REVIEW

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of the materials submitted for participation in a competition
for the academic position of **Professor**
at University of Plovdiv Paisii Hilendarski

in Field of Higher Education 4. Natural Sciences, Mathematics and Informatics

Professional Field 4.6 Informatics and Computer Science (Artificial Intelligence)

In the competition for the academic position of "Professor", announced in the State Gazette, issue No. 98 of 19.11.2024, and on the website of University of Plovdiv Paisii Hilendarski, for the needs of the Department of Computer Informatics at the Faculty of Mathematics and Informatics, the candidate Assoc. Prof. Dr. Stanka Ivanova Hadzhikoleva from the Faculty of Mathematics and Informatics at University of Plovdiv Paisii Hilendarski is participating.

1. General overview of the submitted materials

By Order № RD-22-443 dated 18.02.2025 of the Rector of University of Plovdiv Paisii Hilendarski (PU), I was appointed as a member of the academic jury for the competition for the academic position of **"Professor" at PU** in the field of higher education 4. Natural Sciences, Mathematics and Informatics, professional field 4.6 Informatics and Computer Science (Artificial Intelligence), **announced for the needs of** the Department of Computer Informatics at the Faculty of Mathematics and Informatics.

Only one candidate has submitted documents for participation in the announced competition: Assoc. Prof. Dr. Stanka Ivanova Hadzhikoleva from the Faculty of Mathematics and Informatics at University of Plovdiv Paisii Hilendarski.

The set of materials submitted in hard copy by Assoc. Prof. Dr. Stanka Ivanova Hadzhikoleva **is** in accordance with the Regulations for the Development of the Academic Staff of PU and includes the following documents:

- Curriculum vitae in European format;
- Diploma for higher education with the awarded educational qualification degree "Master";
- Diploma for the educational and scientific degree "Doctor";
- Certificate for holding the academic position of "Associate Professor";
- Lists of scientific works (a complete list, a list of the scientific works submitted for the competition, a list of publications in journals or in proceedings of international conferences, a list of publications co-authored with students);

- Copies of the scientific works submitted for the competition;
- Reports on compliance with the minimum national requirements (short and extended versions);
- Report on compliance with the additional faculty requirements;
- Declaration of originality and authenticity of the submitted documents;
- Abstracts of the materials under Art. 76 of the Regulations for the Development of the Academic Staff of PU (in Bulgarian and English);
- Self-evaluation of contributions under Art. 76 of the Regulations for the Development of the Academic Staff of PU (in Bulgarian and English; short and extended versions);
- List of identified citations;
- Certificate of employment history;
- Documents related to teaching activities (report on teaching and non-teaching academic activities, list of published textbooks and teaching aids, report on work with students and PhD students);
- Documents related to research activity (report on research activity, list of participations in research and educational projects, two official letters from University of Plovdiv Paisii Hilendarski, confirming Assoc. Prof. Stanka Hadzhikoleva's participation in research projects and projects as an "academic mentor", report on participation in national projects and national projects with European funding issued by the Medical University – Plovdiv, list of participations in research and educational projects during the period 2009–2014, report on membership in professional organizations).

The candidate, Assoc. Prof. Stanka Hadzhikoleva, has submitted a total of 30 scientific publications and 1 textbook. All 30 scientific works and the 1 textbook that have not been previously submitted for the award of the educational and scientific degree "Doctor" or for occupying the academic positions of "Assistant Professor" and "Associate Professor" are accepted for review and considered in the final evaluation.

2. Brief biographical information about the candidate

Assoc. Prof. Dr. Stanka Hadzhikoleva graduated with a Master's degree from University of Plovdiv Paisii Hilendarski in 2000 as a mathematician (major in "Mathematics" with a specialization in "Informatics") and as a teacher of mathematics and informatics (major in "Mathematics and Informatics"). In 2013, at the Faculty of Mathematics and Informatics of the same university, she was awarded the educational and scientific degree "Doctor" in the professional field 4.6 "Informatics and Computer Science".

Assoc. Prof. Hadzhikoleva has been a lecturer at the Faculty of Mathematics and Informatics at University of Plovdiv Paisii Hilendarski since 2002. She has successively held the positions of Assistant Professor (since 2002) and Senior Assistant Professor (since 2011). Since 2016, she has been an Associate Professor of Informatics at the Department of Computer Informatics. Assoc. Prof. Hadzhikoleva has also taught several courses at Trakia University – Stara Zagora (2023–2024), Technical University – Plovdiv Branch (2021–2023), Burgas Free University (2016–2021), University of Agribusiness and Rural Development – Plovdiv (2014–2015), and the Academy of Music, Dance and Fine Arts – Plovdiv (2015–2018).

