Annotations of the scientific works

of Senior Assistant Professor, PhD, MEng Ddniela Antonova Shehova
Department of Electric power Engineering and Communication

- **PhD dissertation**

Shehova, D. (2016). Investigation and development of electronic methods and tools for teaching analog and mixed signal circuits**,** Author's abstract of the dissertation for the award of educational and scientific degree "doctor" in 5. Engineering sciences, professional field**,** 5.2. Electrical engineering, electronics and automation, Sofia, 2016.

The research that is the subject of the dissertation investigates the supply of hardware and software solutions in the creation of electronic teaching methods and tools for the training in the area of contemporary analog and mixed signal circuits and their applications. In order for the aim to be reached the following tasks were planned: 1) Creation and investigation of electronic teaching methods and tools for studying the parameters of operational amplifiers using analysis environments. 2) Creation of a methodology for studying linear operational circuits through project-based learning. 3) Creation of a methodology and development and investigation of teaching aids in the study of sine wave oscillations generators and pulse generators using integrated environments for design and analysis. 4) Creation of a methodology and development and investigation of teaching methods and tools for the study of mixed signal circuits applying open source platforms.

Test circuits for determining the parameters and the characteristics of analog and mixed signal circuits through simulation analysis in the Multislim, TINA-TI and Matlab environments have been developed and investigated. Laboratory modules applying open source platforms for physical experiments with analog-digital, digital-analog converters and circuits produced with them have also been developed and investigated. The dissertation suggests detailed methodologies and approaches for performing simulation and physical investigation of analog and mixed signal circuits that have been approbated in the teaching process.

The proposed electronic teaching methods and tools in the study of analog and mixed signal circuits design have formed an educational environment in which the students learn, design, test and analysis analog and mixed devices in order to acquire engineering skills for their real life careers.

- **Book based on the PhD dissertation**

Shehova, D. (2021) Investigation and development of electronic methods and tools for teaching analog and mixed signal circuits, Union of Scientists in Bulgaria, 2021, 248p., **ISBN 978-954-397-049-0.**

This book is intended for students of the educational and qualification degrees "Bachelor" and "Master" in the specialties "Computer and Communication Systems" and "Hardware and Software Systems" in higher technical schools. It could also be useful for PhD students in the Professional field 5.3. Communication and computer equipment.

The book is written on the basis of the author's dissertation for PhD graduation.

- **Annotation of articles**

➢ **Articles that are referenced and indexed in databases of scientific information.**

Г7.1. Yakimov, P. I., Asparuhova, K. K., Grigorova, T.G., **Shehova**, **D.A.** (2020). Industry 4.0 and the Challenges Faced by STEM Education, 2020 XXIX International Scientific Conference Electronics (ET), 16-18 Sept., 2020, Sozopol, Bulgaria, INSPEC Accession Number: 20166144, DOI:10.1109/ET50336.2020.9238223.
https://ieeexplore.ieee.org/document/9238223 (Scopus)

The paper surveys the main factors supporting the implementation of the paradigm Industry 4.0. Their basic characteristics which represent challenges in front of the STEM education are considered. Some tasks faced by the industrial automation engineers are taken into account. A possible correspondence between the required skills and the taught subjects is presented.

Г7.2. Chekichev, A.H., **Shehova**, **D.A.,** Lyubomirov, S.Y., Asenov, S.M., Asparuhova, K.K. (2020). Researching and Modeling of Discrete Linear Time-Invariant Systems with Difference Equations in Matlab, 2020 XXIX International Scientific Conference, Electronics (ET), 16-18 Sept., 2020, Sozopol, Bulgaria, INSPEC Accession Number:20166130, DOI:10.1109/ET50336.2020.9238252.
https://ieeexplore.ieee.org/document/9238252 (Scopus)

The paper examines the opportunities for developing the skills and competencies of engineering students to understand the fundamental concepts embedded in digital signal processing. The Matlab-Simulink development software environment was used for research and teaching of Discrete Linear Time-Invariant (LTI) Systems through Difference Equations (DE), for which purpose a general engineering algorithm and a simulation model have been created, implementing the recursive Discrete LTI systems. The results of the conducted analytical and simulation researches are presented.

Г7.3. **Shehova, D.,** Asparuhova, K., Lyubomirov, S. (2021). Study of Electronic Circuits with Operational Amplifiers Using Interactive Environments for Design and Analysis, 12th National Conference with International Participation "Electronica 2021", May 27 - 28, 2021, Sofia, Bulgaria, 978-0-7381-1372-2/21/$31.00 ©2021 IEEE .

