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

Department of Machines and Apparatus for Chemical and Oil Refining

Computer-integrated technologies for designing modern equipment

Work program of the discipline (Syllabus)

Details of the discipline	
Level of higher education	**Third (graduate)**
Branch of knowledge	13 - Mechanical engineering
Specialty	133 - Industry engineering
Educational program	"Industrial Engineering"
Status of the educational component	Selective
The scope of discipline	150 hours / 5 ECTS credits
Year of preparation, semester	2nd year, spring semester
Form of study	Eye (day)
Timetable	1 lecture per week, 1 practical session every two weeks
Semester control / control measures	Test
Language of instruction	Ukrainian
Information about course leader / teachers	Ph.D., Associate Professor, Seminsky Alexander Olegovich,forstd@ukr.net , @mahnv_kpi
Course placement	http://ci.kpi.ua

Curriculum of the discipline

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

Construction and ability to use control and measuring systems and control devices is an important aspect of research and production management. This is provided by knowledge of applied programming, the principles of determining the properties of environments and quantities that characterize the modes of operation of equipment, as well as the ability to assess the reliability of certain quantities. The results of the study combine theoretical information with examples of their practical application and can be used in research and engineering activities, as well as be used in everyday life.

The purpose of the discipline is to study the principles of construction of measuring systems to control the parameters of technological processes and measurements, the basics of programming end devices, including signal processing and data analysis of control and measuring instruments, control of control devices and indications.

The discipline forms the following competencies:

- ability to apply the acquired knowledge in practice on the basis of general and special methodology;
- ability to apply standard analytical methods and computer software for scientific research and solving engineering and research problems of industrial engineering;

- ability to initiate, organize and conduct comprehensive theoretical and experimental research in the field of research and innovation, which lead to the acquisition of new knowledge.

The program learning outcomes after studying the discipline include:

- ability to use innovative methods of project activities for the implementation of research;
- mastery principles of planning and conducting experimental research with maximum informativeness in terms of hardware and software;
- skills to use information technologies for development of research projects, carrying out of social examination of processes and objects of research activity.

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

The study of the discipline is based on professional knowledge within the study of the normative part of the educational program. Preliminary mastery of the basics of electrical engineering and programming is desirable. The discipline helps to provide the scientific component of the training program for doctors of philosophy.

3. The content of the discipline

Topic 1. Basic information about measurements.

Topic 2. Fundamentals of microcontroller programming.

Topic 3. Programming of input-output devices.

Topic 4. Sensor programming and construction of measurement systems.

Topic 5. Servo drives and stepper motors.

Topic 6. Working with data.

Topic 7. Work on research topics.

4. Training materials and resources

Basic literature:

1. Zori AA Modern microcontrollers. Theory and practice of using standard Arduino modules: a textbook for students of higher educational institutions / A.A. Zori, VP Тарасюк, O.A. Shtepa. - Pokrovsk: DonNTU, 2017. - 280 p.

2. Kurilov AF Heat measurements and devices: a textbook / AF Курилов, B.H. Kozin. - Sumy: Sumy State University, 2015. - 188 p.

3. Petin V. Projects using the Arduino controller / V. Petin. - Санкт-Петербург: БХВ-Петербург, 2014. - 398 с.

4. Sokolov SV Control and measurement in technological and energy systems / S.V. Sokolov, OS Sokolov, SS Antonenko. - Sumy: Sumy State University, 2020. - 242 p.

5. Antonenko SS Control and measurement of parameters of liquids and gases / S.S. Antonenko, EV Kolisnichenko. - Sumy: SSU Publishing House, 2009. - 199 p.

Additional literature:

1. Wojciecki AP Methods and means of measuring environmental parameters: a guide for students majoring in "Ecology and Environmental Protection" / A.P. Wojcycki, BM Fedishin, BV Борисюк. - Zhytomyr: DAU, 2018. - 362 p.

2. Kurilov AF Heat measurements and devices: a textbook / AF Курилов, B.M. Kozin. - Sumy: Sumy State University, 2015. - 188 p.

3. Lukinyuk MV Technological measurements and devices: a textbook for students of higher educational institutions / M.V. Lukinyuk. - Kyiv: NTUU "KPI", 2007. - 436 p.

