

Syllabus
educational component

Digital measuring instruments

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|---|---|
| Discipline name: | Digital measuring instruments |
| Level of higher education: | Initial (short cycle) of higher education |
| Course page in Moodle: | https://dl2022.khadi-kh.com/course/view.php?id=1995 |
| The volume of the educational component | 3 credits (90 hours) |
| Form of final control | Passed |
| Consultations: | on schedule |
| Name of the department: | Department of Metrology and Life Safety |
| Language of instruction: | English |
| Course leader: | Dmytro Petrukovyh, Candidate of Technical Sciences, Associate Professor |
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Summary of the educational component:

The goal is to train specialists in the basics of digital measuring instruments in an amount sufficient to study professionally oriented academic disciplines, develop and educate students of creative abilities, methodological skills and skills of independent work to improve the level of professional knowledge.

Subject: theoretical foundations of the construction of digital measuring instruments at the present stage.

The main tasks of studying the discipline are:

- formation of students' system of knowledge, skills and ideas about the current state of digital measuring devices and their use for the needs of mechanical engineering and the road construction industry.
- formation of a system of knowledge of skills in the use of modern measuring equipment and its use for the needs of mechanical engineering and the road construction industry.

Prerequisites for studying the educational component:

Methodology of scientific activity; Fundamentals of metrology and measuring equipment.

Competences that the applicant acquires:

General competencies:

Ability to apply knowledge in practical situations and justify decisions made.
Skills in the use of information and communication technologies.
Ability to search, process and analyze information from various sources.
Knowledge and understanding of the subject area and understanding of professional activity.

Special (professional) competencies:

Ability to apply knowledge of physics, electrical engineering, electronics and microprocessor technology, to the extent necessary to understand processes in automation systems and computer-integrated technologies.

Ability to freely use modern computer and information technologies to solve professional problems, program and use applied and specialized computer-integrated environments to solve automation problems.

Ability to use knowledge about objects of construction and road engineering for their automation on the basis of computer-integrated and information technologies.

Learning outcomes:

Understand the essence of the processes occurring in automation objects in the field of construction and road engineering, and be able to analyze automation objects and justify the choice of structure, algorithms and control schemes based on the results of the study of their properties.

Know the principles of operation of technical means of automation and be able to justify their choice based on the analysis of their properties, purpose and technical characteristics, taking into account the requirements for the automation system and operating conditions; have the skills to establish technical means of automation and control systems.

Be able to use a variety of specialized software to solve typical engineering problems in the field of automation, in particular, mathematical modeling, computer-aided design, computer graphics methods.

Thematic plan

| Topic number | Title of topics (LK, LR, PR, SZ, WED) | Number of hours | |
|--------------|---|-----------------|----------------|
| | | Eye | Correspondence |
| 1 | LUKE. Basic concepts and definitions of digital measuring instruments. Classification of digital measuring instruments. The main operations are analogous to digital transformation. Characteristics and accuracy indicators of ADC. | 2 | 2 |
| | PR Research of functional devices on operational amplifiers. | 2 | 2 |
| | CP Basic structural components and technical characteristics of digital measuring instruments. Basic frequency-time parameters of measuring signals. Basic block diagram of analog-to-digital converters and frequency-time parameter meters of measuring signals | 10 | 10 |
| 2 | LC Basic frequency-time parameters of measuring signals. | 2 | 2 |
| | PR The study of converters code is an analogue. | 2 | 2 |
| | CP Error and uncertainty of digital measurement of frequency-time parameters of measuring signals. ADC and phase angle meters between two periodic signals. | 8 | 8 |
| 3 | LK Analog-to-digital converters and meters of time interval, pulse duration and periodic signal period. | 2 | 2 |
| | PR Study of a CODE-VOLTAGE converter with weight resistors. | 2 | 2 |
| | CP Method of sequential counting. Typical block diagram of the CVIC, implementing this method; its errors, their physical meaning and the formula for normalizing the main error. The | 9 | 9 |

