OPINION
by Nadezhda Miteva Kafadarova PhD, Professor at the University of Plovdiv "Paisii Hilendarski"

of a dissertation for awarding the educational and scientific degree **"Doctor"**
in: field of higher education 5. Technical Sciences,
professional field 5.2. Electrical Engineering, Electronics and Automation,
PhD program "Electronization (by branches and groups of scientific specialties)"

Author: *Angel Hristov Chekichev*

Topic: *"Remote Laboratory of Electronic Measuring Technology"*

Supervisor: *Prof. Dr. Rumen Kostadinov Popov*

1. General presentation of the procedure and the doctoral student

By Order No. PD-22-1398 of 16-07-2026 of the Rector of the University of Plovdiv "Paisii Hilendarski" (Plovdiv), I am appointed as a member of the scientific jury to provide a procedure for defending a dissertation on the topic ***"REMOTE LABORATORY OF ELECTRONIC MEASURING EQUIPMENT"*** for the acquisition of the educational and scientific degree "Doctor" in: field of higher education 5 Technical Sciences, professional field 5.2 Electrical Engineering, Electronics and Automation, PhD program "Electronization (by branches and groups of scientific specialties)".

The author of the dissertation is *Angel Hristov Chekichev*, PhD student at the Department of Electric Power Engineering and Communications, supervised by Prof. Dr. Eng. Rumen Kostadinov Popov from the University of Plovdiv "Paisii Hilendarski".

The set of materials presented by *Eng. Angel Hristov Chekichev* is in accordance with Art. 36. (1) of the Regulations for the Development of the Academic Staff of the University of Plovdiv, includes the following documents:

- an application to the Rector of the University of Plovdiv for the opening of a procedure for defending a dissertation;
- CV in European format;
- Minutes of the Departmental Council related to the reporting of the readiness to open a procedure and to the preliminary discussion of the dissertation;
- dissertation;
- Abstract;
- list of scientific publications on the topic of the dissertation;
- copies of scientific publications;
- a list of registered citations;
- a declaration of originality and authenticity of the attached documents;
- a reference for compliance with the specific requirements of the respective faculty;

The PhD student has attached five publications.

2. Topicality

The topic of the dissertation is relevant, and its importance is determined primarily by the growing need for modern forms of practical training in engineering specialties. The development of distance and virtual learning places new requirements on the way laboratory exercises are organized and conducted. This is especially important for disciplines such as "Electronic Measuring Equipment", where the acquisition of practical knowledge and skills requires working with both electronic circuits and measuring equipment.

In the development, an approach has been found to combine a real experiment with computer modeling and virtual measurements. In this way, conditions are created for conducting laboratory research outside the traditionally equipped laboratory environment. Such an approach is in line with the processes of digitalization of training and with the need to update and use the available laboratory infrastructure more efficiently.

The relevance of the dissertation research is also confirmed by the wide range of tasks set. They include the study of existing virtual laboratories, the development of a methodology for building a laboratory system, the creation and implementation of hardware modules, the development of simulation models and virtual measuring instruments, as well as their unification in the LabVIEW environment. The experimental verification complements the development and allows for an assessment of the operability of the proposed solution.

In this sense, the dissertation examines a problem that is directly related to the modernization of practical training and to the expansion of opportunities for remote laboratory exercises.

3. Knowledge of the problem

From the literature analysis made in the dissertation, it is clear that the PhD student is familiar with both the main achievements in the field under consideration and the current trends in the development of virtual and distance laboratories. Publications and developments related to distance learning, virtual laboratory environments, measurement systems and the application of modern software products and technologies are considered. A bibliography from 126 sources, including 26 Internet resources, was used for the development of the dissertation. It is noteworthy that a significant part of the publications used are relatively new and have been published in the last decade, which provides an up-to-date information basis for the research. The literature material is not presented only as an overview, but is used as a basis for analysis and evaluation of existing solutions, their advantages and limitations. As a result of this analysis, the need to develop an integrated laboratory environment in which the capabilities of computer simulations, virtual measuring instruments and real experimental objects can be combined is substantiated.

4. Research methodology

The methodological approach adopted in the dissertation corresponds to the set goal and allows the consistent implementation of the formulated tasks. The research was carried out through a combination of theoretical consideration of the problem, computer modeling and simulations, development and research of real electronic circuits, as well as the use of virtual measuring instruments implemented in the LabVIEW environment.

A significant advantage of this approach is the ability to compare and analyze the results obtained by different methods. In this way, the correspondence between the theoretical statements, simulation models and the results of the real measurements is checked. The experiments carried out show that the developed models adequately describe the behavior of the studied schemes and confirm the applicability of the chosen methodology.

Based on the above, it can be concluded that the methodological approach used is well justified and provides the necessary theoretical and experimental basis for solving the tasks set and for achieving the main goal of the dissertation research.

5. Characteristics and evaluation of the dissertation and contributions

The dissertation is clearly structured and has been developed in accordance with the established methodological requirements for this type of research. It has a total volume of 232 pages and contains 142 figures and 6 tables. The material is organized into an introduction, five chapters, general conclusions, formulated scientific, applied and applied contributions, a list of used designations and abbreviations, a list of the author's publications, as well as seven appendices.

In the first part of the dissertation, attention is focused on the place of virtual and distance laboratories in modern engineering education. On the basis of the analysis, the need to build an appropriate laboratory environment for training in "Electronic Measuring Equipment" at the Faculty of Physics and Technology of the University of Plovdiv "Paisii Hilendarski" is argued. The possibilities of these forms of training for expanding access to laboratory equipment and for combining theoretical training with practical work, modeling and research of measuring processes are considered.