4. Stenzel JI Measurement in chemical technology: a textbook / J.I. Stenzel, O.B. Tselishchev, MG Loria. - Luhansk: SNU Publishing House. V. Dalya, 2007. - 480 p.

5. Trishkin V.Ya. Metrological support of measurements of chemical productions: textbook. way. / В.Я. Trishkin, OP Misov. - Dnipropetrovsk: UDKHTU, 2004. - 172 p.

6. Shikalov VS Technological measurements: a textbook / V.S. Шикалов. - Київ: Кондор, 2007. - 168 с.

Educational content

5. Methods of mastering the discipline (educational component)

Calendar-thematic plan

Week	*Content of educational work*	*VTS (96 hours according to the curriculum)*
Topic 1. Basic information about measurements.		
1, And a week	**Lecture 1.**The essence and main characteristics of measurements. Measurement methods. Measurement errors.	Elaboration of the subject of the lesson.
2, Week II	**Lecture 2.**Measuring instruments. Rules for drawing up measurement schemes. Parameters and characteristics of measuring devices. Measurement device errors. **Practical lesson 1.** Working out of drawing up of schemes of measurement.	Elaboration of the subject of classes. Drawing up a measurement scheme for the research topic.
3, And a week	**Lecture 3**. Technological measurements. The use of microcontrollers for the construction of measuring systems	Elaboration of the subject of the lesson.
Topic 2. Fundamentals of microcontroller programming.		
4, Week II	**Lecture 4.**Fundamentals of microcontroller programming. **Practical lesson 2.** Introduction to the Arduino IDE.	Elaboration of the subject of classes. Learning the syntax of the meta-programming language Wiring.
5, And a week	**Lecture 5.**Fundamentals of microcontroller programming (continued).	Elaboration of the subject of the lesson. Study of functions and features of their application.
Topic 3. Programming of input-output devices.		
6, Week II	**Lecture 6.**Working with ports. Serial and SoftwareSerial libraries. **Practical lesson 3.** Development of simple programs for the Arduino microcontroller.	Elaboration of the subject of classes. Practice working with ports.
7, And a week	**Lecture 7.**Principles of operation of liquid crystal displays. LiquidCrystal library functionality.	Elaboration of the subject of the lesson.

Week	*Content of educational work*	*VTS (96 hours according to the curriculum)*
8, Week II	**Lecture 8.**Programming of liquid crystal displays. **Practical lesson 4.** Practice compiling programs for working with liquid crystal displays.	Elaboration of the subject of classes. Practice working with liquid crystal displays.
9, And a week	**Lecture 9.**Programming input tools (keyboard, mouse).	Elaboration of the subject of the lesson. Practice working with the keyboard and mouse.
Topic 4. Sensor programming and construction of measurement systems.		
10, Week II	**Lecture 10.**Working with the 1-Wire protocol. OneWire library functionality. **Practical lesson 5.** Working with the OneWire library.	Elaboration of the subject of the lesson.
11, And a week	**Lecture 11.**Temperature sensors and its measurement using microcontrollers.	Elaboration of the subject of the lesson. Practice of work with temperature sensors.
12, Week II	**Lecture 12.**Humidity sensors and its measurement using microcontrollers. **Practical lesson 6.** Programming of temperature and humidity sensors.	Elaboration of the subject of classes. Practice of work with humidity sensors.
13, And a week	**Lecture 13.**Pressure sensors and its measurement using microcontrollers.	Elaboration of the subject of the lesson. Practice of work with pressure sensors.
14, Week II	**Lecture 14.**Fluid flow sensors. **Practical lesson 7.** Programming of pressure and flow sensors.	Elaboration of the subject of classes. Choice of means for realization of measurements according to the scheme of measurement on research subjects.
15, And a week	**Lecture 15.**Optocouplers and principles of construction of meters based on them. Distance sensors.	Elaboration of the subject of the lesson. Development of programs for selected measuring instruments.
Topic 5. Servo drives and stepper motors.		
16, Week II	**Lecture 16.**Servo drives, stepper motors and their programming. **Practical lesson 8.** Programming of servos and stepper motors.	Elaboration of the subject of classes. Development of programs for selected measuring instruments.
Topic 6. Working with data.		
17, And a week	**Lecture 17.**Working with data drives. Save data to SD card. SD library functionality.	Elaboration of the subject of the lesson. Practice working with SD-card. Preparation of a project on the research topic.

