STATEMENT REPORT

On the competition for the academic position of "Professor"

In the Scientific field: 4. Natural Sciences, Mathematics and Informatics,

Professional field: 4.5. Mathematics, Scientific specialty: „Algebra and Number Theory (Transformation Semigroups)

For the needs at the Institute of Mathematics and Informatics, Bulgarian Academy of Sciences,
Competition announced in State Gazette no. 84 / 21.10.2022 г.

This review has been prepared by

doc. D-r Silvia Parvanova Boumova,

as a member of the Scientific jury for the competition according to Order No. № 536/20.12.2022 г. of Director of the IMI, BAS.

I.General description of the procedure and submitted documents

1. Details of the procedure and documents

Only one candidate submitted documents for participation in the announced competition: Assoc. Prof. Dr. Jörg Kopitz, IMI, BAS.

An author's statement of scientific achievements is presented, which is sufficiently detailed and accurately reflects the scientific contributions of the candidate. A total of 22 other documents were presented: application for participation in the competition; resume; diplomas for completed higher education, doctor and associate professor; official note for the position of associate professor and certificate of work experience, issued by IMI, BAS; a list of doctoral students under the supervision of the candidate and his participation in conference program committees; documents showing the fulfillment of the minimum requirements; the announcement in the State Gazette, as well as data on the candidate's scientific activity.

The documents submitted by the candidate Assoc. Dr. Jörg Kopitz are in accordance with the competition comply with the requirements of the Act on the Development of the Academic Staff in the Republic of Bulgaria (ADASRB), the Rules for Implementation of the ADAS in the Republic of Bulgaria (RIADAS in the RB) and the Rules on the Terms and Requirements for Acquisition of Scientific Degrees and Occupation of Academic Positions at Intitute od Mathematics and Informatics.

2. Short CV of the applicant

Jörg Kopitz was born on 07.09.1966 in Halle, Germany. In 1989, he graduated as a mathematics and physics teacher. He defended his doctoral dissertation on the topic „Über Halbgruppen mit vereinigungshalbdistributivem Unterhalbgruppenverband“ in 1993 at the University of Potsdam. Until 2017, he held various positions at the University of Potsdam, and since 2017 he is an associate professor at the Institute of Mathematics and Informatics, BAS.

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

The candidate submitted 17 scientific publications for participation in the competition, all in journals with an impact factor and a total impact factor: 9.755. The presented articles were published in the period from 2016 to 2021 and 10 of them are with one co-author, 5 – with two co-authors and 2 – with three co-authors. The applicant has declared that the participation of all co-authors is equal.

Assoc. Dr. Kopitz has a total of 67 publications. His scientific interests are in the algebraic theory of semigroups (associative systems), i.e. the general theory of images of a set into itself that are not necessarily invertible.

The submitted documents and declarations show:

a) the scientific works fully meet the minimum national requirements and, accordingly, of IMI-BAN for occupying the academic position of "professor" in the scientific field and professional direction of the competition. With a minimum requirement of 660 points, the candidate has submitted evidence for 839 points;

b) the scientific works presented by the candidate do not repeat those from previous procedures for acquiring a scientific title and academic position;

c) there is no evidence of plagiarism in the scientific works submitted for the competition.

4. Description and evaluation of the candidate`s teaching experience

The candidate has given lectures and exercises on Algebra, Linear Algebra, Number Theory, Arithmetic, Semigroup Theory, Analysis, Graph Theory, etc. for students studying Mathematics, Informatics, Geography at the University of Potsdam – Germany (2001 – 2022). He has lectured at other universities: Brno University of Technology, University of Szeged, South-West University Blagoevgrad, Universidade Nova de Lisboa, Luhansk Traras Shevchenko National University.

He was the scientific supervisor of 8 doctoral students in "Algebra" at the Institute of Mathematics of the University of Potsdam - Germany, of which 1 was active and 7 defended. As well as the second supervisor of 1 successfully defended doctoral student in "Algebra" at the University of Khon Kaen - Thailand.

The candidate is a member of the organizing committee of five international conferences in Potsdam, Germany and a member of the program committee of three international conferences in Blagoevgrad.

He is also a member of the scientific editorial board of the journals "Discussiones Mathematicae" and "Asian-European Journal of Mathematics".

He participated in 5 scientific projects, of which he was the head of one and a member of 4.

5. Detailed analysis of the scientific and applied achievements of the candidate contained in the materials submitted for participation in the competition

The works presented by the candidate can be classified in 4 directions.

I. Transformation semigroups – papers 1, 2, 3, 4, 7, 9, 14, 15.

Any semigroup can be mapped isomorphically into a semigroup of transformations on a suitable set. A semigroup of transformations is a set of images of a set in itself that is closed under the image composition operation. Of interest are the semigroups of order-preserving transformations of a finite chain (ie, a linearly ordered set - one partial order close to the linear is a zig-zag order). The corresponding partially ordered set is called a fence. An open problem is the computation of the rank (minimum number of generating elements) of the semigroup of all zigzag-preserving injections and the semigroup of all zigzag-preserving complete transformations, as well as some questions related to the rank of the semigroup of all zigzag-preserving the order transformations of an infinite set. [1, 9, 14, 15].

