# REVIEW

on a competition to occupy an academic position "Associate Professor" In field of higher education 5. "Technical Sciences", professional direction 5.2 "Electrical, Electronics and Automation", scientific specialty "Elements and devices of automation and computing (Sensors and sensor devices)", declared in the State Gazette, issue 93/26.11.2019 with a single candidate Ivaylo Raychev Belovski, PhD, Eng., chief assistant professor, for the needs of the department of "Electronics, Electrical engineering and Machine science" of the "Prof. Assen Zlatarov" University

**Reviewer: Chavdar Roumenin, Academician, Institute of Robotics, BAS**

## 1. Phenomenology

*Short biographical data*

The candidate was born in 1973 in Sredec. In 1991 he graduated from the High School "St. St. Cyril and Methodius "- Sredets, specialty" Chemical Operator ". In 1998 he obtained a Master's Degree in Electronics and Communications from the Technical University of Varna. From 1999 to 2012 he worked consecutively as an engineer in the telecommunication companies: BTC, ELTA - R and Nexcom EAD. Since 2012 he is an assistant professor in the department of Electronics, Electrical Engineering and Mechanical Engineering at the "Prof. Assen Zlatarov " University with a leading discipline "Semiconductor Elements", and since 2016 he holds the position of "Chief Assistant ".

I. Belovski, PhD is the only candidate in the current competition for the academic position of "Associate Professor".

*Contest materials*

In the competition for "associate professor" the candidate submitted a total of 29 scientific works, of which 1 monograph in co-authorship (accompanied by a separating protocol) and 28 publications. All scientific papers presented are outside his dissertation.

Scientific papers can be distributed as follows:

- monograph - 1 issue [1.1], published by "Prof. Assen Zlatarov " University;

- scientific publications in referenced and indexed in world-famous databases of scientific information (Scopus and Web of Science) - 7 issues [2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7];

- scientific publications in non-refereed journals with scientific peer review - 21 issues [3.1 - 3.21], of which:

• publications in journals abroad - 1 issue [3.4];

• publications in journals and series in Bulgaria - 12 issues [3.1-3.3, 3.5, 3.6, 3.7, 3.8 - 3.13];

• reports of conferences abroad - 3 [3.14 - 3.16];

• reports at international conferences in Bulgaria - 5 [3.17 - 3.21].

From the candidate's works 5 pieces [3.6, 3.8, 3.9, 3.12, 3.13] are independent, 9 pieces [1.1, 2.5, 2.6, 3.5, 3.10, 3.11, 3.17, 3.20, 3.21] have one co-author and 15 pieces [2.1 - 2.4, 2.7, 3.1, 3.2 - 3.4, 3.7, 3.14, 3.15, 3.16, 3.18, 3.19] with two or more co-authors. In 25 of the jobs [1.1, 2.1 - 2.6, 3.3 - 3.17, 3.19, 3.20, 3.21] the candidate is in first place.

Chief Assistant Professor I. Belovski presented a reference to 12 citations, of which 10 [1.1, 1.2, 2.1, 2.2, 3.1, 4.1, 5.1, 6.1, 6.2, 7.1] are in scientific publications, referenced and indexed in world-renowned scientific databases information (Scopus and Web of Science) and 2 [8.1, 9.1] are in monographs and non-refereed peer-reviewed journals.

*Minimum national requirements*

On the basis of the statement submitted by the applicant for the fulfillment of the minimum national and internal university requirements (according to Act of Development of the Academic Personnel of the Republic of Bulgaria (ADAPRB), and the Rules of the Implementation of the ADAPRB for academic position Associate Professor in the professional field 5.2.Electrical Engineering, Electronics and Automation) as well as the independent check that I carried out, prove that Ch. Assistant Professor Belovski covers, and in most of the indicators exceeds the minimum requirements.