3. General overview of the candidate's professional activity

Evaluation of teaching and pedagogical activity

During the period 2016–2025, Assoc. Prof. Stanka Hadzhikoleva has delivered lectures in the following compulsory courses at University of Plovdiv Paisii Hilendarski: "Databases", "Introduction to Cloud Technologies", "Software Technologies 2", and "Mobile Applications". She has also conducted practical sessions in "Business Process Modeling and Management".

Assoc. Prof. Hadzhikoleva has developed new elective courses and delivered classes on highly relevant topics such as "Intelligent Data Analysis with Orange", "Graph Databases with Neo4j", "Introduction to Big Data and Cloud Computing", "Business Process Modeling", "Structuring and Presenting Scientific Works", and "Structuring and Presenting Theses and Scientific Papers".

For the period 2016–2024, Assoc. Prof. Hadzhikoleva has had an approved teaching workload of 360 hours per year, as set by the Rector, which she has consistently fulfilled and exceeded.

To support her teaching activities, Assoc. Prof. Hadzhikoleva has developed numerous curricula, educational materials, and examination resources. She utilizes modern technological solutions and the Moodle e-learning platform to ensure effective course delivery. She has fully or partially developed electronic courses for the following subjects: "Software Technologies 2" (lectures), "Introduction to Cloud Technologies" (lectures), "Mobile Applications" (lectures), "Databases" (lectures and practical sessions), "Intelligent Data Analysis with Orange" (lectures and practical sessions), "Graph Databases with Neo4J" (lectures and practical sessions), "Modeling of E-learning Courses in Moodle" (lectures and practical sessions), "Structuring and Presenting Theses and Scientific Papers" (lectures and practical sessions), "Discrete Structures" (lectures), "Business Process Modeling and Management" (practical sessions), "Organization and Functioning of Data Centers" (lectures).

Assoc. Prof. Hadzhikoleva has delivered lectures in both bachelor's and master's programs at various higher education institutions in Bulgaria, including Trakia University – Stara Zagora - lectures in "Programming for Mobile Devices"; Technical University – Plovdiv Branch - lectures in "Discrete Structures"; Burgas Free University - lectures in "Organization and Functioning of Data Centers"; University of Agribusiness and Rural Development – Plovdiv - lectures in "Database Design", "SQL Queries in Databases", and "Information Retrieval in Databases"; Academy of Music, Dance and Fine Arts "Prof. Asen Diamandiev" – Plovdiv: lectures in "Interactive Design, Interactive Systems, and Installations".

For the needs of the students at the Faculty of Mathematics and Informatics, Assoc. Prof. Hadzhikoleva has co-authored 2 textbooks together with colleagues from the Faculty. Assoc. Prof. Hadzhikoleva actively contributes to the academic development of students and to the improvement of the quality of their education.

The main areas of her extracurricular engagement include: 1) Supervision of thesis students, doctoral candidates, and young researchers; 2) Consulting activities; 3) Organization of extracurricular events; 4) Participation in scientific and educational projects; 5) Participation in committees and academic juries; 6) Involvement in student recruitment campaigns; 7) Popularization of science, among others. It is important to highlight her supervision of thesis students, doctoral candidates, and young researchers.

During the period 2016–2024, Assoc. Prof. Hadzhikoleva supervised students in the process of preparing their bachelor's theses, 12 of whom successfully defended their bachelor's degrees under her guidance.

She is also the academic advisor of seven Doctoral students. Two of them have successfully defended their dissertations, three are currently in training, and two have been deregistered but are in the process of preparing their doctoral theses.

I give a high evaluation of Assoc. Prof. Hadzhikoleva’s teaching, mentoring, and consulting activities, which demonstrate a high level of professionalism and quality, as well as responsiveness to the needs, recommendations, and capabilities of both students and doctoral candidates.

Evaluation of the candidate’s research and applied scientific activity

Assoc. Prof. Hadzhikoleva’s publications can be classified as follows: by type – 15 journal articles and 15 conference papers; by significance – 7 articles in impact factor journals and 12 in journals with SJR; by place of publication – 15 articles in peer-reviewed journals, 13 papers in proceedings of international scientific conferences, and 2 in national conference proceedings; by language – 27 in Eng-

lish and 3 in Bulgarian; by number of co-authors – 12 publications with three co-authors and 18 with four or more, with no single-author publications. Five of the articles are in Q1 and two in Q2 according to the Web of Science quartile classification. All publications were published after she attained the academic position of Associate Professor. Despite the fact that the presented works are co-authored, I have no doubt regarding the candidate's substantial personal contribution and involvement in the submitted materials.

There is no proven plagiarism, established in accordance with the legal procedures, in the scientific works submitted by Assoc. Prof. Stanka Hadzhikoleva for the competition.