The report has been published, reviewed, and published in the journal IEEE Xplore, which is indexed in the global Scopus database. (Official note, reference , 231/18.06.2021 of the Union of Electronics, Electrical Engineering and Teleiommunications is attached.)

The paper presents computer models designed for undergraduate students in the engineering programs of higher education in order help the studying of linear circuits with OpAmp. The models allow the study of inverting and non-inverting amplifiers with OpAmp, different variants of transimpedance amplifiers with photodiodes. Using the NI Multisim Analog Devices Edition software environment allows experimental research like working with kits in the university laboratories. The developed electronic tools allow the teachers to formulate individual projects for each student, and the students - to independently conduct research on the given project. The results of the experimental studies also are showed and discussed in the paper. They have been tested in the training of students in the discipline of analog circuitry at the Faculty of Physics and Engineering Technologies, University of Plovdiv Paisii Hilendarski and in optoelectronics at the Department of Electronics, Faculty of Electronic Engineering and Technologies Technical University of Sofia in conducting online training during quarantine COVID- 19.

- **Science Articles in unreferred journals with peer review or in edited collective volumes**

Г8.1. Nedeva, M., Ilchevska, A., **Shehova, D.(2008).** Automation of a method of selection of the cross - section of a cable power line, X International Scientific Conference "Smolyan-2008" , July 5-6, Proceedings, Smolyan: University publishing house „Paisii Hilendarski“ 2009, pp.182-188, ISBN 1313-9061,

Methods for selection of cross section of medium voltage cable power lines are discussed. A program module within MATLAB has beeen developed for calculation of cable lines using the method of the allovable voltage loss. The program module is applicable in the training of students in the major subjekt of Electrical Networks and Systems and also in the desing of real power lines.

Г8.2.Popov, M., **Shehova, D**., Nedeva, M., (2009). Simulativ models of radio communicative devices in program environmen Multisim, XI International Scientific Conference "Smolyan-2009" , Sept. 26-27, Technical College - Smolyan, Proceedings, Smolyan: University publishing house „Paisii Hilendarski“,2009, pp. 75-82, ISBN 1313-9061

In the offered article simulation models for studying the work of radio communication devices with software environment Multisim are discussed.

The results of the performed simulation reserches are mentioned and reprezent.

The application of the worked out models during the Radiocommunication Techniques laboratory exercises help or students teaching to have more creative thinking and competence Technical College of Smolyan.

Г8.3. **Shehova, D.,** Lyubomirov, S**.,** Nedeva, M. **(2013).** One approach of a computer simulating of the efficiency of Operating Amplifier, Scientific researches of the Union of Scientists in Bulgaria - Smolyan, Volume 1, pp. 87-95, ISSN: 1314-9490, 2013

In the offered article are seen different applications of simulating models of operating amplifiers'that have been examined by a computer simulating program NI Multisim Analog Devices Edition.

The elaborated models in the process of laboratory practice of the branch of science Analog Devices are applied in the education. It orientates the students to develop a creative thinking and competences which are necessary for their future accomplishment as Professional Bachelors.

Г8.4. Lyubomirov, S., **Shehova, D.** (2013). Review of methods for determining the distance to the fault location in the distribution networks, Scientific researches of the Union of Scientists in Bulgaria - Smolyan, Volume 1, pp. 96-101, ISSN: 1314-9490, 2013.

The purpose of this report is to review the main methods for determining the distance to the fault location used in air distribution systems. The most appropriate method of approach to the conditions of Republic Bulgaria, where these networks have different ways of grounding the neutral has to be found. Also the lack of experience, strong branching, the presence of distributed loads and frequent changes in network configuration has to be reported. Direction is to the air power and impedance calculation of exact knowledge of network parameters. Coordinating the work of the measurements with digital relay protection has to be searched.

Г8.5. **Shehova, D.,** Yakimov, P., Lyubomirov, S., Chekichev, A. (2014). Active Filters Design Teaching Using FilterPro^{TM} Software. Annual journal of electronics, XXIII International Scientific Conference, ELECTRONICS ET 2014, 11-13 Sept. 2014, Sozopol, Vol. 8, pp.143-145, ISSN 1314-0078

The paper discusses the using of the software application FilterProTM of Texas Instruments in teaching active filters in Electronic Circuit Design course. The use of FilterProTM as a tool of e-learning gives the students the opportunity to verify the simulation results with the results obtained from the physical lab experiments with Analog System Lab Kit PRO. The module that has been developed will be included in the DIPSEIL project-based learning system used at Paisii Hilendarski University of Plovdiv.

