REVIEW
of the documents submitted for participation in the competition
for occupation of the academic position "Associate Professor"
in professional field 4.6 Informatics and Computer Science (Programming),
announced in State Gazette No. 61 of August 2, 2022
by Sofia University St. Kliment Ohridski (SU),
Faculty of Mathematics and Informatics (FMI)

This review is prepared by Prof. Dr. Maria Nisheva-Pavlova from Sofia University St. Kliment Ohridski, FMI, as a member of the scientific jury for the competition according to Order No. РД 38-561/28.09.2022 of the Rector of SU.

One applicant has submitted documents for participation in the announced competition: Dr. Dafina Petkova, Senior Assistant Professor at FMI, SU.

1. General description of the materials presented

The documents of the applicant comply with the requirements of the Act of the Development of the Academic Personnel of the Republic of Bulgaria (ADAPRB), the Rules for the Implementation of the Act of the Development of the Academic Personnel of the Republic of Bulgaria (RIADAPRB) and the Rules on the Terms and Conditions for Acquisition of Academic Degrees and Occupation of Academic Positions at SU (RTCAADOAPSU).

The applicant has submitted for the competition:

- Professional autobiography,
- Copy of diploma for higher education,
- Copy of diploma for educational and scientific degree "Doctor",
- Copy of certificate for occupation of the academic position "Senior Assistant Professor",
- Certificates of internship in the speciality,
- Documents proving the fulfillment of the requirements of Art. 115, para. 1, item 2 of RTCAADOAPSU,
- Lists of publications (list of all publications and list of publications presented at the competition),
- List of publications, presentations, projects and supervision activities, generated by the information system of SU,
- Reference for the fulfillment of the minimum national requirements and the requirements of SU for the professional field 4.6 Informatics and Computer Science,
- List of citations of publications of the applicant in articles of other authors,
- Reference for original scientific contributions,

- Reference for the degree of fulfillment of the indicators under Art. 112, para. 2 of RTCAADOAPSU,
- Copies of publications presented at the competition,
- Abstracts of the publications presented at the competition (in Bulgarian and in English),
- Copy of the competition announcement in the State Gazette.

The documents of the applicant have been prepared in full compliance with the requirements of RTCAADOAPSU.

2. Details of the applicant

The applicant Dr. Dafina Petkova has a master's degree in Informatics (Bio and Medical Informatics) obtained at the Faculty of Mathematics and Informatics of Sofia University. In 2021, after successfully defending a PhD thesis on the topic "Research and implementation in the theory of generalized nets", she received a doctoral degree. In 2004-2007 she worked as a programmer in various software companies. From 2006 until now, she has worked successively as an assistant professor in the Department of Computer Informatics of FMI, assisting in teaching Introduction to Programming, Object-oriented Programming, Data Structures and Programming, Databases. In the 2021/2022 academic year she was the leading lecturer of the course in Object-oriented programming for Informatics and Information Systems students at FMI.

3. General characteristics of the applicant's scientific work and achievements

The research activities of Dr. Dafina Petkova and the topics of her scientific works are entirely in the field of the competition. She participates in the competition with nine publications that do not repeat those of the previous procedure for the acquisition of her doctoral degree.

All publications submitted for participation in the competition are co-authored. The personal contribution of the individual co-authors is not explicitly indicated in them and I accept that all co-authors have an equal contribution.

There is no proven plagiarism in the scientific works of Dr. Dafina Petkova.

In accordance with the requirements under Art. 1a, para. 1 of the RIADAPRB, the candidates for an the academic position of "Associate Professor" in professional field 4.6 Informatics and Computer Science must have: 50 points in group of indicators "А", at least 100 points in group of indicators "В", at least 200 points in group of indicators "Г", at least 50 points in group of indicators "Д".

RTCAADOAPSU does not define higher additional requirements than those specified in the RIADAPRB.

According to the submitted documents the applicant covers:

- 50 points in group of indicators "А",

- 123 points in group of indicators “В”,
- 210 points in group of indicators “Г”,
- 56 points in group of indicators “Д”.

Therefore, the minimum national requirements and the additional requirements under Art. 1a, para. 2 and para. 3 of the RIADAPRB for occupation of the academic position of “Associate Professor” in the professional field 4.6 Informatics and Computer Science have been completely covered Dr. Dafna Petkova.

4. **General characteristics of the applicant's teaching activities**

The teaching activities of Dr. Dafina Petkova are completely in the area of the competition. She takes part in teaching the compulsory courses in Introduction to Programming, Object-oriented Programming, Data structures and Programming for BSc students in Informatics and Information Systems at FMI. She works actively and engaged with her students, skillfully combining her deep theoretical knowledge with the accumulated practical experience.