A strong impression is made by the integration of research with project work, its practical implementation, and real-world application. Assoc. Prof. Hadzhikoleva has presented participation in a total of 17 research and educational projects: 1 international, 8 national, and 8 university-level projects. She has served as project leader in 4 of the research projects. Notably, she has played a key role in the following scientific and applied research outcomes: the development of a cloud-based application for the automated creation and management of tests using generative artificial intelligence; the creation of software supporting tools for the storage and analysis of information on bioactive peptides; a software application for predicting the execution time of customer orders in the textile industry using AI; the development of multiple educational games with generative AI; and the implementation of a large number of empirical experiments involving learning with AI tools, including analysis and evaluation of ChatGPT as an educational tool capable of generating questions across Bloom's cognitive levels, and the automated, complex assessment of higher-order thinking skills in students using neural networks.

Contributions (scientific, applied scientific, practical) and citations

The works submitted by Assoc. Prof. Hadzhikoleva for participation in the competition can be classified into **four thematic areas**:

A. Education and Artificial Intelligence (AI)

- Models and Methods for Learning with Innovative Technologies [8, 16, 20, 24, 30];
- Models for the Development and Assessment of Higher-Order Thinking Skills [15, 22 и 29];
- Models of Software Applications with AI [2, 3, 7];
- Models for Ensuring the Quality of Education [17, 21, 28];

B. Artificial Intelligence Models

- Models in the Field of Energy [18, 19, 25, 26];
- Models in Textile Production [9, 10];

- Models in Bioinformatics [12, 14];
- Other Applications of AI [1, 4, 5];

C. Neural Networks – Architectures and Research [6, 11, 13, 23, 27];

D. Textbooks and Teaching Aids for Student Training [31].

Като ключови **научни приноси** могат да бъдат отбелязани:

The following can be highlighted as key **scientific contributions**:

- Determination of upper limits for the number of hidden layers and the number of neurons within them for approximating artificial neural networks trained with algorithms utilizing the Jacobian matrix in the error function [11, 27];
- A model for interpolating missing surface segments using three neural networks, each approximating a different coordinate function of the surface points [1];
- An algorithm for improving extrapolation accuracy with neural networks through the generation of additional training data [13];
- A model of a system for forecasting electricity consumption that combines mathematical methods and artificial neural networks to enhance prediction accuracy [18];
- A conceptual model of an instance of a pedagogical pattern [20];
- A formal model of the assessment process, which can be customized according to the needs of educators [22];
- An approach and model for automated comprehensive assessment of higher-order thinking skills [29];
- A model for hierarchical multi-component assessment based on Bloom's taxonomy [22].

The main **applied scientific contributions** of the candidate are:

- Defining conditions under which a single neuron can solve multiple tasks [23];
- Creating neural network models for multi-factor electricity consumption forecasting, including: electricity price [26]; total energy consumption [19]; electricity consumption in Bulgaria's industrial sector [19]; household electricity consumption in Bulgaria [19]; electricity losses in Bulgaria's power system [25];
- Methodology for developing educational games using ChatGPT [2, 7];
- Model of a cloud-based application for automated creation and management of tests using generative artificial intelligence [3];

- Model for predicting quality deviations in worsted yarn during the production process [9];
- Model of a system for forecasting the lead time of customer orders in the textile industry [10];
- Conceptual framework of a software system for e-learning based on pedagogical patterns [20];
- Models of centralized and decentralized quality assurance systems in higher education [17, 28];
- Model of a software ecosystem for ensuring the quality of education [21];
- Methodology for AI-based learning that stimulates the development of higher-order thinking skills [8];
- Methodology for training bachelor's students to develop scientific competencies based on practical research tasks [30];
- Teaching method through modeling pedagogical patterns in an e-learning environment [24];
- Models for studying life expectancy [4];
- Model for the digitalization of social care using AI [5];
- Comparative analysis of approximations using polynomials and neural networks [6].

The most significant **practical contributions** of the candidate can be identified as follows:

- Prototype of a cloud-based application for automated creation and management of tests using generative artificial intelligence [3];
- Prototype of a software application supporting tools for the storage and analysis of information on bioactive peptides [12, 14];
- Prototype of a software application for forecasting the lead time of customer orders in the textile industry using artificial intelligence [10];
- Development of multiple educational games with generative artificial intelligence [2, 7];
- Conducted an empirical experiment on learning with AI tools that stimulate the development of higher-order thinking skills [8];
- Delivery of an elective course in a bachelor's program at the Faculty of Mathematics and Informatics (FMI), aimed at promoting e-learning opportunities through pedagogical patterns [24];
- Delivery of a specialized course in a bachelor's program at FMI, aimed at developing scientific competencies in students [30];
- Conducted experiments, analysis, and evaluation of ChatGPT as an educational tool capable of generating questions aligned with Bloom's cognitive levels [15];

- Conducted an experiment on automated comprehensive assessment of students' higher-order thinking skills using neural networks [29];
- Strategy for student self-study using ChatGPT as an assistant [16];
- Conducted experiments and comparisons of various surface reconstruction methods [1];
- Conducted experiments on electricity consumption forecasting in Bulgaria, including household consumption, industrial consumption, total energy consumption, and more [18, 19];
- Conducted experiments on forecasting electricity system losses in Bulgaria using neural networks [25].

