REVIEW

for competition for holding the academic position “Professor” in the area of higher education 5. Technical sciences, professional field 5.1 Mechanical engineering, and course "Programming of machines and systems with CAM,
with single applicant Assoc. Prof. PhD Eng. Stoyan Dimitrov Slavov

Reviewer: Prof. D.Sc. Eng. Vasil Stefanov Kostadinov, "Angel Kanchev" University of Ruse
(*according to Order № 791/02.11.2023 of the Rector of the Technical University of Varna*)

1. General information and biography data

The competition was announced for the demands of Technical university of Varna, and Department of "Manufacturing Technologies and Machine Tools" (MTMT), and was published in State Gazette, issue No. 67/04.08.2023. Documents for applying have submitted only by one single candidate, namely Assoc. Prof. PhD Eng. Stoyan Dimitrov Slavov.

D-r Stoyan Slavov graduated from the specialty "Mechanical engineering and metal cutting machines" at the MTMT department in 1998. In 2004, he defended the scientific degree “Doctor” in the scientific specialty 02.01.10. "Mechanical engineering technologies" before specialized scientific council of the higher attestation commission. At the beginning of his career, he worked as a management systems consultant according to different international standards. Since 2006, he has been appointed as Chief Assistant in the Department of MTMT, and from 2012 to the present, he hold the academic position of "Associate Professor" in the specialty "Mechanical Engineering Technology" in the same department after passed a competition. He had held the position of Head of the MTMT department, and been a Head of the Quality Center, an Expert at the Center for Rating Analysis, and currently occupying administrative position Head of the Accreditation Center at the Technical University of Varna. He is a member of the Scientific and Technical Society for Machine Building Equipment and Technologies at the Varna Scientific and Technical Unions since 2003, and a member of the Union of Scientists in Bulgaria from 2013 until now. He participated in 17 national research, infrastructure and publishing projects, being a head of six of them. He is a member of the 3-th Group "Scientific organizations, institutes and universities" in Technical Committee 34 "Quality management and conformity assessment" at the Bulgarian Institute for Standardization, as well as he is Editor-in-chief of the (e) Annual Journal of the Technical University of Varna since 2016 until now. He also is an author of two university textbooks and one study guides on manually programing of CNC machines, as well as two distance-learning university study guides for students.

The candidate has participated in six scientific juries with reviews and opinions on competitions for occupying academic positions associate professor, senior assistant, and doctor at the Technical universities of Varna and Sofia. He has carried out over 50 reviews of research articles for 12 journals indexed in the SCOPUS and Web of Science databases. He has supervised four doctoral students, one of whom has successfully defended his doctoral dissertation, and the other three are still in the process of studying. He has conducted five international mobility for teaching and learning under the Erasmus+

program, as well as one short-term two-week international specialization within an educational project in which he participated.

2. General description of the applicant's materials for the competition

The candidate participated with 24 scientific works in the competition, five university textbooks and study guides, as well as with some other activities. They are classified as follows:

2.1. A monograph, entitled "Formation of regular reliefs using CNC machines" is presented, as a habilitation work – **group B.3 (100 points)**

2.2. Scientific publications (a total amount of 23 items, **giving a score of 289.3 points in the group of indicators Г**), which can be divided as follows:

2.2.1. Scientific publications in journals that are referenced and indexed in world-known databases with scientific information (total of 11 items) - from Г.7.1 to Г.7.11 (11 items). Among them in journals with an impact factor and/or an impact rank (5 items) – Г.7.3, Г.7.5, Г.7.9, Г.7.10, and Г.7.11;

2.2.2. Scientific publications in non-refereed journals with scientific review or in reviewed collective works (12 items) - from Г.8.1 to Г. 8.12;

2.3. Several university textbooks E.23.1 and E.23.2, and university study guides from E.24.1 to E24.3, (totally 5 items). Participation and management of several scientific projects. Funds attracted from them, as well as successfully defended doctoral students, **forming 394 points in the group E of the indicators**.

