REVIEW

by Prof. Dr. Maria Petkova Hristova

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 November 19, 2024, and on the official website of University of Plovdiv Paisii Hilendarski, for the needs of the Department "Computer Informatics" at the Faculty of Mathematics and Informatics, the candidate Associate Professor Dr. Stanka Ivanova Hadzhikoleva from the Department "Computer Informatics" at the same Faculty of Mathematics and Informatics is participating.

1. General Provisions of the Competition

By Order No. RD22-443 dated February 18, 2025, issued by the Rector of University of Plovdiv Paisii Hilendarski (PU), I was appointed as a member of the academic jury for the competition announced in the State Gazette, issue No. 98 of November 19, 2024, for the academic position of "Professor" at PU in the professional field 4.6. Informatics and Computer Science (Artificial Intelligence). By decision of the academic jury made at the meeting held on February 24, 2025, I was appointed as a reviewer. This review has been prepared based on the documents submitted for participation in the competition by the sole candidate – Associate Professor Dr. Stanka Ivanova Hadzhikoleva, and complies with the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria (LDASRB), its implementing regulations (ILDASRB), and the Rules for the Development of the Academic Staff at Paisii Hilendarski Plovdiv University (RDASPU).

The set of materials submitted by the candidate complies with the Rules for the Development of the Academic Staff at Plovdiv University Paisii Hilendarski and includes the following documents:

1. Curriculum vitae in the European format.
2. Diploma for higher education with the awarded educational qualification degree "Master", series PU-2000, No. 033252, reg. No. 2617-M, dated November 3, 2000.
3. Diploma for the educational and scientific degree "Doctor", No. 1000062, issued on June 24, 2013.
4. Certificate for the academic position "Associate Professor", No. 3000098, issued on October 19, 2016.
5. List of scientific publications.
6. Copies of the scientific publications submitted for the competition.
7. Report on compliance with the minimum national requirements.
8. Report on compliance with the additional faculty requirements.
9. Declaration of originality and authenticity of the submitted documents.
10. Annotations of the materials under Article 76 of the RDASPU (in Bulgarian and a foreign language).
11. Self-assessment of contributions under Article 76 of the RDASPU (in Bulgarian and a foreign language).
12. Extended habilitation report on scientific contributions.
13. List of identified citations.
14. Certificate of employment history, ref. No. RD-38-20/20.01.2025.
15. Documents related to teaching activity.
16. Documents related to research activity.

Assoc. Prof. Dr. Stanka Hadzhikoleva has submitted for participation in the competition 30 scientific publications, one textbook, and a list of her participation in 17 research and educational projects.

I would like to specifically highlight the exceptional precision with which the competition documents have been prepared.

All of the candidate's academic output falls thematically within the scope of the competition's professional field 4.6 Informatics and Computer Science. All publications were produced during the period 2019–2024 and have not been previously submitted for the acquisition of the educational and scientific degree "Doctor" or for holding the academic positions of "Assistant Professor" or "Associate Professor". Therefore, all contributions are taken into account in the final evaluation for this competition.

No plagiarism, as defined and proven by the procedures established by law, has been found in the works submitted for evaluation. After reviewing the materials submitted for the competition and conducting the necessary checks, I confirm this statement.

2. Brief Biographical Information about the Candidate in the Competition

Assoc. Prof. Dr. Stanka Ivanova Hadzhikoleva graduated from University of Plovdiv Paisii Hilendarski in 2000 with a degree in Mathematics, specialization in Informatics, and a second major in Mathematics and Informatics, obtaining the professional qualification "Teacher of Mathematics and Informatics". Between 2010 and 2013, she was a PhD student in Informatics at the same university, where, after defending her dissertation on the topic "Modeling and Management of Quality Assessment Methodologies (with Application in the Educational System)" in 2013, she was awarded the educational and scientific degree "Doctor" in the professional field 4.6 "Informatics and Computer Science". The candidate has also completed trainings in plagiarism prevention with StrikePlagiarism, teacher training in Juraj Dobrila University of Pula (Croatia), innovative educational technologies, digital psychology, as well as participated in the Google Certified Educator training program. She has worked as a teacher of Informatics, Information Technologies, and Computerized Accounting, and has professional experience as a system software support specialist, manager of the "Academy of High Technologies" Consortium, and Managing Partner at FracTime Ltd. From 2002 to 2016, she successively held the academic positions of Assistant and Chief Assistant at the Faculty of Mathematics and Informatics at Plovdiv University. Since 2016, she has been an Associate Professor in the Department "Computer Informatics".

