

**SYLLABUS OF THE ACADEMIC DISCIPLINE**  
**"METROLOGY FUNDAMENTALS AND ELECTRICAL MEASUREMENTS"**



**Academic degree:** bachelor

**Educational program:** 141 "Electric Power, Electrical Engineering and Electromechanics"

**Training studies:** 3 semester, 5 quarter:

Lectures – 4 academics hour;

Laboratory Work – 2 academics hour.;

Practical Training: 0 academics hour.

**Number of hours (credits):** 120 (4)

**Languages of instruction:** English

**Course page on the distance learning site of NTU "DP":**

<https://do.nmu.org.ua/course/view.php?id=2870>

**University instructor:**



**Khilov Victor Sergeevich:**

Professor, Professor, Doctor of Technical Sciences

**Personal page**

<https://vde.nmu.org.ua/ua/kafedra/khilov.php>

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## **1. Abstract**

The discipline "Fundamentals of Metrology and Electrical Measurements" provides students with the basics of knowledge needed to solve production problems related to the choice of means and methods of measuring electrical, magnetic and non-electrical quantities, as well as to study other disciplines. The subject of study in the discipline are the principles of electromechanical, digital and electronic measuring instruments, their application in electrical measurements and processing of measurement results.

## **2. The purpose and objectives of the discipline**

**The purpose** – is to form the competence of future professionals in the field of professional discipline "Fundamentals of Metrology and Electrical Measurements".

### **The discipline objectives:**

- to teach students to know the principle of operation, properties, characteristics of common means of measuring electrical quantities;
- be able to choose the means and methods of measurement, perform measurements and estimate their errors;
- give students the basics of knowledge needed to solve production problems, related to the choice of means and methods of measuring electrical, magnetic and non-electrical quantities, as well as to study other disciplines of the specialty, which use electrical measuring instruments.

## **3. Learning outcomes**

1. Acquaintance with the basics of metrology, in particular the legal framework.
2. Acquaintance with means of measuring equipment, types of errors.
3. Study of the features of digital and analog measuring instruments.
4. Gaining experience in working with measuring equipment and studying the features of their work.
5. Mastering the skills of processing measurement results in direct and indirect measurement methods, small and large number of observations.
6. Determination and calculation of measurement errors.
7. Ability to apply knowledge of metrology and standards in the field of measuring systems in the development and integration of information technology, systems, products and services.

#### 4. Discipline structure

<b>LECTURES</b>
1. Science metrology. Tasks of measurements
1.1. International system of physical quantities units SI
1.2. Types of measurements
1.3. Methods of direct measurements realization
1.4. Measuring instruments
2. Measurement and measuring instruments errors
2.1. The main types of measurement errors
2.2. Taking into account the random error in the measurement results
2.3. Determination of errors in indirect measurements
2.4. Accuracy classes of measuring instruments
3. Scale measuring converters
3.1. Shunts
3.2. Additional resistors
3.4. Voltage dividers
3.5. Measuring current and voltage transformers
4. Construction principles of electromechanical measuring devices
4.1. Magnetoelectric system devices
4.2. Electromagnetic system devices
4.3. Electrodynamic and ferrodynamic system devices
4.4. Induction system devices
4.5. Electrostatic system devices

4.6. Electronic and digital measuring devices
5. Power and energy measurement
5.1. Measurement of power at DC and active power at a single-phase AC circuits
5.2. Measurement of active power at three-phase circuits
5.3. Measurement of reactive power at three-phase circuits
5.4. Energy measurement in a three-phase circuit
6. Measurement of non-electric quantities
6.1. Resistive measuring transducers
6.2. Electromagnetic measuring transducers
6.3. Induction measuring transducers
6.4. Electrostatic measuring transducers
6.5. Thermal measuring transducers
<b>Laboratory works</b>
EB 1. Ammeter accuracy class calibration
EB 2. Voltmeter accuracy class calibration
EB 3. Evaluation of the accuracy of direct, indirect and multiple measurement results
EB 4. Measurement of active power in three-phase circuits.
EB 5. Measurement of reactive power in three-phase circuits.
EB 6. Research of errors of measuring voltage transformer.
EB 7. Research of errors of measuring current transformer.

## 5. Hardware and / or software

Gadgets with cellular internet are a must in lectures.

University mail account activated (student.i.p.@nmu.one) at Office365.

## 6. Evaluation system and requirements

**6.1. The academic achievements of applicants based on the results of the course will be assessed on the scale below:**

The sum of points for the academic achievements of the applicant	Score on a national scale
90 – 100	perfectly
75-89	fine
60-74	satisfactorily
0-59	unsatisfactorily

**6.2.** Degree-seeking students can receive a **final grade** in the discipline on the basis of current assessment of knowledge, provided that the number of points scored in the current testing and independent work will be at least 60 points.