The table below summarizes the data proving that the candidate has met the minimum national and university requirements for occupying the academic position of associate professor.

| Indicators | Minimum national requirements for the academic position of "Associate Professor" | Minimum University Requirements for Academic Position "Associate Professor" | Chief Assistant Professor Ivaylo Belovski |
|---|---|---|---|
| А | 50 т. | 50 т. | 50 т. |
| Б | - | - | - |
| В | 100 т. | 100 т. | 100 т. |
| Г | 200 т. | 300 т. | 315,02 т. |
| Д | 50 т. | 100 т. | 105 т. |
| Е | - | 100 т. | 106,7 т. |

I. Belovski, PhD defended his dissertation on the topic: "Development, research and application of a thermoelectric system based on Peltier elements".

The number of lectures (equated in exercises) of students studying at the Bachelor Degree Program in the last three years, according to the documents, is 466 hours. The average classroom teaching time is 471 hours and the average total classroom time is 626 hours. For students enrolled in the Master's Degree Program, the candidate has conducted exercises for the past three years with an average classroom teaching of 97 hours.

With regard to the participation of. Assistant Professor Belovski in research and education projects, the list provided show that the applicant has participated in 8 scientific projects at NIS of the "Prof. A. Zlatarov " University and TU-Gabrovo, one external, one international, one to the Research Fund and three educational projects, as follows:

• "Development and Implementation of an Experimental Optical Sensor System", NIH 330/2014, Project leader: Assoc. Prof. Yovka Nikolova;

• "Development and implementation of DDS signal generator", NIH 352/2015, Project leader: Assoc. Prof. Dimitar Rusev;

• "Development of a system based on thermoelectric energy converters", NIH 351/2015, Project leader: Assoc. Prof. Nikola Nikolov;

• "Design and implementation of a thermoelectric cooler powered by a photovoltaic system", NIH 402/2017, Project leader: Assist. Prof. Ivaylo Belovski;

• "Design, implementation and research of a stand-alone intelligent low power system", NIH 419/2018, Project leader: Assist. Prof. Vasil Ivanov;

• Preparation of a project and computer simulation of a new energy efficient lighting area on the territory of the University "Prof. Dr. A. Zlatarov ", NIH 427/2019, Project leader: Assist. Prof. Mladen Proykov;

• Contract No. У1503 "Fault Resistance Study in Optical and Cable Roads", 2015, Project leader: Prof. Anatoliy Aleksandrov;

• Contract No. D1613E "Microelectronic Sensor Devices, Systems and Sensor Networks", 2016, Project leader: Assoc. Prof. Velimira Todorova.

As a member of the external project scientific team:

• Contract №1 / 2017 "Development, Delivery and Installation of Specialized Equipment for Remote Monitoring of Existing Illuminated Buoys with Marking Lamps", 2017-2018, Project leader: Assoc. Prof. Stanislav Simeonov. Contracting Authority State Enterprise "Port Infrastructure".

As an expert in the scientific team of an international project:

• International project "ENGAGE" under the Erasmus + program, 2017-2018, headed by Prof. Sotir Sotirov.

As a member of the scientific team of a project at the NSF:

• ДН 07/18 of 12/15/16 FNI "New Non-Destructive Method for Surface Surface of Semiconductor Structures", 2016, Project budget is BGN 120,000.

As a participant in national educational projects:

• Project BG051PO001-3.1.09-011, "Academic career development - the key to establishing a new type of university", 2014;

• BG05M2OP001-2.002-0001 "Student Practices" - PHASE I, 2016-2018;

• National Program for Young Scientists and Postdoctoral Fellows, 2019

## 2. Characteristics of the applicant's research and application activities, contributions and results

The presented works systematize the obtained results of studies mainly in the field of thermoelectric energy converters - research, optimization and modeling of their characteristics, application of neural networks for predicting their parameters. Technical solutions to several application sensor systems and process management models are also offered.