5. **Substantive analysis of the scientific and applied scientific achievements of the applicant, presented in the materials for participation in the competition**

The scientific papers, presented by Dr. Dafina Petkova for participation in the competition contain original research results in the field of Informatics. The main contributions of the applicant are in three thematic areas: metaheuristic algorithms, generalized nets, intercriteria analysis.

The most significant results presented in the competition materials can be grouped and summarized as follows:

- Group 1: *Metaheuristic algorithms* (publications В4.1, В4.2, В4.3, Г7.1, Г7.2). The behavior and performance of several types of metaheuristic algorithms: genetic algorithms, the firefly algorithm, the ant method, the artificial bee colony algorithm, the water cycle algorithm, as well as their hybrids, have been studied in order to find the most suitable method to solve a specific type of tasks. These algorithms have been adapted and applied to the modeling of non-linear processes and more specifically to the parametric identification of fermentation processes. In particular, an adapted version of the water cycle algorithm has been applied for the first time to the task of parametric identification of models of bacterial and yeast fermentation processes, showing that it achieves better model accuracy than the genetic algorithm tuned optimally for the same task.

  An iterative procedure for setting control parameters of metaheuristic algorithms was constructed, designed to find an optimal set of parameter values from the point of view of the efficiency of the corresponding algorithm and the necessary computing resources. This procedure has been successfully applied to two metaheuristic algorithms – a genetic algorithm and the artificial bee colony algorithm. In the case of the genetic algorithm, appropriate values of the crossover and mutation probabilities were found, and in the case of the artificial bee colony algorithm – values for the population size and the *limit*

control parameter, with the corresponding pairs of parameters set simultaneously. The algorithms adjusted in this way were applied for parametric identification of a model of a semi-periodic cultivation process of bacteria. It has been shown that the proposed process of joint adjustment of the parameters leads to a significant increase in accuracy and a sharp reduction in the amount of necessary computing resources for the operation of the pointed algorithms.

The artificial bee colony algorithm is hybridized with a genetic algorithm for parametric identification of a model of a semi-periodic cultivation process of bacteria. The behavior of the created hybrid algorithm is analyzed and compared with that of other known hybrid metaheuristic techniques in solving the same parametric identification task, and its better computational efficiency is shown.

- Group 2: *Generalized nets* (publications В4.3, Г7.3, Г7.5, Г7.6). A generalized net model has been developed that describes the operation of the artificial bee colony algorithm. In this way, progress has been made in solving one of the open problems in the theory of generalized nets.

  A generalized net model describing the production processes of different types of gasoline is proposed.
- Group 3: *Intercriteria analysis* (publications Г7.2, Г7.4). A study of the influence of the parameters of the artificial bee colony algorithm on its performance was carried out, and for this purpose an intercriteria analysis was applied to extract additional knowledge about the relationships between the differently tuned algorithms of this group.

  A multi-criteria analysis of the decision-making task in the control, diagnosis and evaluation of the indoor hockey training process was performed. Indicators that reflect the training of indoor hockey players have been studied. The obtained results were used for analysis and evaluation of the influence of an introduced experimental methodology for training.

The significance of the applicant's research results is evidenced by their reflection in the works of other authors. Dr. Dafina Petkova submitted data for a total of seven citations of publications, with which she participates in the competition, in articles of other authors that were referenced and indexed in Scopus.

6. Critical notes and recommendations

I have no significant critical comments on the scientific papers of Dr. Dafina Petkova submitted for participation in the competition. I recommend that in her future work she expands the thematic scope of her teaching and research activities. In particular, I recommend her to work more actively with graduate students. I also recommend her to aspire in her future work to some single-authored publications, presenting results to which she has a key contribution.

7. Personal impressions of the applicant

I have excellent personal impressions of Dr. Dafina Petkova's work as an assistant professor at FMI. I highly appreciate her professionalism, her responsible attitude to duties, her initiative and her teaching dedication.

8. Conclusion on the application

Having become acquainted with the materials and scientific works presented in the competition and on the basis of the analysis of their significance and the scientific and applied scientific contributions contained therein, I **confirm** that the academic achievements of the candidate Dr. Dafina Petkova meet the requirements of the ADAPRB, the Regulations for its implementation and the corresponding Regulations of SU for the occupation of the academic position of "Associate Professor" in the professional field "Informatics and Computer Science". In particular, the applicant meets the minimum national requirements in the professional field and no plagiarism has been detected in her scientific papers submitted at the competition.

I give a **positive assessment** of the application of Dr. Dafina Petkova.

GENERAL CONCLUSION

Based on the above, **I recommend the scientific jury to vote on a proposal to the Council of the Faculty of Mathematics and Informatics of Sofia University St. Kliment Ohridski to select Dr. Dafina Petkova for the academic position of "Associate Professor" in the professional field 4.6 Informatics and Computer Science**.

November 20, 2022 Reviewer: .....

(Prof. Dr. Maria Nisheva-Pavlova)