Maximum rating:

The theoretical part	The practical part		Bonus	<b>Total</b>
	With timely delivery of work	In case of late delivery of works		
66	30	20	4	<b>100</b>

Final control takes the form of written work.

The ticket contains 6 questions, of which 5 - tests, 1 task.

Practical works are accepted on control questions to each of work.

### **6.3. Criteria for evaluating the final work:**

5 test tasks with four answer options, 1 correct answer is evaluated in 3 points. The test is conducted using MicrosoftFormsOffice 365 technology.

Correctly solved problem is estimated at 5 points, and:

- **5 points** - compliance with the standard, with units of measurement;
- **4 points** - compliance with the standard, without units of measurement or errors in calculations.
- **3 points** - minor errors in formulas, without units of measurement.
- **2 points** - there are significant errors in the decision

- **1 point** - the given formulas do not completely correspond to the standard.
- **0 points** - no solution is given.

#### **6.4. Criteria for evaluating practical work:**

From each practical work the applicant receives 5 questions from the list of control questions. The number of correct answers determines the number of points obtained.

### **7. Course policy**

**7.1. Academic Integrity Policy.** Academic integrity of degree-seeking students is an important condition for mastering the results of training in the discipline and obtaining a satisfactory grade from the current and final controls. Academic integrity is based on condemnation of the practices of copying (writing with external sources other than those allowed for use), plagiarism (reproduction of published texts by other authors without attribution), fabrication (fabrication of data or facts used in the educational process). The policy on academic integrity is regulated by the Regulation "Regulations on the system of prevention and detection of plagiarism at the National Technical University" Dnieper Polytechnic "[http://www.nmu.org.ua/ua/content/activity/us\\_documents/System\\_of\\_prevention\\_and\\_detection\\_of\\_plagiarism.pdf](http://www.nmu.org.ua/ua/content/activity/us_documents/System_of_prevention_and_detection_of_plagiarism.pdf)."

In case of violation by degree-seeking student the academic integrity (copying, plagiarism, fabrication), the work is evaluated unsatisfactorily and must be repeated. The teacher reserves the right to change the topic of the task.

#### **7.2. Communication policy.**

Degree-seeking students must have activated university mail.

All written questions to teachers regarding the course should be sent to the university e-mail.

#### **7.3. Reassembly policy.**

Works that are submitted in violation of deadlines without good reason are evaluated at a lower grade. Relocation takes place with the permission of the dean's office if there are good reasons (for example, sick leave).

**7.4 Evaluation protest policy.** If the degree-seeking student does not agree with the assessment of his knowledge, he may protest the assessment given by the teacher in the prescribed manner.

#### **7.5. Attending classes.**

Attendance is mandatory for full-time students. Good reasons for not attending classes are illness, participation in university events, student mobility, which must be documented. The student must inform the teacher either in person

or through the headmaster about the absence from class and the reasons for absence.

For objective reasons (for example, international mobility) training can take place online in consultation with the course leader.

**7.6. Bonuses.** At the end of the course and before the start of the session, the degree-seeking student will be asked to fill in anonymously electronic questionnaires (MicrosoftFormsOffice 365), which will be sent to your university mailboxes. Completing the questionnaires is an important component of your learning activity, which will allow you to evaluate the effectiveness of the teaching methods used and take into account your suggestions for improving the content of the discipline "Theoretical Fundamentals of Electrical Engineering". The student receives 4 points for participating in the survey.

## 8 Recommended sources of information

1. Поліщук Є. С. Метрологія та вимірювальна техніка [Текст]: підручник . С. Поліщук; Львів: Новий світ, 2003. – 460 с.
2. Шкрабець Ф.П., Циценков Д.В., Куваєв Ю.В. та ін. Електротехніка, основи електроніки та мікропроцесорної техніки: Навчальний посібник – Дніп-ропетровськ, Національний гірничий університет, 2004. – 515 с.
3. Дорожовець М. та ін. Основи метрології та вимірювальної техніки: Підручник: У 2 т. / М. Дорожовець В. Мотало, Б. Стадник, В.Василюк, Р. Борек, А.ковальчик; За ред. Б. Стадника. – Львів: Видавництво Національного університету "Львівська політехніка", 2005. – Т.2. Вимірювальна техніка. – 656 с.
4. Котур В. І. Електричні виміри і електровимірювальні прилади [Текст]: підручник В. І. Котур, М. Н. Скомська, Н. Н. Храмова; К. : Енергоіздат, 1996. – 324 с.
5. Методичні рекомендації до виконання лабораторних робіт з дисципліни: “Основи метрології та електричні вимірювання” для студентів спеціальностей 141 – Електроенергетика, електротехніка та електромеханіка. /В.С. Хілов, С.І. Федоров; Нац. техн. ун-т. «Дніпровська політехніка» – Д.: НТУ "ДП", 2021. – 38 с.