*Contributions and results in monograph work:*

The presented monographic work is on the topic: "Research and modeling of thermoelectric energy converters" with a volume of 220 pages. The candidate is co-author with Prof. A. Aleksandrov.

The scientific results obtained are related to the creation of analytical and theoretical-experimental models of thermoelectric modules and systems based on real results from experimental studies. The specific scientific contributions and results are:

• Theoretical and experimental models of thermoelectric cooling systems based on single-stage and cascade coupled Peltier and Seebeck modules, formulated by the regression analysis method, have been formulated and implemented;

• Modeling and optimization of the thermal resistance of a cooling radiator in a thermoelectric pump using the finite difference method;

• An analytical model of a thermoelectric cooling system, represented by a neural network, has been proposed and a user application has been created to calculate the basic thermo-physical parameters of Peltier modules.

*Contributions and results in publications from scientific journals and scientific conference proceedings.*

### I. Investigation and optimization of the characteristics of thermoelectric modules and systems

• The influence of several types of thermal conductive pastes with different chemical and physical properties on the operation of a pre-synthesized thermoelectric pump (TEP) based on a single-stage and multi-stage module (s) of Peltier was investigated. Optimized for thermal losses in thermal power plant construction [2.6, 3.7, 3.14, 3.19].

- The basic operating modes of thermoelectric converters are defined. The basic equations for determining the thermal balance and efficiency are presented and the efficiency of work of the Peltier elements is optimized [3.9, 3.10, 3.13, 3.16].

- A thermoelectric cooling system, powered by a solar photovoltaic system, has been synthesized. A method for sizing an aluminum radiator with parallel plates for the needs of thermoelectric cooling has been developed. A user application for simulation of thermal processes in thermal power plants has been created [2.5, 2.7, 3.11, 3.12, 3.20].

## II. Process modeling in thermoelectric modules and systems

- A theoretical-experimental model of thermoelectric cooling system (TOC) was synthesized based on the finite difference method. A user-friendly graphical application TECSv.1.0 was created in Microsoft Visual Studio 2010. Additional features were added to the graphical application, with which the user was able to set a large number of TOC input parameters [3.3, 3.6].

- For the needs of engineering practice, an analytical mathematical model has been synthesized that allows simulation of the operation of various Peltier thermoelectric modules, including the supply current, the temperature gradient, the effective volume. A method is proposed for calculating their basic parameters and simulating them using the MATLAB GUI [3.4, 3.17].

## III. 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 was used to estimate the predicted results [2.1, 2.2].

- A neural network model is proposed to model the parameters of a thermoelectric cooling system with a Peltier module. Intuitionist fuzzy sets were introduced to qualitatively evaluate the parameters of the thermoelectric system and the output of the neural network. A thermoelectric battery was synthesized based on several different Peltier and Zeebeck modules. [2.3, 2.4, 3.15].

## IV. Sensor systems and process control

- A technical solution for the blindness warning device has been proposed and developed [3.1]. The results and results of testing a differential digital thermostat for solar water heating systems are presented [3.8]. The scheme and prototype of a signal generator with direct digital frequency synthesis have been synthesized [3.5]. A design and prototype of a multisensor system for measuring environmental parameters are presented [3.21]. A simulation of the start / stop processes of an electric coupler with an electromagnetic brake is presented [3.18].

## 3. Assessment of the candidate's pedagogical activity

Ch. Assist. Prof. I. Belovski is an established lecturer in the Department of Electronics, Electrical Engineering and Mechanical Engineering. He has over 7 years teaching experience. According to the information provided on the hours of study at the University for the last 3 years, the applicant has spent an average of 626 hours in the disciplines. Given that the competition was announced as an "associate professor" at the University and not at a research institute, I will submit the complete reference, which is from the official documents of the applicant. For me, this is a responsible and essential mission in the field of higher education.

