

REER REVIEW
for the competition for the academic position “Professor”
in the Professional Field 4.5 Mathematics (Mathematical Logic),
for the needs of the Sofia University “St. Kliment Ohridski”
Faculty of Mathematics and Informatics (FMI of SU),
announced in Newspaper of State, No. 59 of 2019
and at the Internet pages of FMI and SU

The peer review is written by **Prof. D.Sci. Vesselin Stoyanov Drensky, Full Member of the Bulgarian Academy of Sciences**, working at the Institute of Mathematics and Informatics of the Bulgarian Academy of Sciences, Professional Field 4.5 Mathematics, as a member of the Scientific Jury for the competition by Order No. ПД 38-555/25.09.2019 of the Rector of the Sofia University.

The only applicant who has applied for the position is

Assoc. Prof. Ph.D. Alexandra Andreeva Soskova from the Department of Mathematical Logic and Applications at the Faculty of Mathematics and Informatics of the Sofia University “St. Kliment Ohridski”.

I. Description of the presented documents

1. Information about the documentation

The documentation presented by the applicant is in accordance with the requirements of the law and the accompanying rules of the Sofia University.

The applicant for the position Assoc. Prof. Ph.D. Alexandra Andreeva Soskova participates in the competition with 11 publications in foreign scientific issues. She has also added 30 other documents which concern: the announcement for the competition; the statement that she wants to apply for the position; CV; diplomas for M.Sci., Ph.D., Assoc. Professorship; documents confirming her position at the University; proofs that she covers the minimal scientific requirements of the law for the position; two recommendation letters of mathematicians from USA, as well as data for the scientific activity of the applicant which we shall comment below.

2. Information for the applicant

The applicant Alexandra Soskova graduated at the FMI of SU and received a Master of Science diploma in Mathematical Logic. Later, she completed the Ph.D. program at the FMI of SU and defended her Ph.D. Thesis on “Effective Algebraic Systems”. With M.Sci. diploma she

worked for national computer firms. After the defence of her Ph.D. Thesis Alexandra Soskova visited for two years UCLA. Later and up till now she works at the Department of Mathematical Logic and Applications of the FMI of SU, consecutively as an Assistant Professor and Associate Professor. She was 8 years Chairperson of the Department and 2 years Vice-Dean of the FMI. For more than 10 years she is a coordinator of Erasmus for Amsterdam, Istanbul, and Siena.

3. General characteristic of the scientific work and achievements of the applicant

The main scientific results of Assoc. Prof. Soskova are in Mathematical Logic and its applications to Theoretical Computer Science. According to Mathematics Subject Classification (MSC 2010) accepted by Mathematical Reviews and Zentralblatt her publications are in the fields:

03C Model theory (Effective and recursion-theoretic model theory);

03D Computability and recursion theory (Other Turing degree structures, Theory of numerations, Effectively presented structures, Abstract and axiomatic computability and recursion theory);

68Q Theory of computing (Abstract data types; algebraic specification).

Most of the main results of the applicant are in the problematics successfully developed both abroad and by the Bulgarian school in Mathematical Logic which is internationally recognized for many years. Assoc. Prof. Soskova has obtained serious results in the above listed branches of mathematics and has shown that she is one of the successful members of the Bulgarian school. The list of her publications consists of 11 papers presented for the competition, and the other publications are 9 papers in journals, 7 in proceedings of conferences, 2 biographical papers, and 11 abstracts in materials of conferences. Assoc. Prof. Soskova is also an author of 2 books. Additionally she has presented a list of 64 talks at conferences and seminars both in Bulgaria and during her visits at universities and scientific centers in Argentina, Austria, Belgium, France, Germany, Great Britain, Italy, New Zealand, Russia, Singapore, and USA. It was a pleasure for me to see that most of the presentations of the talks can be found at the home page of the applicant in the Internet site of the FMI. As an additional argument I like to mention that Assoc. Prof. Soskova was a project coordinator or a member of the team in a series of national and international projects financed by the Bulgarian National Science Fund, Sofia University, USA, European projects, etc.