Assoc. Prof. Hadzhikoleva is actively engaged in public activities, serving as a founder and chairperson of the Management Board of the Association "Science, education, technology", as well as chair of the "Mathematics and computer science" section at the Union of Scientists in Bulgaria – Plovdiv, among others. She is a member of the Union of Mathematicians in Bulgaria, the Union of Scientists in Bulgaria – Plovdiv, and the Union of Electronics, Electrical Engineering and Communications.

She participates in the editorial boards and committees of several journals, including: Computer Science and Interdisciplinary Research Journal (CSIR), Proceedings of the Union of Scientists – Plovdiv, Series B – Natural Sciences and the Humanities and Series C – Technics and Technologies, International Journal of Advanced Technology and Engineering Exploration (IJATEE) – SCOPUS, Journal of Artificial Intelligence Practice, International Journal of Advanced Computer Research, SCIREA Journal of Computer, among others.

3. General Overview of the Candidate's Activity

3.1 Evaluation of the Candidate's Teaching and Educational Activity

The teaching and educational activity of Assoc. Prof. Stanka Hadzhikoleva is extensive and significant, and is reflected in:

- Delivering lecture courses at University of Plovdiv Paisii Hilendarski in key subjects within the field of Informatics and Computer Science: Databases, Software Technologies, Introduction to Cloud Technologies, Mobile Applications, Intelligent Data Analysis with Orange,

Graph Databases with Neo4j, Designing and Presenting Theses and Research Papers, Modeling and Managing Business Processes, etc.;

- Conducting lecture courses in other higher education institutions: Thracian University – Stara Zagora – "Programming for mobile devices"; Technical University – Plovdiv branch – "Discrete structures"; Burgas Free University – Burgas – "Organization and functioning of Data centers"; Higher School of Agribusiness and Regional Development – Plovdiv – "Database design", "SQL queries in databases", "Searching for information in databases"; Academy of Music, Dance and Fine Arts – Plovdiv – "Interactive design, interactive systems and installations";
- Developing fully or partially electronic courses, available on Moodle, for 11 of the aforementioned academic subjects;
- Published 2 textbooks in co-authorship – "Fundamentals of Programming with Java" and "Introduction to Databases", publ. University Press "Paisii Hilendarski" - Plovdiv;
- In the period 2016–2024, she has supervised 12 undergraduate students who successfully defended their theses within the Bachelor's programs at the Faculty of Mathematics and Informatics;
- She is the academic advisor of seven PhD students, two of whom have successfully defended their dissertations;
- For the period 2015–2024, Assoc. Prof. Hadzhikoleva has 15 co-authored publications with students;
- She has served as an academic mentor to over 40 students who completed practical training in business organizations within the framework of the "Student Internships" projects;
- She has led 4 university research and educational projects, involving more than 60 students, PhD students, and young researchers.

I highly value the teaching and educational activity of Assoc. Prof. Hadzhikoleva.

3.2. Evaluation of the Candidate's Scientific and Applied Research Activity

The candidate has submitted a complete list of her scientific works, consisting of 118 scientific publications (including 2 monographs, 2 books), and 2 textbooks.

A total of 30 scientific publications and 1 textbook were submitted for participation in the competition. Twenty-seven (27) of the publications are in English, and three (3) are in Bulgarian. There are no sole-author publications or publications with one co-author; twelve (12) have two co-authors, and eighteen (18) have three or more co-authors. Of the publications, twenty-five (25) are indexed in SCOPUS and/or Web of Science. Seven (7) of them are published in scientific journals with an Impact Factor (IF), and twelve (12) have an Impact Rank (SJR). Five of the publications fall into Quartile Q1, and two into Quartile Q2. Twenty (20) of the publications are in journals and periodicals, and eight (8) are included in the proceedings of international conferences.

The publications appear in authoritative, prestigious, and influential journals and proceedings such as: Mathematics (WoS, Q1, IF=2.3; SCOPUS, SJR=0.475), Applied Sciences (WoS, Q1, IF=2.5; SCOPUS, SJR=0.508), Journal of Theoretical and Applied Information Technology, Filomat (WoS, Q2, IF=0.8; SCOPUS, SJR=0.353), Axioms (WoS, Q1, IF=1.9; SCOPUS), Sustainability (WoS, Q2, IF=3.9; SCOPUS, SJR=0.664), TEM Journal, AIP Conference Proceedings, International Journal of Emerging Technologies in Learning (iJET), International Conference on Virtual Learning, Lecture Notes in Networks and Systems, Computer Networks, Big Data and IoT, Lecture Notes on Data Engineering and Communications Technologies, International Journal of Engineering Trends and Technology, Proceedings of the 2020 IEEE 10th International Conference on Intelligent Systems, Proceedings of the ICERI2019 Conference, among others.

