AUTHOR REFERENCE

on the scientific contributions of the works of Ch. Assistant Professor Ivaylo Raychev Belovski for participation in the competition to occupy an academic position "Associate Professor" in the professional field 5.2. Electrical engineering, electronics and automation, scientific specialty "Elements and Devices of Automation and Computing (Sensors and Sensor Devices)", published in the State Gazette, issue 93 / 26.11.2019

The works of Ch. Assistant Professor Ivaylo Belovski for participation in the competition include 32 / thirty-two / publications (Appendix 2.1):

• monograph - 1, published by "Prof. Dr. Assen Zlatarov " University;

• manuals for laboratory exercises - 3;

• scientific publications in journals, referenced and indexed in world-renowned scientific information databases (SCOPUS) - 7;

• scientific publications in non-refereed scientific peer-reviewed journals - 21, of which:

−articles in journals abroad - 1;

−articles in journals in Bulgaria - 12;

−reports of conferences abroad - 3;

−reports at international conferences in Bulgaria - 5.

The applicant's contributions are divided into four main areas:

1. Application of neural networks and intuitionist fuzzy sets in thermoelectric systems

In this direction, generalized network models of neural networks and algorithms for their training have been developed. Various neural networks have been used to predict the reactions of thermoelectric cooling and generator modules and systems. Scientific papers in this area are: 4 papers presented at IEEE international conferences in Bulgaria and published in the international SCOPUS database [2.1, 2.2, 2.3, 2.4] and 1 report presented at an international conference abroad [3.15].

2. Process modeling in thermoelectric modules and systems

In the modeling of processes in thermoelectric modules and systems some analytical methods, such as the finite difference method, the regression analysis method, etc. have been used. [3.4], 2 articles published in magazines in Bulgaria [3.3, 3.6] and 1 report presented at an international conference in Bulgaria [3.17].

3. Research and optimization of the characteristics of thermoelectric modules and systems

A large number of thermoelectric modules have been studied in their two main operating modes - in cooling mode and in thermoelectric power generation mode. Based on the results obtained,

options are proposed to optimize them. Scientific papers in this area are: 3 papers presented at IEEE international conferences in Bulgaria and published in SCOPUS international database [2.5, 2.6, 2.7], 6 papers published in magazines in Bulgaria [3.7, 3.9, 3.10, 3.11, 3.12, 3.13], 2 papers presented at international conferences abroad [3.14, 3.16] and 2 papers presented at international conferences in Bulgaria [3.19, 3.20].

4. Applied sensor systems and process control

Technical solutions for several application sensor systems and process management models are proposed. Scientific papers in this field are: 4 articles published in magazines in Bulgaria [3.1, 3.2, 3.8, 3.5] and 2 papers presented at an international conference in Bulgaria [3.18, 3.21].

1. Application of neural networks and intuitionist fuzzy sets in thermoelectric systems

• A neural network has been synthesized for predicting the parameters of a thermoelectric system operating in cooling mode. The average deviation value [2.1] was used to estimate the predicted results.

• A neural network is proposed for recognizing the thermoconducting interface in a thermoelectric pump. FTDNN type network is used. The trained neural network was tested with 20 random vectors [2.2].

• A thermoelectric battery has been synthesized, based on several different Peltier and Zeebeck modules. Using neural networks, models have been created to predict the generated thermoelectricity of each module as a function of temperature difference [2.3, 2.4].

• A neural network model is proposed to model the parameters of a thermoelectric cooling system with a Peltier module. Intuitionist fuzzy sets have also been introduced for comparative qualitative estimation between the parameters of the thermoelectric system and the output of the neural network [3.15].

2. Process modeling in thermoelectric modules and systems

• Theoretical and experimental model of thermoelectric cooling system (TCS) with limited computational procedure using the finite difference method has been synthesized. Based on the synthesized model, a user-friendly graphical application TECS v.1.0 was created in Microsoft Visual Studio 2010 [3.3]. In [3.6], additional features have been added to the graphical application, allowing the user to set a large number of TCS input parameters.

• An analytical mathematical model has been synthesized for the needs of engineering practice, allowing simulation of the work of different Peltier thermoelectric modules. A method is proposed to calculate their basic parameters and simulate them using the MATLAB [3.4].