Week	*Content of educational work*	*VTS (96 hours according to the curriculum)*
Topic 7. Work on research topics.		
18, Week II	**Lecture 18.**Presentation of research projects. **Practical lesson 9.** Credit lesson.	Preparation for the test.

6. Independent work of a student / graduate student

Types of independent work are listed in the table in paragraph 5, according to the training weeks and scheduled classes.

Policy and control

7. Course policy (educational component)

System of requirements for students:

- **rules for attending classes**- Attendance of classes of all kinds (lectures, practical classes) - is obligatory both at training in classrooms, and at a distance mode of training. In the latter case, classes are held in the mode of Zoom-conferences and graduate students "visit" them by connecting to the links provided by teachers;

- **rules of conduct in the classroom**- not to interfere with unnecessary activities, conversations (including telephone) to other graduate students to listen to lectures or work in practical classes. Follow safety rules in classrooms and distance learning at home;

- **rules for crediting practical classes and accruing points for their performance** - the teacher evaluates the work of the graduate student during the lesson, the quality and timeliness of the presentation of the results of the task;

- **rules for the protection of individual tasks** - projects on research topics are presented at the last lecture and mandatory discussion of the presented results;

- **rules for assigning incentive and penalty points**- incentive points are not provided; 4 penalty points are awarded for absence from class without good reason, in case of untimely performance of practical tasks or untimely presentation of the project on the research topic;

- **policy of deadlines and rearrangements**:

1) delivery and evaluation of the results of all tasks takes place exclusively during classroom classes;

2) re-grading is carried out according to the schedule established at the university level in the terms determined by the teacher and reported to postgraduate students at the announcement of rating points;

- **academic integrity policy** - Postgraduate students are obliged to comply with the provisions of the Code of Honor and the requirements of academic integrity during the educational process.

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

Current control: evaluation of work in practical classes (performance of tasks in each of the classes is evaluated up to 8 points, the maximum for all practical classes is 64 points), preparation and presentation of the project on the research topic is estimated at a maximum of 36 points.

Calendar control: conducted twice a semester for 7-8 and 14-15 weeks as monitoring of the current state of compliance with the requirements of the syllabus - the student receives "satisfactory" during the

first and second calendar control, if his current rating is not less than 0.5 of the maximum number of points , possible at the time of control.

Semester control: credit.

Conditions of admission to semester control:

- admission to the test is possible only in the case of successful completion of all practical classes and project presentation on the research topic;
- graduate students who received during the semester total rating score <25 before the test is not allowed;
- if at the beginning of the practical lesson 9 the graduate student has a total rating score <60, he can not get a positive result in the test.

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

Scores	*Rating*
100-95	Perfectly
94-85	Very good
84-75	Fine
74-65	Satisfactorily
64-60	Enough
Less than 60	Unsatisfactorily
Admission conditions are not met	Not allowed

9. Additional information on the discipline (educational component)

Rearrangement is carried out according to the "rigid" scheme (with cancellation of previous points) and consists in performance of the control task consisting of one theoretical question (on a lecture material) which is estimated at a maximum of 40 points, and one practical question (applied task) which is estimated maximum of 60 points.

Evaluation of the control task is as follows. For the answer to the question, points are accrued in accordance with the completeness and validity of the answer in proportion to the corresponding maximum number of points. If the answer contains less than 30% of the required information, it is considered unsatisfactory, and it is awarded 0 points. The credit score is defined as the sum of points for answering both questions.

Work program of the discipline (syllabus):

Folded Associate Professor of MAHNV, Ph.D., Associate Professor Seminsky Alexander Olegovich.

Approved at the meeting of the Department of Machines and Apparatus of Chemical and Oil Refining (Protocol № 26 of 19 June 2021)

Agreed metodic commission of the Faculty of Engineering and Chemistry (Protocol № 11 of June 25, 2021)