It can be concluded from the applied documentation that:

- a) The scientific publications satisfy the minimal requirements of the law and the accompanying rules of the Sofia University for the academic position “Professor” in the scientific field of the competition;
- b) The scientific publications submitted for the completion have not been used in previous applications;
- c) No plagiarism has been established in the presented for the competition works.

4. Characteristics and evaluation of the teaching activity of the applicant

Assoc. Prof. Soskova has a longtime and successful teaching activity. She has read and continues to read many courses in the Masters and Bachelor programs at the Department: For Master students: Model Theory and Computability Theory. For Bachelor students: Mathematical Logic, Discrete Mathematics, Logical Programming, etc. She has read courses in foreign languages for the Masters program of the FMI, for the Technical University of Sofia, in Istanbul. She is responsible for one of the Masters programs of the FMI. She is a leader of a team which works for introducing new methods for teaching at the FMI. Assoc. Prof. Soskova was an advisor of two Master students who later became her Ph.D. students. One of them already defended his thesis and the thesis of the other is in preparation.

5. Analysis of the scientific and scientific-applied achievements of the applicant contained in the documents and publications presented for the competition

The applicant has presented for the competition 11 papers: 4 published in J. Logic and Computation, 4 in Lecture Notes in Computer Science, and 3 are in proceedings of conferences in Greece; 4 papers are with the applicant as a single author, 4 are joint with Ivan Soskov, 1 with Maria Soskova, 1 with the students of the applicant, and one paper is with 7 coauthors, 5 of them are from abroad. I accept that the coauthors have the same participation in the joint papers. (For some of the papers this is stated in the documentation.) All papers are published in the period 2006 – 2018.

Besides the abstracts of the papers presented for the competition in Bulgarian and English Assoc. Prof. Soskova has included in her documentation detailed exposition for her achievements (on 49 pages with list of references containing 113 items). This text gives an excellent possibility for orientation in the problems and exactly reflects her achievements and their place in the general picture. One can see also the interrelations in the investigations of the members of the Bulgarian school of Mathematical Logic.

In Classical Computability Theory one studies countable or finite constructive objects, e.g., sets of words in a finite alphabet. The natural generalization Computability Theory in

Abstract Structures allows the study of more general objects. A special merit for this is due to Prof. Dimiter Skordev who started the development of Algebraic Theory of Recursion. On the other hand Enumeration Reducibility gives an approach to compare information for sets of nonnegative integers. The combination of methods of Enumeration Reducibility and Abstract Computability gives rise for a new direction in Effective Model Theory. The leading idea of the papers presented for the competition is to show how Enumeration Reducibility helps to solve a series of problems in Effective Model Theory. Classical problems in the theory are also studied, e.g., jumps of structures, jump inversion theorems, effective coding and decoding of one class of structures to another class. In the proofs the applicant uses a large arsenal of techniques of Mathematical Logic.

The character of the scientific contributions of the applicant are in developing of new methods and enriching of the existing knowledge. Since the results have some relations with Theoretical Computer Science they may have also indirect impact on the applications in practice.

Assoc. Prof. Soskova has grouped her publications in several groups.

Properties of quasi-minimal degrees with respect to the enumeration spectrum.

The paper [1] from 2013 written jointly with Ivan Soskov contains analogues of classical results on enumeration degrees. The authors develop further earlier ideas of Soskov combined with techniques developed by Ganchev. As a consequence they obtain results by other authors.

Relativized spectra. One way to characterize the complexity of a structure is by the description of the definable sets of the structure. This gives more information about the structure than the spectrum because structures with the same spectrum may have different model theoretical properties. In this direction is the paper [7] from 2007 and its preliminary shorter version [4] from 2006 presented in the proceedings of a conference. The author introduces the notion of relativized spectrum which generalizes the notion of spectrum. A series of results of the spectra are transferred to relativized spectra. Such results are the theorem for minimal pair and the existence of quasi-minimal degrees.

ω -enumeration spectra. This part of the contributions of the applicant is contained in the paper [3] from 2008. As in [4] and [7], the notion of enumeration spectrum of a structure with respect to an infinite sequence of sets is generalized this time based on ω -enumeration reducibility. Again, it has turned out that many properties of spectra can be transferred also to this case.

