R E V I E W

on the competition for the academic position of "Professor"
in a professional field 4.5. Mathematics (Algebra – Transformation semigroups)
area of higher education: 4. Natural Sciences, Mathematics, and Informatics
announced in State Gazette, issue 84 of 21.10.2022

with a single candidate Assoc. Prof. Dr. Jörg Koppitz
associate professor at the "Algebra and Logic" Section of IMI–BAS

reviewer: Prof. D.Sc. Nako Angelov Nachev

1. Brief biographical data about the candidate.

Jörg Koppitz is a German citizen by nationality, born on 07.09.1966. He received his education and training at Pedagogical University "N. K. Krupskaja" in Halle (Saale)/ Köthen, Germany, from 01.09.1983 to 31.07.1989, and acquired the qualification of Teacher of Mathematics and Physics. Later (01.08.1989 – 31.07.1992), Jörg Koppitz continued his studies at Martin Luther University, Halle, Germany, and acquired the qualification of Doctor. From 01.10.1992 to 31.05.1995 and from 01.03.1999 to 28.02.2008 he worked as an assistant professor at the University of Potsdam, Germany. His main activities and responsibilities were teaching and research. From 01.04.2010 to 30.09.2015 he held the position of visiting professor at the same university. Since 04.02.2017, he has been working at the Bulgarian Academy of Sciences as an associate professor and has been engaged in scientific research. His native language is German, and he can also speak English and Russian at a sufficiently high level.

2. General description of the presented materials and scientific works.
   - Mr. Jörg Koppitz presents a diploma, dated 06.07.1989, which certifies the successful completion of his higher education studies at the Pedagogical University "N. K. Krupskaja" in Halle/Köthen, GDR. Also, there is a document with the official translation from German to Bulgarian and a certificate of authenticity of the copy, testifying that it corresponds to the original.

   - Holds a diploma for an academic-educational degree awarded by Pedagogical University "N. K. Krupskaja".

   - Has a diploma for a Ph.D. degree, which is recognized by IMI–BAS as the educational and scientific degree DOCTOR.

   - Submits a certificate for holding the academic position of ASSISTANT PROFESSOR, issued by IMI–BAS on 05.05.2017 by an appointed Scientific Jury.

   - Presents a copy of SG, issue 84 of 21.10.2022, in which the competition for the academic position of PROFESSOR for the needs of IMI–BAS was announced.

- Has an official note issued by IMI–BAS, which describes Jörg Koppitz's general work experience. This note was issued to him in order to participate in the competition for the academic position PROFESSOR at IMI–BAS.

- The scientific works of Associate Professor Jörg Koppitz are classified into four groups.

    I. Publications in refereed journals. The number of these publications is 83.

    II. Publications in collections and scientific conferences. These are 13 in number.

    III. One dissertation work and one habilitation work.

    IV. One textbook reviewed in Zbl. 109408001.

- Of all his scientific publications, Assoc. Prof. Dr. Jörg Koppitz presents only 17 for participation in the competition. These publications are divided thematically into the following areas:

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

    II. Doppelsemigroups – publications 8, 10, 11.

    III. Semigroups from the point of view of universal algebra – publications 5, 6, 13, 16, 17.

    IV. Semihypergroups – publication 12.

I find this classification quite convenient and will use it when considering scientific and applied scientific contributions.

3. General characteristics of the candidate's scientific and applied scientific activities.

The scientific and applied scientific interests of Assoc. Prof. Dr. Jörg Koppitz lie in the field of transformation semigroups. The field is current and of significant interest. Jörg Koppitz actively participated in the life of the mathematical society in Germany and abroad. We will note some of the activities that support this conclusion. He participated in 8 program and organizing committees from 2003 to 2021. Five of them were in Potsdam and three in Blagoevgrad. In 2008, he was a member of several journal editorial boards. Jörg Koppitz has been a supervisor to 9 Ph.D. students. Eight of them have already been awarded their degrees, and one is in a state of creative development. There is a certificate that Jörg Koppitz was awarded a habilitation degree by Potsdam University, dated 18.04.2002.

4. Evaluation of the pedagogical training and activities of the candidate.

In addition to scientific research, Jörg Koppitz also engaged in many teaching and pedagogical activities. From 2001 to 2013, he gave 22 lectures at the University of Potsdam, Germany, on topics in Algebra, Linear Algebra, Analysis, Inverse Semigroups, Analytic Geometry, Number Theory, Graph Theory, etc. In addition, from 2017 to 2022, again in Potsdam, he gave four lectures and participated in six seminars. A list of 9 lectures delivered in

German and foreign universities is also presented. With his activities, Jörg Koppitz proves that he possesses the qualities of a teacher, a pedagogue, and a populariser of science.