2.4. Additionally, a reference for works that are not subject to review in the current competition is presented, which are as follows:

2.4.1. Publications related to his PhD dissertation thesis (10 items) - №1.1 to №1.10;

2.4.2. Publications included in the competition for holding the academic position "Associate Professor" (total of 27 items) - from № 2.1.1 to № 2.1.10, and from № 2.2.1 to № 2.2.12, and also from № 2.3.1 to № 2.3.5;

2.5.The candidate's role in the works presented in the competition is as follows:

2.5.1. He is the solely author of five works (В3.1, Г8.2, Г.8.7, Г.8.11, and Г.8.12) and in four of the presented textbooks and guides (E.23.1, E.23.2, E.24.1, and E24.2);

2.5.2. He is the first co-author in 15 of the works (Г.7.1, Г.7.2, Г.7.3, Г.7.7, Г.7.10, Г.7.11, Г.8.1, Г.8.3, Г.8.4, Г.8.5, Г.8.6, Г.8.8, Г.8.9, Г.8.10, and E24.3);

2.5.3. A second co-author in one work (Г.7.8);

2.5.4. The applicant is a third co-author in four of the works (Г.7.4, Г.7.5, Г.7.6, and Г.7.9);

Twelve of the works have been published in Bulgarian, and the remaining 17 items are in English. All of submitted candidate’s works are relevant to the subject of the current competition.

2.6. Citations of the candidate's works.

The submitted reference **contains 60 citations** of the applicant's works related to the indicators of group Д, and they are as follows:

2.6.1. Citations from works indexed in Scopus and/or Web of Science databases – 49 item (Д.12.1 – 3 items; Д.12.2– 4 items; Д.12.3 – 2 items; Д.12.4 – 1 item; Д.12.5 – 1 item, Д.12.6 – 4 items, Д.12.7 – 4 items, Д.12.8 – 3 items, Д.12.9 – 13 items, Д.12.10 – 2 items, Д.12.11 – 2 items, Д.12.12 – 3 items, Д.12.13–2 items, Д.12.14–1 item, Д.12.15– 2 items, Д.12.16 – 1 item, Д.12.17 – 1 item);

2.6.2. Citations from monographs – 2 items (Д13.1 -1 item, and Д13.2 - 1 item)

2.6.3. Citations from papers in peer-reviewed but no indexed scientific journals or conference proceedings – 9 item (Д.14.1 – 3 items; Д.14.2 – 5 items; Д.14.3 – 1 item).

Assoc. Prof. Stoyan Slavov's **total score for indicators from group Д is 514 points**.

2.7. The data on the academic load of the candidate shows that for the last 3 academic years Assoc. Prof. Stoyan Slavov has conducted 768.2 academic hours of lectures, which means that **in the group of indicators Ж he has a result of 768.2 points**.

The submitted reference by groups of indicators А, В, Г, Д, Е and Ж, as well as the evidence applied, shows that the applicant not only fulfills, but even significantly exceeds some of the minimum requirements of the Bulgarian legislation and those of the internal regulations for development of the academician stuff of Technical University of Varna.

3. General characteristics of the applicant's scientific research and applied activities.

The publications of Assoc. Prof. Stoyan Slavov can be summarized in two main directions:

3.1. Development of technological schemes for the formation of regular reliefs by ball burnishing (BB) process using CNC- machines, which is the subject of works (В.3.1, Г.7.2, Г.7.4, Г.7.7, Г.7.9, Г.8.2, Г.8.3, Г.8.4, Г.8.6, Г.8.8, Г.8.9, Г8.10, Г.8.11, etc.);

3.2. Research on the parameters of the BB process and the process regime parameters over the resulting regular reliefs, which can be seen from publications (Г.7.1, Г.7.3, Г.7.5, Г.7.6, Г.7.8, Г.7.10, Г.7.11, Г.8.1, Г.8.5, Г8.7, Г8.12, etc.).

The candidate has submitted a reference and evidence for participation in 14 scientific, infrastructural and educational projects, five of which are at the state level (E.18.1, E.18.2, E.18.3, E.18.4, and E.20.1). He has been head of six of these projects (from E.20.1 to E.20.6). A certificate for the implementation of BB-technology for none-planar surfaces in the production process of the factory Tcherno more Co., Varna has also applied.