Г8.6. Chekichev, A., **Shehova, D**., Raydovska, V., Hunev, Z. (2015). Computer Modeling of Transmitter of a Digital Communication System, Annual Journal of Electronics, XXIV International Scientific Conference, ELECTRONICS ET 2015, 15 - 17 September 2015, Sozopol, , Volume 9, pp. 92-95, ISSN 1314-0078.

The report offers a computer model of the transmitter part of a digital communication system for data transmission, which was developed in the environment of Matlab Simulink.

In the digital transmission of the information, fundamentally the new methods for signal processing allow creating devices with unique features, unavailable for the methods of analog signal processing. The architecture of the digital communication systems ensures efficient use of the spectrum and the energy resource of the communication channel in ever-changing conditions of signal distribution in it. The aim of the report is to provide a computer-based method for examination of the behavior of the transmission part of the digital communication system based on blockdiagram, which was developed in the graphical environment for imitation modeling Simulink.

Г8.7. Chekichev, A., **Shehova, D.,** Lyubomirov, S. (2015). Trends in the development of the colorimetric systems until 1830, International Journal of Engineering, Business and Enterprise Applications (IJEBEA), 2015, ISSN (Print): 2279-0020, pp..22-25, ISSN (Online): 2279-0039,

The article discuses the main trends of various types and forms of colorimetric systems until 1830 used in creating and building digital images.

Г8.8. Chekichev, A., **Shehova, D.,** Lyubomirov, S. (2015). Creating of 3D graphic forms in the RF-3D and Matlab GUI environment. International Journal of Engineering, Business and Enterprise Applications (IJEBEA), 2015, ISSN (Print): 2279-0020, pp. 63-67, ISSN (Online): 2279-0039

The aim of the article is to fundamentally visualize the conceptual approaches and methods for creating, modeling and improvement (modification) of the 3D graphic forms through application of R-functions in the communication and the practical use of the programming environments RF-3d and Matlab GUI.

Г8.9. Chekichev, A., **Shehova, D.,** Lyubomirov, S. (2015). Trends in the development of the colorimetric systems after 1830, International Journal of Engineering, Business and Enterprise Applications (IJEBEA), 2015, ISSN (Print): 2279-0020, pp.,73-76 ISSN (Online): 2279-0039

The article discuses the main trends of various types and forms of colorimetric systems after1830 used in creating and building digital images.

Г8.10. Chekichev, A., Lyubomirov, S., **Shehova, D.,** Raydovska, V., Shotarova, S. (2016). Modeling of Communication Channel in the Simulink Environment. International Journal of Computer and Information Technology, pp 483-486.,.ISSN: 2279 – 0764, Volume 05 – Issue 06, November 2016, Global Impact Factor (2015): **0.876**

The article discuses a study of the phenomena and processes that occur in the communication channel in a digital communication system for data transmission in Simulink.

The aim of the report is to provide a computer-based method for examination of the behavior of the communication channel of the digital communication system based on blockdiagram, which was developed in the graphical environment for imitation modeling Simulink.

Г8.11. **Shehova, D.,** Lyubomirov, S., Shotarova, S. (2016). Study of a Frequency Synthesizer in the MATLAB-SIMULINK environment, Scientific researches of the Union of Scientists in Bulgaria - Smolyan, Volume 2, pp. 271-279, ISSN:1314-9490, 2016

In the proposed article an approach about research of the work of the work of Fractional Frequency Synthesizer is examined. The research is realized by a computer model of the frequency synthesizers created by SIMULINK model integrated in program environment MATLAB.

Experimental simulation researches of the steady of synthesized frequency at different values of fractional coefficient and the choice of the type of synthesizers filters are performed.

The proposed model can be used for teaching students, so as it allows easy settings of the different blocks, realizing of measuring and visualizing of realized process during the researches.

Г8.12. Nedeva, M., **Shehova, D.,** Lubomirov, S., (2016). Lighting instalation in a computer laboratory**,** Scientific researches of the Union of Scientists in Bulgaria - Smolyan, Volume 2, 2016, pp. 304-309, ISSN:1314-9490,

The article discusses the major photometric characteristics of the lighting installation in a computer laboratory and the sanitary and health requirements when using computers in the teaching and training process.

Comparative analysis of the photometric characteristics of an existing lighting installation with fluorescent lamps which was renovated using LED light sources has been made.

Г8.13. **Shehova, D.,** Chekichev, A., Lyubomirov, S., Raydovska, V., Shotarova, S.(2016). Simulated Examination of the Parameters of Linear Operating Schemes using Design and Analysis environments, Scientific researches of the Union of Scientists in Bulgaria - Smolyan, Volume 2, pp. 262-271, ISSN:1314-9490

This article presents the results from the creation and the examination of simulation models for studying the linear operating schemes with using of environments for analysis.