In [1, 15], the rank of the semigroup FIn was obtained from all partial automorphisms preserving the zig-zag order of an n-element fence. In [15] a description of the Green's relations of this inverse semigroup is given. Green's relations show how "far" a semigroup (monoid) is from a group. It was also shown in [15] that FIn arises from transformations of rank greater than (n−3), i.e. of transformations with a set of images containing more than (n−3) elements.

In [14], the zig-zag order in the set of natural numbers N (an infinitely enumerable set that can also be ordered by zig-zag order) was considered and the relative rank of the semigroup PF_N of all order-preserving transformations of N was determined.

In [9], complete transformations preserving the zig-zag order were studied. A characterization of the elements of the monoid TFn from all zig-zag order-preserving transformations of a given n-element set is given.

A formula for the relative rank of T(X,Y) modulo OP(X,Y) is presented in [2]. Relative generating sets with a minimal number of elements are characterized.

In [3] a complete answer is given to an open problem formulated in [FJS,2021] by Fernandes et al "to find the relative rank of OP(X) modulo O(X) for a given infinite set X", for a certain class infinite chains.

Papers in [4 and 7] used known techniques to solve some problems in algebraic graph theory. Endomorphisms establish a natural connection between graph theory and semigroup theory. In [4] the rank, cardinality and Green's relations properties of the monoid IEnd(Pn) of all injective partial endomorphisms and the monoid PAut(Pn) of all partial automorphisms of Pn, where Pn is a finite undirected path, are studied.

In [7] two monoids are considered: the monoid of all endomorphisms of Pn (denoted EndPn) and the monoid of all weak endomorphisms of Pn (denoted wEndPn). The rank and cardinality of these two monoids are calculated. It is shown that EndPn as well as wEndPn are regular if and only if n=1,2,3 and n=1,2,3,4,5, respectively. The regular elements in EndPn for n > 3 and in wEndPn for n > 5 are characterized.

II. Doppelsemigroups – papers 8, 10, 11.

In [8], the free rectangular doppelsemigroup of arbitrary rank is constructed. The main result in [10] is the theorem for representations of ordered doppelsemigroups. In [11] he gives a description of all commutative n-tuple semigroups.

III. Semigroups under point of view of Universal Algebra – papers 5, 6, 13, 16, 17

Some subsets of the symmetric semigroup T(X,T) are considered. In [6, 13, 16] Y is a two-element set. Green's relations [13] for $T_P(X,Y)$ are studied, and in [6] the structure of its ideals. In [16] the regular elements and idempotents of $T_P(X,Y)$ are studied.

In [5] the idempotents and regular elements of the monoid of all generalized hypersubstitutions for algebraic systems are defined (inspired by issues of theoretical informatics). The idempotents and regular elements in this monoid are characterized.

In [17], all stable varieties of semigroups are characterized.

IV. Semihypergroups – paper 12.

In [12] it was proved that every semihypergroup can be considered as a semigroup. It is shown that there are exactly 17 non-isomorphic semihypergroups of order two.

The total number of noticed citations (not including self-citations) is 102, 26 citations from eminent scientists have been submitted for participation in the competition.

The candidate has declared that the participation of all co-authors is equal in the joint scientific works submitted for participation in the competition.

6. Critical notes and recommendations

I have no critical remarks. Very precisely prepared documents.

7. Personal impression of the applicant

I know Prof. Dr. Kopitz from his participation in the international conference "Trends in Combinatorial Ring Theory", dedicated to the 70th anniversary of Academician V. Drensky and the Algebra and Logic Seminar. Apart from the nice talks he gave, I have no other impressions.

8. Conclusion on the application

Having become acquainted with the documents and scientific papers presented in the competition and on the basis of the analysis of their importance and the scientific and applied contributions contained therein, I **confirm** that the scientific achievements meet the requirements of the ADAS in the Republic of Bulgaria, the Rules for its Implementation and the corresponding Rules at the Institute of Mathematics and Informatics, BAS for the occupation by the candidate of the academic position “Professor” in the scientific field and professional field of the competition. In particular, the applicant meets the minimal national requirements in the professional field and no plagiarism has been detected in the scientific papers submitted for the competition. I **give** my **positive** opinion to the application.

II. GENERAL CONCLUSION

On the basis of the above said, I **strongly recommend** to the Scientific Jury of the competition to propose to the competent body of choice of the the Institute of Mathematics and Informatics, BAS to select Assoc. Dr. Jörg Kopitz, for the academic position “Professor” in professional field: Professional field: 4.5. Mathematics, Scientific specialty: „Algebra and Number Theory (Transformation Semigroups).

Date: 20.03.2023 г. Signature:

(*Assoc. Prof. Dr. Silvia Boumova*)