5. Basic scientific and applied scientific contributions.

Along with other algebraic structures, the semigroup theory plays a significant role in modern algebra. It is to Jörg Koppitz's credit to have chosen to work in this field, particularly in "Transformation semigroups". The main objective in this section will be to determine the contributions of Jörg Koppitz, embedded in those 17 scientific publications with which he participated in the competition. We will examine these publications following the classification offered by their primary author.

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

(1) Koppitz J., T. Musunthia. If: 0.768, Zbl 07333917.

Attention is drawn to a partial zig-zag order that gives rise to a partially ordered set called fence. A set FI_n of all partial injections on a set X that preserve the zig-zag order, is defined. The main problem is the calculation of the rank of FI_n. For even n this is not that difficult and has already been done by other authors. The main result of the present paper is the computation of this rank for odd n.

(2) Dimitrova I., J. Koppitz. If: 0.446, Zbl 07441687.

In this article, the semigroups $T(X,Y)$, $OP(X,Y)$ and $O(X,Y)$ are defined. The relative rank of the semigroup $T(X,Y)$ modulo $OP(X,Y)$ is obtained. In addition, the relative ranks of $OP(X,Y)$ modulo the set $O(X,Y)$ is found. In both cases, the minimal relative generating sets are characterized.

(3) Dimitrova I., J. Koppitz. If: 0.294, Zbl 1491.20128.

The semigroups $O(X)$ and $OP(X)$ are well studied in case X is a finite chain. However, if X is an infinite chain, the situation is quite different. Then the concept of the relative rank is considered. In this paper, it is proved that the relative rank of $OP(X)$ modulo $O(X)$ is equal to 1 if X has a maximum or a minimum.

(4) Dimitrova I., V.H. Fernandes, J. Koppitz., T.M. Quinteiro. If: 0.768, Zbl 1467.05137.

This paper establishes a connection between graph theory and semigroup theory by means of graph endomorphisms. Partial automorphisms and injective partial endomorphisms of a finite undirected path are studied. The main goal of paper is to give formulas for the ranks of the monoids $IEnd(P_n)$ and $PAut(P_n)$ of all injective partial endomorphisms and of all partial automorphisms of the undirected path P_n with n vertices. In addition, a description of Green's relations is given. Generating sets of minimal size for the above mentioned monoids are found.

(7) Dimitrova I., V.H. Fernandes, J. Koppitz., T.M. Quinteiro. If: 0.856, Zbl 1434.05081.

A main goal of this paper is to determine the rank of the monoids $wEnd(P_n)$ and $End(P_n)$ of all weak endomorphisms and all endomorphisms, respectively, of the undirected path P_n with n vertices. It is shown that the monoid $Aut(P_n)$ has rank 1.

(9) Fernandes V., J. Koppitz., T.Musunthia. If: 0.867, Zbl 1454.20110.

In this article, an n-element set with a zig-zag order (or fence) is considered. Denote by TF_n the set of all transformations preserving the zig-zag order. The rank of TF_n is determined, something that had not been done before. A formula for the number of idempotents in TF_n is given.

(14) Dimitrova I., Koppitz J., Lohapan L. If: 0.299.

In this paper, semigroups of transformations on infinite sets are studied. The set N of natural numbers is chosen as a typical example. Denote by PF_N the infinite monoid of all partial transformations of N, preserving a zig-zag order on N. The relative rank of PF_N modulo a set containing all idempotents and all surjections in PF_N is determined. A fundamental role is played by the transformation γ, defined by $\gamma(n) = n + 2$ for every $n \in N$.

(15) Dimitrova I., Koppitz J. If: 0.489, Zbl 1429.20045.

An important place in this article takes the partial order $X_n = \{1 < 2 > 3 < 4 > ...n\}$, which is a zig-zar order and is called fence. The authors study the semigroup IF_n of all partial preserving the zig-zag order injections f of X_n, such that f^{-1} is also such an injection. Green's relation J for the semigroup IF_n is characterized. It is noted that for an odd n, there is no least generating set for IF_n. For even n, the rank of IF_n equals $n + 1$.

II. Doppelsemigroups – publications 8, 10, 11.

(8) Zhuchok A.V., Yn.V. Zhuchok, J. Koppitz. If: 0.61, Zbl 1454.08010.

This article defines a doppelsemigroup and provides some initial information on doppelsemigroups. As a main result, a criterion for an isomorphism of endomorphism semigroups of free rectangular doppelsemigroups is given.

(10) Zhuchok Y., J. Koppitz. If: 0.241, Zbl 1448.08003.