The proposed models for studying the parameters of the linear operating schemes create aneducational environment in which students study, design, explore and analyze analog devices to formed engineering skills to work in real conditions.

They provide new opportunities for organizing of the knowledge and new ways of teaching and learning, aimed at the developing of key competencies and achieve a higher quality of the learning outcomes.

Г8.14. Raydovska**,** V., **Shehova**, **D.,** Lybomirov, S. (2016). Research of the coupled tank circuits in programming environments, FIFTEENTH International Scientific Conference Renewable Energy & Innovative Technologies - RE & IT, Conference Proceedings, 10-11 June 2016, Smolyan, Bulgaria, Volume 1, pp. 184-187, ISBN: 978-619-7180-78-7

The research of the coupled tank circuits entirely in programming environments is presented in the paper. A program is developed to calculate the parameters and trequency characteristics of the coupled tank circuits in the programming environment Matlab. Their work is simulated in the programming environment Muitisim. There is a comparative analysis of the values obtained through experiments in a virtual environment. The program which is presented in the paper will be used in the educational process in the Electrical Engineering or Analog Devices course, included in the curriculum of the specialty "Electricity technology" or "Computer and Communication Systems" for the Bachelor education degree.

Г8.15. Raydovska, V., Chekichev, A., **Shehova, D**., Lyubomirov, S. (2016). Simulation study of the quadripole via using integrated environments for the design and analysis, International Journal of Engineering, **Business** and Enterprise Applications, pp. 10-15, ISSN (Online): 2279-0039 18(1), September-November 2016.

The research of the quadripole entirely in programming environments is presented in the paper. A program is developed to calculate the frequency characteristics of the quadripole in the programming environment Matlab. Their work is simulated in the programming environment Multisim An analysis and a comparison of theoretically and experimentally obtained frequency responses are made. The program which is presented in the paper will be used in the educational process in the Electrical Engineering course, included in the curriculum of the"Electricity technology" or "Computer and Communication Systems" specialties for the Bachelor educational degree.

Г8.16. Raydovska, V., Lyubomirov, S., **Shehova, D**., Chekichev, A. (2017). Microprocessor realization of the meteorological station in Arduino development environment, International Scientific Conference "UNITECH'17, 17-18 November 2017**,** Gabrovo, Selected Papers, pp. 110-115, ISSN 2603-378X

The meteorological station has been designed and realizated based on Arduino Mega microprocessor development board and sensors which is used for learning goal. The development includes selection of the necessary hardware components (input/output board, display, sensors) for realization of the meteorological station, assembling of the used hardware, software implementation for the functioning of the meteorological station.

Г8.17. Asenov, S., **Shehova, D.,** Lyubomirov, S., Nedev, D. (2017). Application of ARDUINO PLC (CONTROLLINO) in engineering education, International Scientific Conference "UNITECH'17, 17-18 November 2017, Gabrovo, Vol. 1, pp. I-218-222, ISSN 1313-230X

This article discusses key aspects related to the application of ARDUINO-based PLCs, focusing on their implementation in engineering education. The principles and capabilities of Controllino plc as a means of controlling and managing automated processes, as well as prototypes for industrial purposes, are explored.

Г8.18. **Shehova, D.,** Raydovska, V., Lyubomirov, S.,Asenov, S. (2017). Teaching digital controlled gain stage amplifiers with modelling in TINA-TI environment application of open source platforms, International Scientific Conference "UNITECH'17, 17-18 November 2017, Gabrovo, Vol. IV, pp. IV-264-269, ISSN 1313-230X

This article suggests a methodology for simulation and physical examination of digital amplifiers. A computer- generated amplifier model is created within the „TINA-TI" environment to aid students in the comprehension of its parameters.

Results of the study are presented and analysed. The article emphasises the possibility of using the „TINA-TI" environment in the Analogue Devices education of engineering students.

Г8.19. Raydovska, V., Luybomirov, S., **Shehova, D. (**2018). Functional Testing and Assembly of Modules of a Microprocessoral Meteorological Station, Realized via the Arduino Development Environment, International Scientific Conference "Unitech'18", 16-17 Nov. 2018, Gabrovo, pp.III- 142-147, Volume III, ISBN1313-230X

The *construction of a meteorological station and its implementation in the process of engineering education allows students from the engineering specialties to work with software development environments. They also acquire the ability to develop specific applications, based on sensors.*

The paper discusses the assembly of the hardware used, as well as the software implementation for the operation of the meteorological station.

Fragments of the source code needed for the operation of the selected sensors are included in the paper.