Assoc. Prof. Stanka Hadzhikoleva has provided a list of her participation in research and educational projects, in which, in my opinion, she has made a significant contribution and achieved tangible results. As a member of the team from University of Plovdiv Paisii Hilendarski, the candidate participated in the international project "Future Education and Training in Computing: How to Support Learning at Anytime Anywhere (FETCH)" (2013–2016), funded by the European Commission under the Lifelong Learning Programme. Assoc. Prof. Hadzhikoleva has also

contributed to eight national projects funded by the Operational Programme "Human Resources Development" of the European Social Fund, some of which include: "Standardization and Integration of Diverse Information and Management University Systems (SIRIUS)", "Plovdiv Electronic University (PeU): A National Benchmark for Delivering High-Quality E-Learning in the Higher Education System", "Support for the Creative Development of Doctoral Students, Postdoctoral Researchers, and Young Scientists in the Field of Computer Science", and others. Her work on the national projects "Student Internships" (2013–2015), "Student Internships – Phase 1" (2016–2018), and "Student Internships – Phase 2" (2020–2023) includes developing training programs, providing supervision, and supporting the practical training of students in real-world environments.

Assoc. Prof. Hadzhikoleva has participated in eight university projects funded by the Research Fund at University of Plovdiv Paisii Hilendarski, serving as the project leader for four student projects. The main objective of these projects is to stimulate the creative development of students and help them acquire basic competencies for conducting scientific research.

Compliance with the criteria for appointment to the academic rank of Professor

Pursuant to Article 61 of the Regulations for the Implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria (respectively Article 29 of the Law), candidates for the academic position of Professor are evaluated based on the fulfillment of the conditions set out in Article 60, paragraphs 1 and 2, and in accordance with the information provided in the references under Article 60, paragraph 3. Upon reviewing the submitted documents, it is established that Assoc. Prof. Hadzhikoleva meets the requirements of the above-mentioned legal provisions. According to a certificate issued by Plovdiv University, as of January 16, 2025, Assoc. Prof. Hadzhikoleva has a total length of service of 23 years, 7 months, and 15 days, of which 8 years, 2 months, and 27 days in the position of Associate Professor, thereby proving compliance with the required professional experience.

With regard to the fulfillment of the minimum national requirements under the groups of indicators for holding the academic position of Professor in Field of Higher Education 4.6 "Informatics and Computer Science" (pursuant to Article 2b, paragraphs 2 and 3, and Article 29, paragraph 5 of the Law on the Development of the Academic Staff in the Republic of Bulgaria), the following conclusions can be drawn:

- For ***Group A*** of the minimum national requirements, the candidate has submitted Diploma No. 1000062 / 24.06.2013, for a successfully defended doctoral dissertation entitled "Modeling and Management of Quality Assessment Methodologies (with Application in the Educational System)", awarded for the acquisition of the educational and scientific degree "Doctor".
- For ***Group C*** (Indicator 4: Habilitation work – scientific publications in journals that are referenced and indexed in internationally recognized scientific databases such as Web of Science, Scopus, Zentralblatt, MathSciNet, ACM Digital Library, IEEE Xplore, and AIS eLibrary), ***14 publications*** have been submitted, of which 10 are indexed in Scopus (3 with SJR), and 5 are indexed in Web of Science (1 with an Impact Factor of 2.5, in Quartile Q1).
- For ***Group D***, under Indicator D7. Scientific publications in journals that are referenced and indexed in internationally recognized scientific databases (such as Web of Science and Scopus), excluding the habilitation work, ***16 publications*** have been submitted. Of these, 7 are indexed in Web of Science (6 with an Impact Factor, 4 in Quartile Q1 and 2 in Quartile Q2), and 9 are indexed in Scopus with SJR.
- For ***Group E***, a list of ***76 citations*** (excluding self-citations) in Web of Science and/or Scopus has been submitted for the period 2018–2024, referencing 25 of the candidate's publications. The citations appear in publications such as: A Brain Machine Learning Approach. Brain Sciences (2023); International Journal of Data Mining, Modelling and Management; Journal of Mining Institute; International Conference on Industrial Engineering, Applications and Manufacturing (ICIEAM); Advances in Computing. CCC 2023. Communications in Computer and

Information Science, Springer; Physical and Engineering Sciences in Medicine (2023); Education and Development Conference (INTED), Valencia, Spain; Journal of Applied Statistics, and many others.

