igor Sikorsky" https://osvita.kpi.ua/node/39; "Regulations on the system of internal quality assurance of higher education in KPI them. Igor Sikorsky" https://osvita.kpi.ua/node/121;*
- *rules of conduct in the classroom (activity, preparation of short reports or texts, disconnection of telephones, use of communication tools to search for information on the teacher's Google disk or on the Internet, etc.) are regulated by the "Regulations on the organization of the educational process in KPI them. Igor Sikorsky" https://osvita.kpi.ua/node/39, ;*

- *rules for the implementation and delivery of the workshop; each student personally performs and passes the workshop;*
- *rules for the protection of individual tasks; each student personally passes individual works;*
- *in this credit module there are only incentive points that a student can receive on a voluntary basis performing a certain list of additional tasks related to the subject of the credit module;*
- *the policy of deadlines and re-examinations is regulated by the "Regulations on the current, calendar and semester control of learning outcomes in the KPI. Igor Sikorsky" https://osvita.kpi.ua/node/32, "Regulations on the system of evaluation of learning outcomes in the KPI. Igor Sikorsky" https://osvita.kpi.ua/node/37 ;*
- *The policy on academic integrity is regulated by the "Regulations on the system of prevention of academic plagiarism in the KPI. Igor Sikorsky" https://osvita.kpi.ua/node/47; provisions "Regulations on the resolution of conflict situations in the KPI them. Igor Sikorsky" https://osvita.kpi.ua/2020_7-170;*

8. Types of control and rating system for evaluating learning outcomes (RSO)

Distribution of study time by type of classes and tasks in the discipline in accordance with the working curriculum Table 8.1.

Semester	Just	Distribution by semesters and types of classes				FDM	RGR	Passed
		Lek.	Prak.	Lab.	SRS			
6	144	36	18	18	72	+	-	+
Just	144	36	18	18	72	+	-	+

The student's rating in the discipline consists of points that he receives for:
- performance and protection of 4 laboratory works - 40 points;
- implementation and defense of 4 practical works - 40 points
- modular tests - 20 points;
- at the request of the student, a test paper is possible - 10 points.

Rating (weight) points system and evaluation criteria

8.1. Practical work (r1)

The weight score of one practical work is 10 points (Table 8.2). Maximum points for all works: r1 = 4 works x 10 points = 40 points.

The maximum number of incentives is +4 points for all practical classes.

Rating points for one practical work Table 8.2

Points	*Evaluation criterion*
10,0	There are no comments on the report, there are answers to all questions
8,0	Comments on the results, answer to some questions
5,00	The work has been done, the correct results have been obtained, but not protected.
0,00	Work not done, report missing

8.2. Laboratory work (r2)

The weight score of one laboratory work is 10 points (Table 8.3). The maximum number of points for all works: r1 = 4 works x 10 points = 40 points.

The maximum number of incentives is +4 points for all laboratory classes.

Rating points for one practical work Table 8.3

Points	*Evaluation criterion*
10,0	There are no comments on the report, there are answers to all questions
8,0	Comments on the results, answer to some questions

5,00	The work has been done, the correct results have been obtained, but not protected.
0,00	Work not done, report missing

8.3. Modular control (r3)

The modular test consists of two questions of the ICR, which are carried out before the first attestations and at the end of the academic semester. The weight score of the MKR is 10 points. The maximum number of points for modular tests is: r2 = 10 points x 2 mod.contra. robot и = 20 points.

MKR Rating Points Table 8.4

Points	Evaluation criterion
10,0	Correct answer to more than 80% of questions
7,0	Correct answer to 60% of questions
5,0	Correct answer to 50% of questions
0,0	The correct answer to less than 50% of the questions or the student was absent without a good reason

8.4. Penalty and incentive points

The overall rating in the discipline includes only incentive points (Table 8.5). The total amount of incentive points may not exceed 10 points.

Incentive Points Table 8.5

Action	*Points*
Participation in the modernization of laboratory or practical work	plus 2 points
Improvement of didactic materials on the discipline	plus 3.. .5 points
Application of the original approach in solving problems	plus 1 point

8.5. Conditions of boundary certification

At the 8th week of training (first certification), the schedule provides for the implementation of: 2 practical works 20 points; MKR 10 points. Which is in the amount of 20+10=30 points. Thus, in order to obtain "satisfactory" from the first milestone certification, a student must have at least 30x0.5 = 15 points. At the 14th week of study (second certification), the schedule provides for the implementation of: 4 practical works and 2 laboratory works: 4pr x 10 points + 2lr x 10 points = 60 points; Thus, to obtain "satisfactory" from the second line of certification, a student must have at least 60 x0.5=30 points.

8.6. Calculation of the rating scale for the discipline (Rd):

The rating scale in the discipline is Rd = $\sum_i$ Ri, where Ri is the rating or weight points for each type of work in the discipline (Table 8.2-8.5). Rd = 40pr + 40lr + 20 μr = 100 points.

Table of correspondence of rating points to assessments on a university scale. Table 8.6

Score	*Score*
100-95	Perfectly
94-85	Very good
84-75	Well
74-65	Satisfactory
64-60	Enough
Less than 60	Disappointing
Admission conditions not met	Not allowed

9. Additional information on the discipline (educational component)

The list of typical examples of questions that are submitted for semester control (the above list is incomplete):

- Translate numbers and perform arithmetic operations in binary between numbers A and B. Values of numbers: A= 21_{10};B=11_2.
- Translate numbers and perform arithmetic operations in binary between numbers A and B. Values of numbers: A= 22_{10};B=10_2.
- Develop a parallel DAC scheme for six bits of binary code. Take the value of the reference voltage $U_{op} = 16\ V$, and the feedback resistance of the operational amplifier $R_{zz} = 50\ k\Omega$.
- Develop a parallel DAC scheme for four bits of binary code. Take the value of the reference voltage $U_{op} = 6\ V$, and the feedback resistance of the operational amplifier $R_{zz} = 20\ k\Omega$.
- Make a diagram of the elements and perform the following sequence of operations on two numbers: (A or B)or(A and (no *B*)). Number values: $A = 110_2$; $B = D_{16}$.
- Make a diagram of the elements and perform the following sequence of operations on two numbers: (A excludes_ or B)or(A and *B*). Number values: $A = 11000_2$; $B = E_{16}$.

Work program of the discipline (syllabus):

Compiled by Ph.D., assoc., Subin A.A.

Approved by the Department of Mechanical Engineering Technology (protocol No 1 dated 31.08.2023)

Approved by the Methodical Commission of NN MMI (protocol No 5 dated 31.08.2023)