### for Professional Bachelor Degree Program :

- "Electronics" for the specialty "Electrical Engineering" - 30 h. part-time exercises;

- Semiconductor Elements for Computer Systems and Technologies - 180 h. exercises for regular form of training and 30 hours of lab. part-time exercises;

### for Bachelor's Degree Program:

- "Introduction to the specialty" for the specialty "Electronics" - 40 h. exercises for regular form of training and 8 pm lab. part-time exercises;

- Semiconductor Elements for Electronics and Computer Systems and Technology majors - 495 hrs. exercises for regular form of training and 145 hours of lab. part-time exercises;

- "Measurements in Electronics" for specialties "Electronics" - 120 hours of lectures and 150 hours. lab. exercises for regular form of training; 60h. lectures and 60 h lab. part-time exercises;

- "Technological Workshop" for the specialty "Electronics" - 150 h. exercises for regular form of training and 60 hours of lab. part-time exercises;

- "Materials and Components in Electronics" for the specialty "Software Engineering" - 30 hours of lectures and 30 hours of laboratory work. exercises for regular form of training; 16 hours of lectures and 8 hours of lab. part-time exercises;

- "Sensors and Sensor Devices" for the specialty "Electronics" - 180 hours of full-time lectures and 60 hours of part-time lectures;

### for the Master's Degree Program:

- "Specialization Workshop" for specialty "Electronics" (narrow profile) - 45 h. Exercises for full-time education and specialty "Electronics" (wide profile) - 45 h. part-time exercises;

- "Electronic control systems in transport" for the specialty "Electronics" (narrow profile) - 45 h. exercises for regular form of training;

- "Electronic circuit" for the specialty "Electronics" (wide profile) - 45 h. part-time exercises;

- "Practice" for specialty "Electronics" (wide profile) - 45 h. part-time exercises;

- "Industrial electronic devices" for the specialty "Electrical Engineering" - 45 h. part-time exercises;

- "Engineering presentations" for the specialty "Electrical Engineering" - 9 pm family exercises for part-time training.

• According to the information provided by the applicant, it is evident that in the period 2015-2019 he was in charge of the preparation of 21 successful graduates. Ch. Assistant Professor I. Belovski is the author of three textbooks.

The above data give me reason to rate the applicant's pedagogical preparation and activity as too good.

I value the importance of the applicant's contributions and results for the practice as being creatively motivated and led to working prototypes. This is of particular importance for the industry's link with higher education.


## 5. Critical notes and recommendations

In the applicant's materials the results are convincing, they are achieved with methodically correct approaches and experimental techniques, the data are with acceptable error, typical for the research orientation. I will not comment on a number of repetitions, unnecessary comments, analyzes, etc. They are typical of each participant. However, I would venture to comment with emphasis on a proposal to I. Belovsky that the very interesting and noteworthy innovations are not patented in the National Patent Office. He owns such in the field of Peltier and Seebeck elements. I do not think that a sum of 137,50 BGN will make it difficult for either the University or the Institute of BAS. I would even support the submission of the almost unnecessary utility model. However, technology transfer to the national industry does not come with articles, documentation and sweet talk, but with recognized patents for inventions guaranteeing intellectual / industrial property!

There are no claims from others on the intellectual property implemented by Dr. I. Belovski. At the same time, his work has long been in the public scientific space.

I have no unregulated financial or lobbying relationship with the applicant, nor have I ever co-authored it.

## CONCLUSION

As a result of the submitted scientific papers, the scientific and applied contributions contained therein, the extensive teaching and methodological activity and teaching experience, I consider that the candidate meets the requirements for "associate professor" of the "Prof. Assen Zlatarov" University - Burgas.

As a result of the above, I propose to the Honorable Scientific **Jury Ch. Assistant Professor Eng. Ivaylo Raichev Belovski** to be offered for the choice of the academic position of **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)" for the needs of the "Prof. Assen Zlatarov" University.

Sofia                                    Reviewer:

22.02.2020                               /Cha