| | | | |
|-----------------|--|----|----|
| | method of proportional conversion of constant voltage to ADC; block diagram of such ADCs and basic errors. | | |
| 4 | LC Analog-to-digital converters and voltage meters. | 4 | 4 |
| | PR Research of a digital-analog converter on resistive matrices R-2R. | 2 | 2 |
| | PR Research of analog-to-digital converter of two-stroke integration. | 2 | 2 |
| | PR Research of ANALOG-TO-DIGITAL converter of unfolding balancing with bitwise approximation. | 2 | 2 |
| | CP Method of two-stroke integration: the essence of the method when measuring constant voltage, its error. Principles of construction of digital volt meters of AC and universal digital voltmeters. | 10 | 10 |
| 5 | LC Analog-to-digital converters and frequency meters of the periodic signal. | 2 | 2 |
| | PR Study of the digital frequency meter of averages. | 2 | 2 |
| | CP Digital time-pulse methods for measuring instantaneous and average values of phase shifts. Block diagrams of the corresponding digital phase meters, describe their errors. Digital phasometer with intermediate conversion of phase shift into constant voltage: block diagram and errors. | 10 | 10 |
| 6 | LK Analog-to-digital converters and phase angle meters between two periodic signals. | 2 | 2 |
| | LC Analog-to-digital converters and meters of the ratio of frequencies (periods) of two signals. | 2 | 2 |
| | PR Research of the digital periodometer. | 2 | 2 |
| | CP Direct methods for measuring the concentrated parameters of electrical circuits. Digital bridges. Digital sinusoidal signal generators. Digital pulse generators | 11 | 11 |
| Together | LUX | 16 | 16 |
| | AVE | 16 | 16 |
| | WED | 58 | 58 |

Individual educational and research task (if any):

Teaching Methods:

- 1) verbal: 1.1 traditional: lectures, explanations, narration, etc.;
- 1.2 interactive (non-traditional): problem lectures, discussions, etc.;
- 2) visual: the method of illustrations, the method of demonstrations
- 3) practical: 3.1 traditional: practical classes;

Grading system and requirements:

Current success

1 The current success of applicants for the performance of educational types of work in training sessions and for the performance of tasks of independent work is assessed using a four-point scale of grades, followed by recalculation into a 100-point scale. During the assessment of current performance, all types of work provided for by the curriculum are taken into account.

1.1 Lectures are evaluated by determining the quality of the specified tasks.

1.2 Practical classes are assessed by the quality of the control or individual task, the performance and design of practical work.

2 Evaluation of the current performance of applicants for higher education is carried out at each practical lesson on a four-point scale ("5", "4", "C", "2") and recorded in the journal of academic performance.

– "excellent": the applicant perfectly mastered the theoretical material, demonstrates deep knowledge of the relevant topic or academic discipline, the main provisions;

- "good": the applicant has mastered the theoretical material well, has the main aspects from primary sources and recommended literature, reasonably teaches it; has practical skills, but assumes certain inaccuracies;

- "satisfactory": the applicant has mainly mastered the theoretical knowledge of an educational topic or discipline, is oriented in primary sources and recommended literature, but unconvincingly answers, confuses concepts, uncertainly answers additional questions, does not have stable knowledge; answering questions of a practical nature, reveals inaccuracy in knowledge;

– "unsatisfactory": the applicant has not mastered the educational material of the topic (discipline), is almost not oriented in the primary sources and recommended literature, there is no scientific thinking, practical skills are not formed.

3 The final score for current activities is recognized as the arithmetic average sum of points for each lesson, for individual work, current tests according to the formula:

$$K^{nomou} = \frac{K1+K2+\dots+Kn}{n},$$

where K^{nomou} is the final assessment of success based on the results of current control;

$K1, K2, \dots, Kn$ – assessment of the success of the n-th measure of current control;

n – the number of measures of current control.

Scores are converted to points according to the recalculation scale (Table 1).