The Ethernet R3 module is used to transmit real-time data over a network. The source code for the software implementation of the module is also included.

A real-time clock (RTC) built with the DS1307 integrated circuit is used to synchronize data from the meteorological station.

Considering the capabilities of the processor and the integrated Arduino programming environment, it can be concluded that the device has good functionality and useful application. The development shows that it is possible to create a meteorological station that works with the assembled microprocessor boards and sensors and produces good results.

Γ8.20. **Shehova, D.,** Lyubomirov, S., Asparuhova, K., Chekichev, A. (2020). Use of Software Environments and Open Source Platforms for Teaching Mixed-Signal Circuits, EDULEARN2020 (12th International Conference on Education and New Learning Technologies), 6th-7th July 2020, Spain, pp. 1637-1643, ISBN:978-84-09-17979-4, ISSN: 2340-1117, doi: 10.21125/edulearn.2020.0529

Multisim and Proteus are Spice (Simulation. Program with Integrated Circuit Emphasis) based and are intended for simulation and analysis of analog, digital and mixed-signal circuits. Their interface is constantly improved and their capabilities are expanding. This makes them suitable for teaching and mastering mixed-signal circuits through circuit modelling.

An Arduino 2560 integrated environment was chosen to serve as the microcontroller, as it is is intended for application development in various fields. In the current article it is used to extend the capabilities of the Texas Instruments Analog System Lab Kit PRO (ASLK PRO) and to enhance the ability of the students to develop their own projects.

Proteus is suitable for simulating, testing and analyzing the processes taking place in digital-to-analog converters (DACs), since it keeps the teaching focused on the concepts of the course and provides the opportunity to study the hardware and software aspects of the material taught. Trainees learn about the engineering workflow: designing and simulating the feasibility of circuits using virtual tools.

A simulation model of a DAC with summation of voltages, made of 8 bit R2R matrix was created in the Proteus Design Suite. It allows the trainees knowledge of the principle of the superposition theorem to be easily reinforced. In order to demonstrate the resolution of the DAC, the input binary combinations are generated by an Arduino Mega 2560.

The output waveforms observed with the EasyScope software oscilloscope are displayed on a computer monitor. EasyScope allows control and adjustment of the generated signals so that their parameters can be read with high accuracy.

A DAC simulation model with current summation was created in the Multisim environment. A Multisim simulation is a good method for the successful training of the students to prototype a real circuit. The model uses switches to send different combinations of the bits of the digital input signal, for which currents and voltages in the circuit branches are measured with measuring probes without the need to wait or to restart the simulation. The article presents the theoretical calculations for the resolution of a 4-bit DAC and an 8-bit DAC and compares the obtained simulation results.

The simulation models can be deployed using real hardware (a laboratory platform) to conduct physical experiments. Proteus and Multisim enhance the students' creative thinking and prepare them for the physical examination of these types of DAC.

The trainees verify the results of the DAC simulation tests using the laboratory models created. The results of the experimental studies are presented.

Training future engineers necessitates using diverse strategies and resources for teaching, training and support. The transformation of the learning process into a modern educational environment requires students to master methods of knowledge, among which the

combination of simulation and experimental study of mixed-signal circuits is becoming increasingly important.

Г8.21. Lyubomirov, S., **Shehova, D**., Yakimov, P., Chekichev, A. (2020). Hardware and Software for Teaching Digital-to-Analog Converters in Engineering Education, EDULEARN2020 (12th International Conference on Education and New Learning Technologies), 6th-7th July 2020, Spain, pp. 1629-1636, ISSN:2340-1117, ISBN: 978-84-09-17979-4, doi: 10.21125/edulearn.2020.0528

The aim of the article is to share our experience in creating experimental modules controlled with an open source platform and used for teaching modern Digital-to-Analog Converters in university digital circuits courses.

The modules were created using the Texas Instruments' ASLK PRO lab kit, an Arduino Mega 2560 microcontroller development platform built with the ATmega2560 AVR MCU and precise measuring equipment. They are intended for students trained in engineering majors at the Paisii Hilendarski University of Plovdiv and are utilized when studying the processes of digital-to-analog conversion.

The first module was developed to experimentally study integral DACs so that the trainees can learn the principles of converting digital code into analog value. The module is implemented using a 12-bit DAC 7821, OPAMP-TL 082CP, operating as a voltage to current converter and Arduino Mega 2560, which provides the digital levels of the input signals.

During the study process, students make a series of measurements. The results for the measured and calculated values of the output analog voltage at different values of the input signals and the value of the reference voltage Uref=5V are presented and analyzed. The waveforms of the output signals observed using an oscilloscope are also analyzed.