4. Pedagogical activities of the applicant.

Assoc. Prof. Stoyan Slavov has developed study programs and delivers lectures on the following study disciplines:

4.1. Computer programming of CNC- machines and systems;
4.2. Programming of CNC -machines and systems with CAM;
4.3. Material processing machines and systems – 2-nd part.
4.4. Manually Programming of CNC-machines and systems;
4.5. Computer Integrated Manufacturing.
4.6. Production systems;

They are completely correspond to the subject matter of the competition subject for academic position "Professor". He is the solely author in the development and publishing two university textbooks on the topic of automatically programming CNC-machines by using CAM software, as well as the author and co-author of three academic students guides related to the same topics.

Under his guidance, 53 graduates have successfully defended their bachelor and/or masters theses. One of the doctoral students has successfully defended his PhD thesis, and he supervising three more doctoral students who are still studying.

Based on this, as well as the large number of lectures held on disciplines, I assess the pedagogical qualification of Associate Professor Stoyan Slavov as fully meeting the requirements for acquiring the academic position "Professor" under the current competition.

5. Main scientific, scientific-applied, applied and methodical contributions

The contributions contained in the candidate's works can be referred to the following groups:

5.1. Scientific contributions (proved by new means of substantial new aspects of already existing scientific fields, problems, theories, hypotheses)

5.1.1. The need to use forced oscillations of the deforming tool is avoided, which significantly simplifies the design and dimensions of the BB-tool. This enables the BB-operation to be performed on the same CNC- machine where the preceding shape-forming operations are also conducted. – (B 3-1, Г 7-2);

5.1.2. Based on research and analysis of the kinematics of the vibration-assisted ball burnishing process, carried out according to classical schemes, mathematical models have been derived for calculating the coordinates of characteristic points of the trajectory of the deforming element. In this way, a concept has been developed for automated creation of numerical codes for turning and milling multi-axis machining centers with CNC when forming partially and completely regular reliefs by ball burnishing, suitable for processing machine parts having the following types of surfaces: planar surfaces (B 3-1, Г 7-2, Г 7-4, Г 7-5, Г 8-2, Г 8-9); cylindrical and tapered surfaces (B 3-1, Г 7-1, Г 7-2, Г 8-2, Г 8-11); nonplanar surfaces (B 3-1, Г 7-2, Г 8-1, Г 8-6).

5.1.3. Original approaches have been developed for automated identification of the number of cells on completely regular reliefs (Г 8-12) and determination of their topographical characteristics, based on standardized criteria (B 3-1, Г 7-9, Г 7-11);

5.1.4. A group of uncorrelated three-dimensional topographic criteria has been identified, according to the ISO 25179-2 standard that describe the complex topographic characteristics of regular reliefs obtained after ball burnishing operation using CNC machines – (B 3-1, Г 8-7).

5.2. Applied scientific contributions (obtaining and proving new facts and creating new classifications, methods, constructions, technologies, schemes).

5.2.1. Computer models have been developed and applied in practice for calculating toolpaths when forming regular reliefs by ball burnishing on different types of surfaces, depending on the contour of the processing domain - (B 3-1, Г 7-1, Г 7-2, Г 7-4, Г 7-5, Г 8-1, Г 8-2, Г 8-6, Г 8-9).

5.2.2. Algorithms have been created to optimize the calculated toolpath for ball burnishing operations, so that they obtained with minimum necessary unfolded length, depending on the shape and dimensions of the processed surface – (B 3-1, Г 7-2, Г 7-9, Г 7-10).

5.2.3. An algorithm has been developed for directly obtaining numerical control programs for CNC turning centers about forming regular reliefs onto cylindrical and tapered external surfaces by ball burnishing – (B 3-1).

5.2.4. Developed algorithm to generate polyline in the DXF format, which is widely supported by CAD and CAM software, describing the toolpath of the deforming element, to import it into appropriate CAM software and using it for automated

programming of the ball burnishing operation and obtaining the numerical code for corresponding CNC machine – (B 3-1).

5.2.5. An algorithm is proposed for filtering the high-frequency components of the measured profilograms, by means of a finite impulse response filter and a resampling technique, allowing an adequate spatial representation of the regular reliefs as a 3D model of the surface roughness or waviness – (B 3-1).

5.2.6. A set of uncorrelated three-dimensional criteria has been identified, according to the ISO 25179-2 standard, describing the complex topographic characteristics of regular reliefs obtained after ball burnishing process using CNC machines - (B 3-1, Г 8-7);

5.2.7. A generalized algorithm is proposed for analysis of the degree of significance of the effects and the nature of the influence of the regime parameters of ball burnishing process, as well as the deforming tool toolpath. (B 3-1, Г7.9, Г8-1, Г8-6, Г 8-7).

