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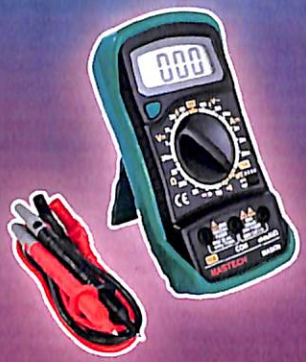
METROLOGY AND STANDARDIZATION

Part III



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МІНІСТЕРСТВО ОБОРОНИ УКРАЇНИ
ХАРКІВСЬКИЙ НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ
ПОВІТРЯНИХ СИЛ імені ІВАНА КОЖЕДУБА

METROLOGY AND STANDARDIZATION

Part III

Навчальний посібник

Харків
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Затверджено до видання вченою радою Харківського національного університету Повітряних Сил імені Івана Кожедуба (протокол № 17 від 29.09.2020)

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Of theoretical positions which are needed at the study of disciplines of «Basis of metrology and electric measurings», «Bases of metrology and standardization».

У навчальному посібнику викладені основи теоретичних положень, що необхідні при вивченні дисциплін "Основи метрології та електричних вимірювань", « Основи метрології та стандартизації.

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FREFACE

The development, manufacture and operation of radio-electronic and electronic computing tools are inevitably associated with the performance of a large number of measurements. In this case, the resulting measurement information is used both for the actual measurement, and for generating appropriate control signals, logical conclusions and judgments in such procedures as management, control, diagnostics, identification, and so on. It is obvious that the choice of methods and means of measurement in each particular case should ensure that the required indicators of the quality of the final result are obtained. Thus, the specialist is faced with the task of choosing the correct method and means of measurement, proper organization of the measurement experiment, processing and presentation of measurement results in accordance with the principles of Metrology and current regulatory documents in this area. Increasing production efficiency and improving the quality of developments is also associated with the widespread use of various forms and methods of standardization.

This implies the need for appropriate metrological training of specialists in the field of design and technology of radio-electronic and electronic computing tools, so that they can solve a variety of measurement tasks and ensure compliance with the requirements of the system of standards of the State measurement system in everyday practice. The acquired knowledge will allow the specialist to professionally solve the issues of metrological preparation of production, metrological examination of design and technological documentation.

The textbook is intended for training certified specialists in the direction 6.051001 " Metrology and information and measurement technologies in accordance with the requirements of State educational standards of higher professional education. This tutorial can be useful for students of other technical specialties and areas of training, as well as engineering and technical workers and graduate students.

The authors consider it a pleasant duty to Express their deep gratitude to the reviewers: professor S. I. Kondrashov, as well as to the staff of the Department of "Metrology and standardization" for the valuable comments made during the review of the textbook.

INRODUCTION

In the process of human cognitive activity, there are many tasks that require quantitative information about a particular property of objects in the material world (phenomena, processes, substances, products). The main way to obtain this information is to measure, when properly organized and performed, the measurement result is obtained with greater or less accuracy reflecting the properties of the object of knowledge of interest. Information about the properties and qualities of objects obtained by measurements is called measurement information.

Students of physical and engineering specialties of higher educational institutions, starting from the first semester, work in laboratories, performing laboratory work on the profile of General technical and special departments, while most laboratory work is based on measurements. The results of any measurements, no matter how carefully and at what high level they are performed, inevitably contain some errors. Absolutely accurate measurements cannot be made in principle. That is why the successful work of students in laboratories, along with the study of measurement methods and tools and the acquisition of measurement skills, also involves their familiarity with modern methods of mathematical processing of measurement results, analysis and estimation of errors.

Preparing for future independent work on the profile of the chosen specialty, students should keep in mind that today measurements permeate all areas of engineering work. The activities of a research engineer and a process engineer are related to measurements.the design engineer must have a clear understanding of the capabilities of measuring equipment in order to ensure the interchangeability of parts and components, and the controllability of the product being developed at all stages of its life cycle. Measurement information is the basis for making technical and managerial decisions when testing products, evaluating their technical level, certification and quality certification. Therefore, knowledge of modern rules, norms and requirements in the field of measurement is also mandatory for specialists who perform the functions of management and organization of production.

The result of any measurement is noteworthy only if it is accompanied by an assessment of the measurement error, or supplemented

information that allows the user of measurement informationto evaluate the accuracy of measurement independently. On the other hand, it is important not only to be able to perform the measurement and estimate the error of the result,

but also to plan and implement the measurement procedure in such a way as to ensure the required accuracy or minimize errors.