- For ***Group F***, the indicators in this group are fulfilled through the following: supervision of two successfully defended PhD students; participation in six national scientific/educational projects; participation in one international scientific project; and publication of one university-level textbook.

The candidate meets the minimum requirements, as shown in the table below:

Indicator Group	***Indicator***	***Required points***	***Assoc. Prof. Stanka Hadzhikoleva***
A	Indicator 1	50	**50**
B	Indicator 2	…	**…..**
C	Indicator 4	100	**279**
D	Indicator 7	200	**612**
E	Indicator 11	100	**608**
F	Sum of indicators 12 to end	100	**190**
	Total		**1739**

To meet the additional faculty requirements of the Faculty of Mathematics and Informatics at Plovdiv University for participation in a competition for the academic position of Professor, which include at least 25 publications not used in previous academic promotion procedures, the candidate has submitted 30 publications. Of these, 29 are published in journals or proceedings of international scientific conferences, exceeding the faculty's minimum requirement of 15. Additionally, in response to the requirement of at least 10 publications in journals, the candidate has submitted 15. Regarding the minimum requirement of 20 citations, the candidate has provided a list of 76 verified citations.

A well-founded conclusion can be drawn that the candidate Assoc. Prof. Stanka Hadzhikoleva not only fully meets, but also exceeds the minimum national requirements under the indicators for holding the academic position of Professor in Field of Higher Education 4.6 "Informatics and Computer Science", as well as the additional requirements of the Faculty of Mathematics and Informatics at University of Plovdiv Paisii Hilendarski.

The reports (as of 31.03.2025) from Web of Science and Scopus show the following scientometric indicators for the candidate: Web of Science: H-index – 4, 24 cited publications, 59 citing articles, 62 citations; Scopus: H-index – 5, 31 cited publications, 142 citations across 124 documents. These figures provide further evidence of the high professional level of the candidate's research work and its international visibility.

Assoc. Prof. Hadzhikoleva serves on the editorial boards of scientific journals in both Bulgaria and abroad, including: International Journal of Advanced Technology and Engineering Exploration (ISSN: 2394-7454), Journal of Artificial Intelligence Practice (ISSN: 2371-8412), International Journal of Advanced Computer Research (ISSN: 2277-7970), Proceedings of the Union of Scientists in Bulgaria – Plovdiv, Series B – Natural Sciences and the Humanities (ISSN: 2534-9376), Series C – Technics and Technologies (ISSN: 2534-9384), and Series G – Medicine, Pharmacy and Dental Medicine (ISSN: 2534-9392). She also participates in organizational and program committees of scientific conferences such as the International Conference of Young Scientists – Plovdiv and the Scientific Conference "Days of Science 2024" – Plovdiv.

4. Identification of the candidate's contributions to scientific research

Based on the scientific works of the candidate Assoc. Prof. Hadzhikoleva, four main directions of her research interests can be distinguished:

- *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, 29];
- Models of AI-based software applications [2, 3, 7];
- Models for ensuring the quality of education [18, 19, 25, 26];

- *Artificial Intelligence Models*
  - Models in the field of energy [8, 16, 20, 24, 30];
  - Models in textile manufacturing [9, 10];
  - Models in bioinformatics [12, 14];
  - Other applications of AI [1, 4, 5];
- *Neural Networks – Architectures and Studies [6, 11, 13, 23, 27];*
- *Textbooks and Teaching Materials for Student Education [31];*

The scientific, applied-scientific, and practical contributions can be classified according to the thematic areas and research methods as follows:

The scientific contributions can be summarized as follows:

- 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 ***applied-scientific contributions*** in the works can be systematized as follows:

- 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 ***practical contributions*** are related to the development and experimentation of the following: a prototype of a cloud-based application for automated test creation and management using generative artificial intelligence [3]; a prototype of a software application supporting tools for storing and analyzing information on bioactive peptides [12, 14]; a prototype of a software application for predicting the execution time of customer orders in the textile industry using artificial intelligence [10]; multiple educational games based on generative artificial intelligence [2, 7]; an empirical experiment on learning with AI tools that stimulate the development of higher-order thinking skills [8]; experiments, analysis, and evaluation of ChatGPT as an educational tool capable of generating questions aligned with Bloom's cognitive levels [15]; an experiment on the automated comprehensive assessment of students' higher-order thinking skills using neural networks [29]; experiments on forecasting electricity consumption in Bulgaria, including household consumption, industrial consumption, total energy consumption, and more [18, 19]; experiments on predicting power system losses in Bulgaria using neural networks [25], and others.