The significance of the candidate's research results is further evidenced by their impact in the works of other authors. Assoc. Prof. Hadzhikoleva has presented 76 identified citations of 25 of her scientific publications, all indexed in global scientific databases (Scopus and/or Web of Science). The citations are predominantly from international and unrelated authors. The majority of the citations are from the past 5 years, distributed as follows: 2024 – 4 citations, 2023 – 29 citations, 2022 – 20 citations, 2021 – 13 citations, 2020 – 7 citations, 2018 – 2 citations, and 2017 – 1 citation.

Assoc. Prof. Hadzhikoleva reports a total of 1,739 points according to the national criteria for holding the academic position of "Professor", significantly exceeding the required minimum of 550 points. The candidate also meets and surpasses all specific requirements set by the Faculty of Mathematics and Informatics, including: 30 scientific publications (minimum required: 25), 30 publications in journals or proceedings of international conferences (minimum: 15), 17 publications in journals (minimum: 10), 1 textbook (minimum: 1 textbook or teaching aid), 76 citations (minimum: 20), and supervision of 2 PhD students who have successfully defended their dissertations (minimum: 1).

In my opinion, the contributions of Assoc. Prof. Dr. Stanka Hadzhikoleva characterize her as an established scholar with significant achievements, which fully support the assertion that she meets all the criteria for being considered a leading researcher in the field of Informatics, and more specifically, in the area of Artificial Intelligence.

4. Evaluation of the candidate's personal contribution

I acknowledge that serious research in the scientific field in which Assoc. Prof. Stanka Hadzhikoleva works is generally a collective effort; however, I have no doubt regarding her personal involvement and contribution to the submitted materials. I have found no evidence of plagiarism.

5. Critical remarks and recommendations

I have no critical remarks regarding the materials submitted by the candidate. I recommend that Assoc. Prof. Stanka Hadzhikoleva continue to actively supervise Doctoral students, postdoctoral researchers, and young scientists in order to pass on her extensive academic and teaching experience to the next generation of Bulgarian educators and researchers.

6. Personal impressions

I have known Assoc. Prof. Hadzhikoleva since 2013, from the period of our collaboration on the FETCH LdV project ("Future Education and Training in Computing: How to Support Learning at Anytime Anywhere"). Since then, I have had the opportunity to evaluate the dissertations and academic work of her Doctoral students. I consider Assoc. Prof. Stanka Hadzhikoleva to be an outstanding professional in both her research and teaching activities – a valuable asset to the Faculty of Mathematics and Informatics at University of Plovdiv Paisii Hilendarski, with significant scientific achievements and strong teaching competencies.

CONCLUSION

The documents and materials submitted by Assoc. Prof. Dr. Stanka Ivanova Hadzhikoleva **meet all the requirements** of the Law for the Development of the Academic Staff in the Republic of Bulgaria (LDASRB), the Regulations for the Implementation of the LDASRB, and the relevant regulations of University of Plovdiv Paisii Hilendarski.

The candidate in the competition has presented a **substantial** number of scientific works published after the materials used for the defense of her Doctoral degree and for the competition for the academic position of Associate Professor. Her research contains original scientific and applied contributions that have received international recognition, with a representative portion published in journals and scientific collections issued by international academic publishers. Her theoretical developments have practical applicability, with part of her work being directly oriented toward teaching. The scientific and teaching qualifications of Assoc. Prof. Dr. Stanka Hadzhikoleva are **beyond doubt**.

The results achieved by Assoc. Prof. Dr. Stanka Hadzhikoleva in her teaching and research activities **fully comply** with the minimum national requirements and the additional requirements of the Faculty of Mathematics and Informatics, established in accordance with the Regulations of

University of Plovdiv Paisii Hilendarski for the implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria.

After reviewing the materials and scientific works submitted for the competition, and analyzing their significance as well as the scientific, applied scientific, and practical contributions they contain, I find it well justified to give my **positive** evaluation and to **recommend** that the Academic Jury prepare a report-proposal to the Faculty Council of the Faculty of Mathematics and Informatics for the election of Assoc. Prof. Dr. Stanka Ivanova Hadzhikoleva to the academic position of *Professor* at University of Plovdiv Paisii Hilendarski in the field of higher education: Area 4. Natural Sciences, Mathematics and Informatics, Professional Field 4.6. Informatics and Computer Science (Artificial Intelligence).

April 11, 2025 Reviewer: .....

(*Prof. Dr. Desislava Paneva-Marinova*)