This paper introduces the notion of an ordered doppelsemigroup. The main result is a representation theorem, which shows that every ordered doppelsemigroup can be embedded isomorphically into an ordered doppelsemigroup of binary relations on a suitable set.

(11) Zhuchok A.V., Koppitz, J. If: 0.362, Zbl 1450.20017.

In this article, the concept of n-tuple semigroup is introduced. The article is devoted to the study of the free product of n-tuple semigroups. A method for constructing a free commutative

n-tuple semigroup of any rank is described. It is proved that its automorphism group is isomorphic to a symmetric group.

III. Semigroups from the point of view of universal algebra – publications 5, 6, 13, 16, 17.

(5) Phusanga D., J. Joomvong S. Jina, J. Koppitz If: 0.294, Zbl 1477.08007.

In this paper, a monoid is formed under the composition of functions. The aim of the paper is to study this monoid by characterizing its idempotent as well as regular elements.

(6) Anantayasethi A., Koppitz, J. If: 0.179, Zbl 1491.20125.

In this article, as in the previous one, a semigroup is defined that is related to Boolean functions on a finite set. The algebraic structure of this semigroup is determined. Left, right and two-sided ideals are characterized, as well as the Green's relations. In addition, for each of the Green's relations, the greatest included congruence is provided.

(13) Anantayasethi A., Koppitz, J. If: 0.27, Zbl 1399.20074.

The main idea of this article is similar to the ones in articles (5) and (6).

(16) Anantayasethi, Ananya, Koppitz, J. If: 0.249, Zbl 1364.20043.

Let X be a nonempty set, and Y be its two-element subset. Let $T(X,Y)$ be the semigroup of transformations on X in Y. Next, the semigroup $T_p(X,Y)$ of all nonempty subsets of $T(X,Y)$ under the complex product of sets is introduced. Results are proved for the maximal idempotent subsemigroups and the maximal regular subsemigroups of $T_p(X,Y)$.

(17) Slavcho Shtrakov, J. Koppitz. If: 0.536, Zbl 1339.20054.

The article deals with terms and stable and s-stable varieties of algebras. Groupoid manifolds are also studied. Some fundamental results in semigroup theory are used and it is proved that the varieties of commutative and idempotent groupoids are stable.

IV. Semihypergroups – publication 12.

(12) Worawiset S., Koppitz, J. If: 0.314, Zbl 07093112.

This article provides a comprehensive answer regarding second and third order semihypergroups and their classification.

We will note that the scientific results obtained by Jörg Koppitz and his co-authors are new to science and have immediate application in practice. It is also important to point out that the proofs of the main results are done in a rigorous mathematical form and by using an accessible language.

The total Impact factor of all publications of Jörg Koppitz is 18.368, and of those with which he participated in the competition is 7.842. The total number of citations of all publications is

103, with some works cited several times. Of all scientific publications, 80 are reviewed in Zentralblatt.

6. Participation in scientific forums.

Assoc. Prof. Dr. Jörg Koppitz has given lectures at many international conferences – more than 49. He has also lectured at foreign universities. He serves as a peer-reviewer for international mathematical journals. He is a member of the scientific editorial boards of the journals "Discussiones Mathematical" and "Asian-European Journal of Mathematics". He was a member of the program committees of the 5th International Scientific Conference FMNSLO13 and the 8th International Scientific Conference FMNS2021.

7. Participation in research projects.

Assoc. Prof. Dr. Jörg Koppitz has been the head of a research project since 11.05.2009 – DFG-Project. He has participated in 4 projects – from 1996, 2008, 2009 and 2016, respectively.

8. Significance of contributions to science and practice.

The scientific works of Assoc. Prof. Dr. Jörg Koppitz are widely reflected in German and foreign literature. This is quite clear from the numerous citations. I believe that the quantitative indicators required to obtain the academic position of PROFESSOR have been achieved.

9. Critical notes and recommendations.

I have no critical notes. I recommend that the candidate continue working in the area of his choice and obtaining new results in this direction.

C O N C L U S I O N

In the current competition, Assoc. Prof. Dr. Jörg Koppitz presents himself with scientific production of maximal quantity and quality. He has remarkable scientific and applied contributions, as well as pedagogical experience and knowledge. After getting acquainted in detail with the presented scientific works, their importance, and their scientific and applied contributions, I find it reasonable to propose to the Honorable Scientific Jury that Assoc. Prof. Dr. Jörg Koppitz occupy the academic position of PROFESSOR of Algebra (Transformation semigroups) in a professional field 4.5 Mathematics and area of higher education 4. Natural sciences, Mathematics, and Informatics.

March 7, 2023   Reviewer:

Plovdiv   /Prof. D.Sc. Nako Nachev/