To enable trainees to study the precision of digital-to-analog conversion, a second module was developed to examine and compare the work of two DACs simultaneously. The output voltage of the second DAC is filtered through a suitable low pass filter. Thus, trainees can examiine and compare the stages of digital-to-analog conversion without filtering the converted signal and in the presence of a low-pass filter, which increases the precision of the digital-to-analog conversion process. The waveforms of the two output signals for the same digital input codes generated by Arduino are analyzed.

The third module enables students to develop DAC control skills using LED indication and a keyboard. The LED indication provides an opportunity to monitor the change of the input combination of bits. Connecting the keyboard to the microprocessor module allows flexible control of the parameters of the output signal. With this module, students develop practical skills for software management of peripherals through microcontrollers.

The article presents snippets of the source code used to manage the performance of the three modules.

The proposed hardware and software tools for teaching DAC in engineering education increase the students' motivation to master the principles of digital-to-analog signal conversion and boost their willingness to conduct and manage engineering research and to present the results of experimental work. The skills developed can be applied in the educational process and research practice and in other university engineering courses.

Г8.22. Bozhikov, I., Popov, R., Lyubomirov, S., **Shehova, D.** (2020). Analysing the Reasons for Computer System Failures Through the Focus of Engineering Training, ICERI2020, Conference, 9th-10th November, 2020, Spain, pp.8940-8945, ISBN:978-84-09-24232-0, doi:10.21125/ iceri.2020.1976.

The main purpose of the article is to present the authors' research about the integration of a new approach in the educational process of students from computer specialities in higher education. The aim is to overcome the difficulties associated with the study of computer subjects and the development of competencies in students. Also, it is intended to support students' personal development and reduce the habits that obstruct their successful implementation of the

approach. The document discusses the main reasons for computer system failures as well as hardware and software failures. The main points that the authors present in the research are temperatures of the components outside the allowable operating temperature range; abnormal parameters of the voltage, frequency and spectral composition of the supply line; incorrectly selected power supply; low-quality computer components; poor packaging of the computer equipment by the manufacturer; natural disasters and accidents. All these issues are important for a good understanding of the reasons for hardware failures by the trainees in order to be able to successfully participate in engineering teams that consider designing highly reliable energy control systems.

The continuous development of modern technologies, as well as the demand and supply of new computer systems, lead to the need for in-depth knowledge by students regarding the proper function of the systems. The article presents a tabular analysis of the results obtained regarding the main reasons for computer failures that cause data loss. The percentage of failures of the computer components in the hardware is specified. The results of the performed statistical researches, concerning the reasons for the failures of the hard disks after the processing and the analysis of 290 000 failures of the hardware in the data processing centers are graphically visualized.

Our experience in using these approaches shows that they can be successfully used to clarify the nature of these problems. They are useful for increasing students' motivation for self-studying and consolidating their knowledge. The data obtained from the conducted statistical analysis of the causes of computer failures is used not only for the theoretical training of students, but also serves as a link to their direct application in practical training courses. For example, the analysis of the reasons for failures related to the increase in the operating temperature of the computer components determines the conduct of practical classes related to the improvement of cooling. The educator provides a demonstration of the process of cleaning the heat-sinks, replacement of the thermal conductive paste of the processor, lubrication, replacement of the fans, etc. The students then perform the same procedures one by one and analyse the mistakes that were made. Similar practices are performed with hard drives, RAM, power supplies, network equipment and more.

Overcoming the difficulties associated with the study of computer systems will support the professional preparation of students and their successful implementation.

Г8.23. **Shehova, D.,** Simulative Study of Parameters of Integral Amplifiers, Scientific Works of the Union of Scientists in Bulgaria - Plovdiv, Series C. Technics and Technologies, Vol. XIX, pp. 8-11, ISSN 1311 -9419 (Print), ISSN 2534 - 9384 (Online), 2021

This article describes the results of the simulative models' creation and analysis for learning of operating amplifiers parameters with the usage of an analysis environment.

The models have been developed based on the teaching material and follow the tendencies for electrical circuitry development. They support the students while learning operational amplifiers parameters and reveal opportunities for individual work which aim to establish permanent knowledge in this field.

Г8.24. **Shehova, D**., Modelling and Study of Voltage Converters in Electronics, Scientific Works of the Union of Scientists in Bulgaria - Plovdiv, Series C. Technics and Technologies, Vol. XIX, pp. 4-7, ISSN 1311 -9419 (Print), ISSN 2534 - 9384 (Online), 2021

This article describes the implementation of the educational simulating software NI Multisim for voltage converters teaching and studying in power supplies universities' courses.