Speaking of measurement accuracy, it should be noted that the level of accuracy to which one should strive should be determined by criteria of technical and economic feasibility. It is known that increasing the accuracy of measurement twice increases the cost of the measurement itself several times. At the same time, a decrease in the measurement accuracy in production below a certain norm leads to product defects. When assigning measurement accuracy, it is also important to consider their significance. In some cases, the lack of accuracy of the received measurement information is of small or local significance, in others it plays an extremely important role: the accuracy of the measurement may depend on a scientific discovery or the life and health of people.

With the development of science, technology and development of new measurement technologies cover more and more physical quantities, greatly expanding the measurement range in the direction of measuring ultra small values and very large values of physical quantities. The requirements for measurement accuracy are constantly increasing; it is necessary to measure the parameters and characteristics of processes in the frequency range from infra-low to ultra-high frequencies with high accuracy; at the same time, the geometric dimensions of measurement objects differ many times from each other (microelectronics products and large-scale engineering products).

In these conditions, in order to successfully cope with numerous and diverse measurement problems, it is necessary to master some General principles of their solution, we need a unified scientific and legislative Foundation that ensures high quality measurements in practice, regardless of where and for what purpose they are made. Such a Foundation is Metrology - the science of measurements, methods and means of ensuring their unity and ways to achieve the required accuracy.

Currently, Metrology (from the Greek words "Metron" — measure, "logos" — teaching) is developing in several directions.if at the beginning of the XX century, the word Metrology was understood as a science, the main task of which was to describe all kinds of measures applied in different countries, regions, cities, now this concept has acquired a much broader scientific and practical meaning, expanded the content of metrological activities. Two interrelated branches of Metrology have been formed and are developing: scientific and legal Metrology Scientific Metrology, being the base of measurement technology, studies the problems of measurement in General and the elements forming measurement: measuring instruments, physical quantities

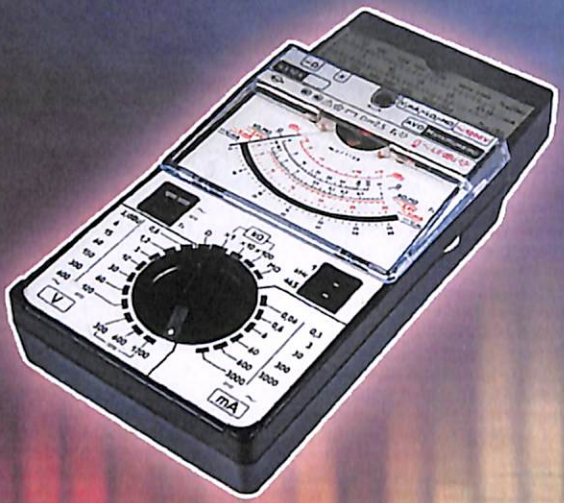
and their units, measurement methods and techniques, measurement results and errors, etc.

Millions of measurements are made every day in the country. It is obvious that measurements made using various methods of operation, application and accuracy of measurement tools can be useful only when they can be trusted, when the measurement results obtained by different experimenters at different times and in different places, if necessary, can be compared, compared with each other. In other words, it is necessary to ensure the unity of measurements at the scale from a small enterprise to the state as a whole.for this purpose, Metrology is endowed with legislative functions. The legal Metrology develops and implements standards and rules for performing measurements, establishes requirements aimed at achieving the unity of measurements, the procedure for developing and testing measuring instruments, establishes terms and definitions in the field of Metrology, units of physical quantities and rules for their application. All these norms, rules and requirements are established by the state standards of the State system for ensuring the uniformity of measurements (GSI standards) and other mandatory normative and technical documents.

The scope of modern Metrology also includes determining the most accurate values of the most important physical constants (speed of light, acceleration of gravity, etc.), which are necessary for many branches of science and technology. Metrology provides consumers with standard samples of substances and materials, the composition and physical and chemical characteristics of which are determined with the necessary accuracy. Metrology methods are widely used in related fields of knowledge, such as product quality assessment and control, certification of industrial products, certification of programs and algorithms for data processing, etc.

When a specialist enters the production process, being directly or indirectly connected with measurements, he faces an abundance of measurement tasks, normative documents of General technical and metrological content, the execution of which is mandatory (standards, guidelines, instructions). To facilitate the study of methods and means of measurement and the implementation of the requirements of these documents should study the discipline "Fundamentals of Metrology and measurement technology".

However, knowledge of metrological rules and regulationsdoes not give.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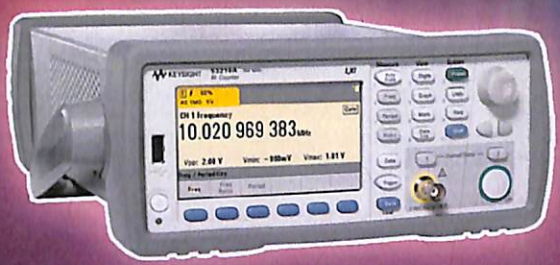
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