• Two theoretical and experimental models of thermoelectric cooling system were synthesized by the method of regression analysis. The first one models the influence of the current I flowing through the Peltier TEM, the time t and the volume V of the TCS on the temperature of the cold radiator T_C, and the second the influence of the current I flowing through the TEM, the time t and the volume V of the TCS on the temperature in volume of T_V. [3.17].

3. Research and optimization of the characteristics of thermoelectric modules and systems

• The influence of several thermally conductive pastes with different chemical and physical properties on the operation of a pre-synthesized thermoelectric pump (TEP) based on a single-stage Peltier module was investigated. Optimized for thermal losses in TEP design [3.7, 3.14].

• The basic modes and sub-modes of operation of thermoelectric converters are defined. The basic equations for determining the thermal balance and efficiency of the Peltier elements are presented [3.9, 3.13].

• The efficiency of the operation of a Peltier module included in the TEP, powered by a PWM controller, has been investigated and optimized [3.10]. A TEP with two Peltier modules was synthesized and tested. An analysis of their work in series and parallel connections has been made [3.16].

• A thermoelectric cooling system, powered by a solar photovoltaic system has been synthesized. The main conversion characteristics were investigated [3.11, 3.12].

• Two cascade Peltier modules for TEP synthesis were used. A methodology for calculating the basic thermoelectric parameters of the modules is proposed and a comparison is made between experimental and software simulated results [3.19]. In [2.6], the two modules in the TEP were replaced by a 4-storey Peltier cascade module. Extensive research has been done on the performance of the system.

• A technique for optimal sizing of an aluminum radiator with parallel plates for the needs of thermoelectric cooling has been synthesized [3.20]. In [2.5], on the basis of the methodology, a comparison of the total thermal resistance of an aluminum and copper radiator, depending on the number and length of the plates, was made. In [2.7], a user application was created to simulate the thermal processes in thermal power plants.

4. Applied sensor systems and process control

• A technical solution for the thermal warning device for the blind has been developed [3.1]. [3.8] presents the implementation and results of testing a digital differential thermostat for residential solar water heating installations. In [3.5] a scheme and prototype of a signal generator with direct digital frequency synthesis was synthesized. [3.21] presents a design and prototype of a multi-sensor system for reading environmental parameters.

• Using the MATLAB Graphics Editor, a "computer lab" was created in the discipline "Analog Circuit Engineering". Processes related to the parameters of the low frequency amplifiers and bipolar transistors have been modeled [3.2]. In [3.18], a simulation of the start / stop processes of an electric coupler with an electromagnetic brake is presented.

Methodological contributions

• Belovski I., Y. Georgiev, P. Rakhnev, Manual for Laboratory Exercises in Semiconductor Elements, University "Prof. Assen Zlatarov, 2014, ISBN 978-619-7123-12-8

The manual is intended for students in the specialties "Electronics", "Automotive Electronics" and "Computer Systems and Technologies" at the Professional Bachelor's Degree and Bachelor Degree at the University "Prof. Dr. Assen Zlatarov". The presented laboratory layouts are based on minimum and affordable hardware and help students' practical skills.

• Belovski I., P. Rahnev, Manual for Laboratory Exercises in Semiconductor Elements and Modules, University "Prof. Dr. Assen Zlatarov ", 2019, ISBN 978-619-7123-88-3

The manual is intended for students in the specialties "Electronics", "Automotive Electronics" and "Computer Systems and Technologies" at the Professional Bachelor's Degree and "Bachelor" of the University "Prof. Dr. Assen Zlatarov".

The guide also covers topics related to thermoelectric converters.

• I. Belovski, Manual for Laboratory Exercises in Electronics Measurement, University "Prof. Dr. Assen Zlatarov ", 2019, ISBN 978-619-7559-00-2

The manual is intended for students in the specialties "Electronics" and "Automotive Electronics" at the Professional Bachelor's and Bachelor's Degree at the University "Prof. Dr. Assen Zlatarov". The theoretical notes to each exercise are the basis for understanding the nature of the processes and a prerequisite for successful mastering of the study material.

The author's reference was prepared by Ch. Assistant Professor Ivaylo Raychev Belovski, PhD.

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Signature: ……

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