NI Multisim allows for possible simulation researches to be undertaken with virtual devices, which face panels match their industrial analogy. In this suggested article those devices interact with the analysed power supply circuits in a way which is not by any means different than the traditional methods for measuring their electrical values.

The virtual results visualising concept of the measured values prepares the learners for work in real laboratory environment

Γ8.25. Paunkov, N., Lyubomirov, S., Popov, R., **Shehova, D.** (2021). Implementation of Virtual Statistical Measuring Instruments in Engineering Education During COVID-19, INTED 2021 (15th International Technology, Education and Development Conference), 8-9 March, 2021, ISBN: 978-84-09-27666-0, ISSN: 2340-1079, pp 9801-9809, doi: 10.21125/inted.2021.2041

Online teaching requires specifying how learners and teachers are prepared to respond to change and refine the effectiveness of teaching methods and tools. Digital learning management systems, communication tools and e-learning platforms play an important role throughout this pandemic. Software and applications can help learners manage, plan, deliver, and track the learning process

The authors in this article identify new directions in the development of information management technologies and measurement, control and regulation systems. The use of computer-based measurement and control systems, known as PC-based Data Acquisition (DAQ) systems and control, based on specialized PC boards, modules and components, is required.

A virtual statistical data processing tool has been developed and tested. It is used for training bachelor and master students in the discipline of electrical measurements. The data is taken from a real working installation. The virtual tool is integrated into a real-time online software system. A statistical virtual tool has also been developed to check the distribution of data obtained from multiple measurements. The tool is implemented in the LabVIEW programming environment and this allows it to be embedded as a module in more complex data processing programs. The statistical virtual tool is based on the LabVIEW software platform developed by NI - Instrument. It consists of a LabJack UE9 data acquisition module (DAQ) and an expansion card that increases the number of measurement channels through virtualization. The measured values can be temperature, voltage and current through the respective sensors. The information from the sensors converted into an electrical signal falls on the input of differential amplifiers of the respective channels of the expansion card.

The results are processed in the following sequence: exclusion of gross and systematic errors;determining the type of distribution of the results of repeated observations; elimination of uncertainty in the final result due to random errors.

Γ8.26. **Shehova, D.,** Lyubomirov, S. (2021). Computer Modeling and Research of Diode Rectifiers and Voltage Regulators, INTED 2021 (15th International Technology, Education and Development Conference), 8-9 March, 2021, ISBN: 978-84-09-27666-0, ISSN: 2340-1079, pp. 8754-8759, doi: 10.21125/inted.2021.1824

Electronic devices need power. Although AC energy is the most available, a small percentage of it is powered directly from the standard AC network. Therefore, students' understanding of the key concepts related to voltage conversion and the available practical alternatives is a good start to master successfully the Power Supplies operation's principles.

The courses in which Power Supplies are taught are included in the curriculum of almost all technical specialties. Due to the unequal level of preparation of students, a different approach to teaching is needed. For some specialties, it will be useful for learners to gain more knowledge by computer-based learning using computer models and simulations. In specialties where this is the main topic, computer simulations support the practical training.

The article presents simulation models of one-and-a-half-cycle Half Wave Rectifier and two-and-a-half-cycle Full Wave Bridge Rectifier. Their operation is simulated at active load and in the presence of Smoothing Capacitor. Computer models allow a virtual oscilloscope to monitor the shapes of the signals in their various modes of operation and measure their basic parameters. The virtual concept for visualization of the results of the measured quantities assists students in their preparation for work in real laboratory conditions.

A parametric analysis is performed to investigate the effect of Smoothing Capacitor on the value of the upright voltage and the ripple superimposed on it. The table presents the theoretically calculated and simulated readings of the studied electrical quantities: average value of the rectified voltage, pulsation frequency, pulsating voltage. An analysis of the obtained results is made.

The computer model of the Voltage Regulator, implemented with IC LM317 LM from National Semiconductors, is useful for understanding how the input voltage, which can be up to 40 V, can be regulated at the output in the range from 1.2V to 37V. The model uses measuring probes at nodal points to monitor the change in electrical quantities in real time. The theoretically calculated and simulated readings of the modified adjustable output voltage are not only presented but compared as well.

Multisim gives students the chance to monitor and master the normal work process of engineering work: design, simulation, testing and debugging, presentation of the results.