Table 1 – Recalculation of the average score for current activities into a multi-point scale

| 4-point scale | 100- point scale | 4- point scale | 100- point scale | 4- point scale | 100- point scale | 4- point scale | 100- point scale |
|---------------|------------------|----------------|------------------|----------------|------------------|-------------------|------------------|
| 5 | 100 | 4,45 | 89 | 3,90 | 78 | 3,35 | 67 |
| 4,95 | 99 | 4,4 | 88 | 3,85 | 77 | 3,3 | 66 |
| 4,9 | 98 | 4,35 | 87 | 3,80 | 76 | 3,25 | 65 |
| 4,85 | 97 | 4,3 | 86 | 3,75 | 75 | 3,2 | 64 |
| 4,8 | 96 | 4,25 | 85 | 3,7 | 74 | 3,15 | 63 |
| 4,75 | 95 | 4,20 | 84 | 3,65 | 73 | 3,1 | 62 |
| 4,7 | 94 | 4,15 | 83 | 3,60 | 72 | 3,05 | 61 |
| 4,65 | 93 | 4,10 | 82 | 3,55 | 71 | 3 | 60 |
| 4,6 | 92 | 4,05 | 81 | 3,5 | 70 | from 1,78 to 2,99 | from 35 to 59 |
| | | | | | | Reassembly | |
| 4,55 | 91 | 4,00 | 80 | 3,45 | 69 | from 0 to 1,77 | from 0 to 34 |
| 4,5 | 90 | 3,95 | 79 | 3,4 | 68 | Re-study | |

Final assessment

1 The applicant for higher education receives credit at the last lesson in the discipline based on the results of the current assessment. The average score for current activities is converted into points on a 100-point scale, according to the recalculation table (Table 1). Applicants for higher education who have an average current grade in a discipline lower than "3" (60 points) in the last lesson can increase their current score by passing tests in the discipline.

Assessment of knowledge of applicants by testing is carried out on a scale:

- "Excellent": at least 90% of correct answers;
- "Very good": from 82% to 89% of correct answers;
- "Good": from 74% to 81% of correct answers;
- "Satisfactory": from 67% to 73% of correct answers;
- "Satisfactory enough": from 60% to 66% of correct answers;
- "Unsatisfactory": less than 60% of correct answers.

2 The condition for obtaining the test is:

- working out all missed classes;
- the average current score in the discipline is not lower than "3" (60 points).

3 For the performance of individual independent work, applicants are awarded additional points.

3.1 Additional points are added to the sum of points scored by the higher education student for current academic activities (for disciplines for which the test is the final form of control), or to the final grade in the discipline for which the exam is the final form of control

3.2 The number of additional points awarded for different types of individual tasks depends on their volume and significance:

- prizes in the discipline at the international / all-Ukrainian competition of scientific student works – 20 points;
- prizes in the discipline at the All-Ukrainian Olympiads – 20 points;
- participation in the international / all-Ukrainian competition of scientific student works – 15 points
- participation in international / all-Ukrainian scientific conferences of students and young scientists – 12 points;
- participation in all-Ukrainian olympiads in the discipline – 10 points
- participation in olympiads and scientific conferences of KhNADU in the discipline – 5 points;
- implementation of individual research (educational and research) tasks of increased complexity – 5 points.

3.3 The number of additional points may not exceed 20 points.

4 The result of training is evaluated (*choose the right one*):

- on a two-point scale (credited/not credited) according to table 2;
- on a 100-point scale (for differentiated standings) according to Table 3.

The final score, together with additional points, cannot exceed 100 points.

Table 2 – Scale of transfer of points to the national grading system

| On a 100-point scale | On a national scale |
|------------------------------|---------------------|
| from 60 points to 100 points | enrolled |
| less than 60 points | not credited |

Table 3 – Scale of assessment of applicants' knowledge based on the results of the final control in the discipline