Jump of structure. The papers [5, 6, 8] from 2007 – 2009, two of them written jointly with Ivan Soskov, are devoted to the notion jump of structure. A theorem for jump inversion is

established using Marker extensions and forcing. The joint paper [9] with Ivan Soskov contains applications which allow to construct structures with given spectra and jumps. The paper [10] from 2015 is a joint work with the students of Assoc. Prof. Soskova. The authors suggest a generalization of the notion jump sequence and jump polynomial of sets to the corresponding notion of sequences of structures. As an application they give a condition for equivalence of structures. The paper [11] from 2018 is written by 7 authors five of them from abroad. It establishes a general result which gives sufficient conditions for strong jump inversion. The result is applied for several well known structures.

A survey article. This is article [2] from 2017 written jointly with Maria Soskova. It gives the complete picture of the results of the Bulgarian group working in the field of enumeration degrees and the relations with Effective Model Theory.

As a confirmation for the quality of the results of Assoc. Prof. Soskova she has presented a list of 72 citations of 15 of her publications, the Master Thesis and the Ph.D. Thesis. Most of the citations are in publications of established foreign mathematicians. I want also to mention two letters of recommendation by Prof. Valentina Harizanov from the George Washington University at Washington DC and by Prof. Antonio Montalbán from the University of Berkeley which contain comments on concrete results of Assoc. Prof. Soskova. Especially impressive is the letter of recommendation in 6 pages of Prof. Harizanov which may be considered as an additional peer review.

Unfortunately Assoc. Prof. Soskova has presented data for the impact factor and SJR for each of her publications but she has not presented data for the total impact factor of all of her publications. Eight of the papers presented for the competition have total impact factor 4,028 (2 are in Quartile Q2, 2 – in Q3 and 4 – in Q4) with total SJR 3,914.

6. Critical remarks and recommendations

I do not have essential critical remarks and recommendations to the documentation presented for the competition. Reading the list of all publications of Assoc. Prof. Soskova one can see that before 2017 all joint papers are with Bulgarian coauthors. The last two years the situation changed and her latest four papers are with active foreign participation. I would suggest to Assoc. Prof. Soskova to extend in the future the field of her investigations. I am convinced that she has the potential for this.

7. Personal impressions for the applicant

I know Assoc. Prof. Alexandra Soskova for almost 30 years. In that time the Bulgarian groups in Algebra and Mathematical Logic had many contacts and several times we had joint

conferences. These contacts became stronger when the Sections of Algebra and Mathematical Logic of the Institute of Mathematics and Informatics were integrated in the Section of Algebra and Logic. I have excellent personal impressions for Assoc. Prof. Soskova. In particular, she was the main driving force in the organization of the joint project between the University of Ghent and the Institute of Mathematics and Informatics in the frames of the bilateral cooperation between the Bulgarian Academy of Sciences and the Research Foundation – Flanders. As a result the project which continued two times for three years each, was very successful both for the Belgian colleagues and the Bulgarian mathematicians working in Mathematical Logic, Algebra, and Algebraic Geometry, not only at the Bulgarian Academy of Sciences but also at the Sofia University and other Bulgarian universities.

8. Conclusion for the application

After my careful and critical reading of the documentation and the publications presented for the competition and my analysis of their significance and the scientific and scientific-applied contributions **I confirm** that the scientific contributions are sufficient (as required by the law and the additional requirements of the Sofia University) for the position “Professor” in the scientific field of the competition. In particular, the applicant satisfies the minimal national requirements for the scientific field and there is not a plagiarism in the presented publications for the competition.

I give my **positive** evaluation for the application.

II. CONCLUSION

I **recommend** the Scientific Jury to suggest that the Council responsible for the election of the Faculty of Mathematics and Informatics of the Sofia University “St. Kliment Ohridski” to elect Assoc. Prof. Ph.D. Alexandra Andreeva Soskova for the academic position “Professor” in the professional field 4.5 Mathematics (Mathematical Logic).

November 26, 2019 г.

Referee:

(Prof. D.Sci. Vesselin Drensky, Full Member of the BAS)