The methodological part of the development is developed in the second chapter. It provides the necessary theoretical basis for the subsequent design and study of electronic circuits. Basic issues related to active filters, their synthesis and their characteristics are considered, affecting the

approximations of Butterworth and Chebyshev, filters of different order, low-frequency and tape structures, as well as separate units of the second order. Consideration of the top detector as a functional element of the measuring system is also included.

The actual development of the laboratory system is presented in Chapter Three. Here, the theoretical statements from the previous part are implemented through specific hardware circuits and their simulation models. Various filter structures and a peak detector have been developed, and in parallel a virtual measuring environment has been created in LabVIEW. The latter combines functions for signal generation and measurement, oscilloscopic observation and spectral analysis. This allows the developed system to perform not only the role of a virtual learning tool, but also to be used to conduct practical research.

Chapter Four is experimental in nature and presents the verification of the developed solutions. The characteristics obtained in the real measurements are compared with both theoretical dependencies and the results of the simulations. The established correspondence between the three groups of results is an indicator of the adequacy of the models used and the proper functioning of the implemented schemes. Through FFT analysis, the behavior of filters in signals with harmonic ingredients is additionally studied, which expands the assessment of their practical applicability.

In the final part of the dissertation, the results of the work carried out are systematized and the main conclusions and contributions are drawn. The overall sequence of the development – from the study of the existing laboratory solutions, through the construction of a methodological and technical basis, to the experimental proof of performance – shows the complete nature of the study. As a result, a concept for a virtual and remote laboratory in "Electronic Measuring Equipment" has been created and practically implemented.

The formulated ten contributions are systematized in two groups – applied scientific and applied.

I accept the scientific, applied and applied contributions formulated by the PhD student and believe that they reflect the main results achieved in the dissertation. At the same time, I have a remark about their structuring and the degree of generalization.

In my opinion, some of the formulated scientific and applied contributions are essentially directly related to and are contained in the respective applied contributions. For example, the development of a methodology and an architectural model are an integral part of the implementation of the remote laboratory platform, and the developed approach to the management and processing of measurements is integrated into the implemented virtual measuring complex.

Therefore, I believe that contributions can be optimised and merged, avoiding their partial overlap and highlighting more clearly the essential scientific and applied results of the dissertation. Such a restructuring would make the wording shorter, more specific and precise, and would highlight the original results and their practical application more clearly.

6. Assessment of the publications and personal contribution of the PhD student

A list of five scientific publications is presented to the dissertation, which reflect the main results of the research. In three of them, the PhD student participates in a team of three authors and is listed in the first place, and the other two publications are of his own authorship. This distribution of authorship is indicative of the leading role of the PhD student in the development of research topics.

The comparison between the content of the dissertation and the presented publications gives grounds to assume that the doctoral student has a direct and significant participation in the research work performed. Particularly indicative in this regard is the fact that he is the first author of the three publications presented at the international scientific forums ICERI in 2021 and 2022, while the two publications from 2024 are entirely independent.

These circumstances, together with the analysis of the results presented in the dissertation, allow us to assess the personal contribution of the PhD student as essential. It covers both the study and analysis of existing solutions and the development of the methodological approach, as well as the implementation of the laboratory system, the conduct of experiments and the processing and interpretation of the results obtained.

In addition to my dissertation, I have noticed several gaps in the layout. For example, figures 4.17, 4.18, 4.19 and 4.20 do not carry essential information that would bring additional clarity to the

thesis defended. There are no indications of the axes of some of the figures, such as those presented on page 161, and on others there are no units of measurement of the magnitudes along the axes of the graphs (for example, figs. 4.21, 4.22, 4.24, 4.26, etc.).

The remarks made are of a building nature and do not reduce the scientific value of the dissertation.

7. Abstract

The abstract to the dissertation has a volume of 32 pages and is prepared in Bulgarian and English. It selects and presents the main results and achievements of the research, reflecting the essence of the development and the results obtained in the dissertation.

8. Recommendations for the future use of dissertation contributions and results

The dissertation is a completed research with a clearly expressed scientific and applied orientation, and the set goal and the resulting tasks have been realized. The developed laboratory environment has the potential for practical use in the training in "Electronic Measuring Equipment". As a perspective for the further development of the development, some directions for its expansion can be indicated.

It would be appropriate to gradually complement the existing laboratory system with new modules and experimental tasks covering a wider range of electronic circuits and measurement methods. This would allow its use in more academic disciplines and increase its practical value. An additional possibility is the expansion of the virtual measurement toolkit and the provision of more functions to control and interact with the actual measuring equipment remotely.

CONCLUSION

The dissertation ***contains scientific, applied and applied results that represent an original contribution to science*** and meet **all the** requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (RASRA), the Regulations for the Implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria and the relevant Regulations of the University of Plovdiv "Paisii Hilendarski".

The dissertation shows that the doctoral student *Angel Hristov Chekichev*

has in-depth theoretical knowledge and professional skills in the scientific specialty Electronization (by branches and groups of scientific specialties), **demonstrating** qualities and skills for independent scientific research.

In view of the above, I confidently give my ***positive assessment*** of the conducted research, presented by the above-reviewed dissertation, abstract, achieved results and contributions, and propose ***to the honorable scientific jury to award the educational and scientific degree of "Doctor"*** to *Angel Hristov Chekichev* in the field of higher education 5. Technical Sciences, professional field 5.2 Electrical Engineering, Electronics and Automation, PhD program Electronization (by branches and groups of scientific specialties).

16.09.2026

Drafted the opinion: .....
(signature)
Prof. Nadezhda Kafadarova PhD
(*Ac. dl., n. st., name, surname*)