| Score in points | National scale score | | ECTS score | |
|-----------------|----------------------|-----------------|-------------|--|
| | | | Score | Criteria |
| | Exam | Passed | | |
| 90-100 | Perfectly | Enrolled | A | The theoretical content of the course is mastered entirely, without gaps, the necessary practical skills of working with the mastered material are formed, all the training tasks provided by the training program have been completed, the quality of their implementation is estimated by the number of points close to the maximum |
| 80-89 | Well | Enrolled | B | The theoretical content of the course is mastered entirely, without gaps, the necessary practical skills in working with the mastered material are mainly formed, all the training tasks provided by the training program have been completed, the quality of most of them is estimated by the number of points close to the maximum |
| 75-79 | | | With | The theoretical content of the course is mastered entirely, without gaps, some practical skills of working with the mastered material are not sufficiently formed, all the training tasks provided by the training program have been completed, the quality of none of them is assessed by the minimum number of points, some types of tasks are performed with errors |
| 67-74 | Satisfactory | | D | The theoretical content of the course is partially mastered, but the gaps are not significant, the necessary practical skills in working with the mastered material are mainly formed, most of the training tasks provided by the training program have been completed, some of the tasks performed may contain errors |
| 60-66 | | | And | The theoretical content of the course is partially mastered, some practical skills of work are not formed, many of the training tasks provided by the training program have not been completed, or the quality of some of them is estimated by the number of points close to the minimum. |

| Score in points | National scale score | | ECTS score | |
|-----------------|----------------------|--------------|------------|---|
| | | | Score | Criteria |
| | Exam | Passed | | |
| 35–59 | Disappointing | Not credited | FX | The theoretical content of the course is partially mastered, the necessary practical skills of work are not formed, most of the provided training programs have not been completed, or the quality of their implementation is estimated by the number of points close to the minimum; with additional independent work on the course material, it is possible to improve the quality of the training tasks (with the possibility of re-compilation) |
| 0–34 | | | F | The theoretical content of the course has not been mastered, the necessary practical skills of work are not formed, all completed training tasks contain gross errors, additional independent work on the course material will not lead to any significant improvement in the quality of the training tasks (with a mandatory repeated course) |
| | Unacceptable | | | |

Course Policy:

- the course involves working in the classroom;
- mastering the discipline involves the obligatory attendance of lectures and practical classes, as well as independent work;
- independent work involves the study of individual topics of the discipline, which are made in accordance with the program for independent study, or were considered briefly;
- all tasks envisaged by the program must be completed within the prescribed period;
- if the applicant for higher education is absent from the classroom for a good reason, he presents the completed tasks during the independent preparation and consultation of the teacher;
- while studying the course, applicants for higher education must comply with the rules of academic integrity set forth in the following documents: "Rules of academic integrity of participants in the educational process of KhNADU" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_dobroch_1.pdf), "Academic integrity. Verification of the text of academic, scientific and qualification works for plagiarism" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_85_1_01.pdf), "Moral and ethical code of participants in the educational process of KhNADU" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_MEK_1.pdf).
- in case of detection of the fact of plagiarism, the applicant receives 0 points for the task and must re-complete the tasks provided for in the syllabus;
- write-offs during tests and exams are prohibited (including using mobile devices). Mobile devices are only allowed to be used during online testing.

Recommended literature: *(literature no later than 10 years, except for 1 fundamental classical textbook or monograph)*

1. Chinkov V.M. Fundamentals of metrology and measuring equipment. Kharkiv: Ministry of Defense of Ukraine, CVU. 2001.
2. Glavchev M.I., Klimenko A.M., Drawn's O.M., Filonenko A.M. Digital devices and microprocessors. Organization and programming: textbook. manual/. MOU, CUE, H. 2001. 327 p.
3. Dorozhovets M.M., Mokrytskyi V.O. Analogo – digital converters: textbook. manual. Lviv: Lviv Polytechnic Publishing House, 2013. 1187 p.
4. Dorozhovets M. M. Fundamentals of metrology and measuring technology: Textbook in 2 vols. / Ed. B.I. Stadnik. – Lviv: Lviv Polytechnic, 2005. vol. 1,530 pp., v. 2,656 p.
5. Polishchuk E.S. Means and methods of measurement of non-electric quantities: Textbook. Lviv: Beskyd Bid. 2008. 618 pp.
6. Polishchuk E.S. Metrology and measuring equipment. Lviv: Beskyd Bid, 2003. 544 p.

Additional Sources:

1. Distance course:


<https://dl2022.khadi-kh.com/course/view.php?id=1995>

Developer (developers)
syllabus of the discipline _____


signature

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