*The developed models of diode rectifiers and voltage regulators as well as the research conducted with them were useful in organising and implementing of an online training during the COVID-19 lockdown in the discipline "Power Supplies". This training was applied to bachelors in the following specialties "Computer and Communication Systems " as well as " Hardware and software systems" at the Faculty of Physics and Technology of Plov*div University *Paisii Hilendarski.*

- **Manual**

1. **Shehova, D**., Lyubomirov, S., Chekichev, A. (2014). MATLAB Part I Exercise Guide, University of Plovdiv "P. Hilendarski", Branch - Smolyan, pp. 155, ISBN 978-954-8767-53-8.

The study material is designed to contribute to the full implementation of the exercises in the discipline "Workshop with software products for engineering solutions" and for the independent preparation of students. 10 exercises are presented, which have an applied character. Each exercise consists of theoretical information, which gives the features, characteristics and description of the topic. The exercises end with tasks that students have to solve during the exercise.

The acquired new knowledge and skills in the discipline will be useful for students in developing coursework and projects in specialized disciplines.

The content of the manual, the volume of the individual exercises and their structure are discussed by the authors as follows: Exercises № 4, 6, 8, 10, are developed by Chief Assist. Prof. Daniela Shehova; № 5, 7, 9, 10, from Senior. Assist. Prof. Slavi Lyubomirov and № 1, 2, 3, 10, by Assist. Prof. Angel Chekichev.

2. Nedev, D., **Shehova, D.,** Asenov, S. (2019). Manual to Microprocessor Technology, Marti-Deni Group, pp.146, ISBN 978-619-7207-13-2

The manual on Microprocessor Technology is intended for students majoring in "Hardware and Software Systems", "Computer and Communication Systems" and "Electrical Engineering" trained at the Faculty of Physics and Technology of Plovdiv University "Paisii Hilendarski". It has been developed in accordance with the curriculum in the discipline Microprocessor Engineering for the educational qualification degree "Bachelor".

The content of the manual, the volume of laboratory exercises and their structure are discussed by the authors as follows: Exercises №1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 16, 17 were developed by Assist. Prof. Eng. Dimitar Nedev; №14 and 15 of Senior. Assist. Prof. Eng. Daniela Shehova and №8 from Assist. Prof. Eng. Stanislav Asenov.

- **Textbook**

1. Lyubomirov, S., Chekichev, A, **Shehova, D.** (2014). Computer Peripherals-Part One, Plovdiv of University "P. Hilendarski", Branch - Smolyan, pp. 220, ISBN 978-954-8767-56-9, COBISS.BG-ID - 1265911524.

The textbook on Computer Peripherals discusses the basic principles, organization and features of the operation of computer peripherals and their input-output interfaces.

It is designed for students majoring in "Telematics" and "Computer and Communication Systems".

The content of the textbook, the volume of the individual topics and their structure are discussed by the authors as follows: Topics № V, VI, VII, VIII, are developed by Senior. Assist. Prof. Slavi Lyubomirov; № III, IV, VIII by assistant Angel Chekichev and № I, II, VIII by. Ch. Assist. Prof. Daniela Shehova.

- **Workbook**

1. Lyubomirov, S., Chekichev, A, Raydovska, V., **Shehova, D.,** Nedeva, M. (2017). Computer simulations in the teaching of electrical engineering and electronics, Workbook, Marti-Deni Group, pp. 219, ISBN 978-619-7207-04-0, COBISS.BG-ID - 1279852260

The workbook is suitable for practical training of students in technical disciplines of professional fields 5.2. Electrical engineering, electronics and automation and 5.3. Communication and computer equipment.

The topics developed by Senior. Assist. Prof. Daniela Shehova are: Visual simulations of oscillator circuits (RC generator with Vin-Robinson bridge); Computer aided design and modeling of analog adders; Simulation models of inverting and non-inverting integrated amplifier; Simulation of pulse generators by amplitude (Schmidt trigger) in the middle of

MULTISIM; Test schemes for Determining the parameters of operational amplifiers using analysis media.

- **Book**

1. Lyubomirov, S., **Shehova, D.,** Programming for Mobile Devices. Book, Marti-Deni Group, pp. 274, ISBN 978-619-7207-10-11, COBISS.BG-ID - 1286839012

The book Programming for Mobile Devices is intended for students of the educational qualification degree "Bachelor" in the specialties "Hardware and Software Systems" and "Information and Computer Engineering" at Plovdiv University "Paisii Hilendarski". The content is in accordance with the relevant curricula. It can also be used in the education of students from other universities and colleges.

The content of the book, the volume of the individual topics and their structure are discussed by the authors as follows as follows: Topics 3, 5, 7 and 8 were developed by Assoc. Prof. Eng. Slavi Lyubomirov, topics 1, 2 and 4 of Senior. Assist. Prof. Daniela Shehova, Chapter 6 was developed jointly by the authors.