5.3. Applied contributions (classifications, designs and technologies)

5.3.1. New, simpler and compact designs of tools for forming regular reliefs by ball burnishing operation, designed to work with CNC turning and milling centers, have been created. – (Г 7-7, Г 8-4, Г 8-8).

5.3.2. The ball burnishing tools have integrated sensors for measuring the deforming force in the process, as well as controllers for wireless transmission of processing data to an external computer device. – (Г 7-7, Г 8-4, Г 8-8).

5.3.3. Using methodology of designed experimental studies, the potential to increase the number of cycles to fatigue failure of AISI 304L and AISI 316 austenitic steel specimens that have regular reliefs formed by ball burnishing was established in comparison with smooth rolled specimens. – (Г 7-3, Г 8-5).

5.3.4. The recommended values of the regime parameters of the ball burnishing process is established experimentally in order to obtain the maximum number of cycles to fatigue failure of austenitic steels AISI 304L and AISI 316 with a formed regular relief in the stress concentrator – (Г 7-3, Г 8-5).

5.3.5. The influence of the deforming force and the feed rate magnitudes in the ball burnishing operation of samples made of aluminum alloy, brand 2024 on the topographic characteristics of the resulting regular reliefs on cylindrical surfaces is experimentally established - Г 7-1.

5.4. Methodological contributions

The candidate's publications listed above (Г.7.2, Г.7.9, Г.8.2, Г.8.3, Г.8.7, Г.8.10, Г.8.12), contain numerous methodical contributions, as such can be found in the two textbooks presented (Е.23.1 и Е.23.2) and in the three teaching guides for students (Е.24.1 – Е.24.3).

6. Significance of the candidate's contributions to science and practice.

There are enough scientific, methodological and applied contributions, that significantly enriching the theory, teaching material and practice in the field of the announced competition in the discipline "Programming of machines and systems with CAM". A wide knowledge base has been created by the candidate including the formation of regular reliefs on various surfaces of machine parts using contemporary machines. The

approaches for measuring and determining the topographical characteristics of these reliefs based on standardized criteria also are systematized.

The recognition of the candidate's works by the scientific circles at home and abroad is supported by the large number of citations of his works of international scholars from abroad. The quantitative indicators of the criteria for occupying the academic position "Professor" have been met. According to all indicators, the minimum requirements in groups Г, Д, Е and Ж were exceeded. The information presented in points 2, 3 and 4 above speaks of the wide recognition of the candidate's work and gives reason to claim that the contributions are his personal work or are obtained with his significant participation.

A significant volume of the methodical and analytical part of his scientific activity is also implemented in the educational process through the disciplines taught by the candidate.

7. Critical remarks and recommendations

Reviewing the works of the candidate for the competition, I did not find any fundamental omissions or drawbacks. I have some minor remarks on the way of structuring part of the candidate's works and recommendations that if adopted by the candidate and his team of assistants and doctoral students, will help to better present the results of their research work. They will be discussed with the candidate during the procedure for achieving the academic position "Professor".

8. Personal impressions of the applicant and opinion

I personally know Assoc. Prof. Dr. Eng. Stoyan Slavov from my participation in his scientific jury in the competition for occupying the academic position "Associate professor" in 2012, as well as in the scientific jury for acquisition the "Doctor" degree of his doctoral student, in 2019. I have personal impressions of his competence and awareness both from his publications before current competition for “Professor” and from joint participation in different scientific forums.

9. Conclusion

Based on the review of the scientific work and results submitted by the candidate in the current competition, I believe that Associate Professor Stoyan Dimitrov Slavov is a highly qualified specialist and can be characterized as a recognized researcher and educator in the field of application of CNC- machines in contemporary mechanical production processes. Therefore, I find it reasonable to propose the candidate Assoc. Prof. PhD Eng. Stoyan Dimitrov Slavov to hold the academic position "Professor" in professional field 5.1. Mechanical engineering, and the course "Programming machines and systems with CAM" for the needs of the department "Manufacturing Technologies and Machine Tools" from the Faculty of Manufacturing Engineering and Technologies of the Technical University of Varna.

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