Educational and Methodological Contributions

The candidate's authored textbook "Introduction to Databases" is professionally written and offers a comprehensive and systematic approach to the study of relational databases, combining theoretical concepts with practical applications. It is intended for students enrolled in Field of Higher Education 1.3 "Teaching Methodology of..." and 4.5 "Mathematics".

In summary, the research of Assoc. Prof. Hadzhikoleva is related to: 1) The development, investigation, and validation of educational resources, models, methodologies, frameworks, and pedagogical patterns using innovative technologies, including artificial intelligence (in 14 publications); 2) The conduction of numerous experiments with neural networks and the creation of models, algorithms, and applications in various fields such as energy, textile manufacturing, bioinformatics, and others (covered in 11 publications); 3) Analytical studies and experiments in the field of neural networks, focused on the automated detection, analysis, and comparison of neural networks for approximation (included in 5 publications).

Significance of the contributions to science and practice

Based on the overall analysis of the scientific, applied-scientific, practical, and educational-methodological contributions of Assoc. Prof. Hadzhikoleva, it can be concluded that these contributions are original and significant for science, practice, and the educational process. Evidence of their importance is also reflected in the numerous and reputable citations they have received. The contributions are the result of the candidate's individual work or collaborative efforts with her active involvement, and they carry academic weight in advancing the field of 4.6 Informatics and Computer Science, as relevant to the competition at Plovdiv University.

5. Critical Remarks and Recommendations

I have no critical remarks.

I do, however, have a recommendation. In my opinion, the inclusion of authorship contribution statements (authorship declaration protocols) for the co-authored scientific works would help to more clearly highlight the candidate's individual contributions.

I would recommend that Assoc. Prof. Hadzhikoleva further strengthen her individual publication activity and, based on her scientific work, publish a monograph through which to disseminate the recognized scientific contributions of her research.

These remarks and recommendations do not diminish the positive overall impression of the candidate's scientific achievements presented in the competition.

6. Personal Impressions

I am not personally acquainted with the candidate in this competition and therefore do not have any direct impressions of her. Nevertheless, I believe that Assoc. Prof. Stanka Hadzhikoleva is an erudite lecturer and researcher, thoroughly familiar with the current state of science in her field. This impression is supported by the references cited in her works, the quality of her research - meeting high contemporary standards – and her membership in reputable academic and professional organizations in the field of informatics and computer science.

CONCLUSION

The documents and materials submitted by Assoc. Prof. Dr. Stanka Ivanova Hadzhikoleva comply with all the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its Implementation, and the corresponding Regulations of University of Plovdiv Paisii Hilendarski. The candidate has submitted a significant number of scientific works published after those used in support of her PhD degree and her application for the academic position of Associate Professor. Her works contain original scientific, applied-scientific, and practical contributions that have received international recognition, with a representative portion published in journals and scientific proceedings issued by international academic publishers. The scientific and teaching qualifications of Assoc. Prof. Dr. Stanka Ivanova Hadzhikoleva are unquestionable.

The results achieved by Assoc. Prof. Dr. Stanka Ivanova Hadzhikoleva in her teaching and research activities are related to issues and specific tasks within the scope of the announced competition and characterize her as a scholar with a high level of professional qualification. The results fully meet the minimum national requirements as well as the additional requirements of the Faculty of Mathematics and Informatics, adopted in accordance with the Regulations of Plovdiv University for the implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria.

All of the above provides a solid basis for me to give my entirely **positive evaluation** of the submitted materials and scientific works, and to recommend that the Scientific Jury prepare a report-proposal to the Faculty Council of the Faculty of Mathematics and Informatics for the appointment of Assoc. Prof. Dr. Stanka Ivanova Hadzhikoleva to 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).

10.04.2025 г. Reviewer: ……

/Prof. Dr. Maria Hristova/