

Report

by **Professor D. Sci. Geno Petkov Nikolov, Faculty of Mathematics and Informatics of Sofia University St. Kliment Ohridski**

on the materials submitted for participation in the contest for occupation of the academic post *Professor* in the Institute of Mathematics and Informatics of Bulgarian Academy of Sciences in: Area of Higher Education 4. Natural Sciences, Mathematics and Informatics, Professional Field 4.5 Mathematics, Scientific Specialty Mathematical Analysis (Special Functions), announced in *State Gazette* no. 52/02.07.2019

1 Subject of assessment

In the contest for the academic post *Professor* announced in *State Gazette* no. 52/02.07.2019 for the needs of Institute of Mathematics and Informatics of Bulgarian Academy of Sciences (in short, henceforth written as IMI–BAS), Section: Analysis, Geometry and Topology, participates only one candidate: Associate Professor D. Sci. Yordanka Paneva-Konovska.

By Order no. 321/02.09.2019 of the Director of IMI–BAS I have been appointed as a member of the Academic Board of the aforementioned contest. By a decision of this Academic Board from 16.09.2019 I was assigned assessor of the contest.

As a member of the Academic Board I have received in electronic format the following documents of the Applicant:

1. Application Letter to the Director of IMI–BAS;
2. Curriculum Vitae;
3. Diploma of Higher Education;
4. Ph. D. Diploma;
5. D. Sci. Diploma;
6. List of Applicant's publications, including 6.1 List of publications during the period 2009–2019;
7. List of Applicant's publications deposited for the contest;
8. Self assessment of Applicant's contributions in the papers deposited for the contest;
9. Abstracts of the papers deposited for the contest (in Bulgarian and in English);
10. Copies of the papers in item 7.;
11. List of citations of all Applicant's papers;
12. List of citations of Applicant's papers deposited for the contest;
13. State Gasette no. 52/02.07.2019 with the Contest announcement;
14. Work Experience Certificates issued by Technical University of Sofia (TU–Sofia) and IMI–BAS, in compliance with art. 29 (1.2) of the Development of Academic Staff in the Republic of Bulgaria Act (DASRBA);

15. Certificate for Associate Professor in Mathematical Analysis no. 25433/20.02.2009 issued by the Higher Attestation Commission;
16. Lists of: 16.1 abstracts of Ph.D. Thesis and D. Sci. Thesis; 16.2 textbooks and lecture notes written by the Applicant; 16.3 Master Theses defended under Applicant's supervision; 16.4 Supervision of a Ph.D. Student; 16.5 Membership in Organizing Committees of conferences; 16.6 Participation in conferences and workshops; 16.7 Participation in Research Projects; 16.8 Teaching load of the Applicant;
17. Reference of compliance with the minimal national requirements according to art. 26 (par. 2 and 3), art. 26(par. 5) of DASRBA, as well as with the minimal requirements of IMI-BAS, with evidences attached (Appendix 2.1);
18. Declaration of the Applicant that all papers, citations and evidences in the reference of compliance with the minimal national requirements, submitted for the present contest, have not been deposited for preceding promotion procedures (Appendix 3.1);
19. Declaration of consent for storage and processing of personal data (Appendix 4.1).

The deposited set of documents and materials contributes for the objective and complete assessment of the candidate according to the Development of Academic Staff in the Republic of Bulgaria Act (DASRBA) and the Rules for its application as well as the regulations of IMI-BAS.

2 Brief biographical data of the applicant

The applicant in the contest, Associate Professor D. Sci. Yordanka Paneva-Konovska graduated in Mathematics from Shumen University Konstantin Preslavski in 1977. In 1999 she defended Ph. D. Thesis entitled *Basicity and completeness of Bessel functions and polynomials* in Section Complex Analysis of IMI-BAS. In 2018 Paneva-Konovska acquired D. Sci. Degree for a Thesis entitled *Functions of Bessel and Mittag-Leffler and generalizations*.

During the period 1977–1987 Yordanka Paneva-Konovska works in Shumen University as Assistant. Since 1987 she has been working in the Faculty of Applied Mathematics and Informatics (FAMI) of Technical University (TU) - Sofia, occupying initially posts of Assistant (1987–1993) and Senior Assistant (1993–2008). In 2008 she was promoted Associate Professor in the Department of Mathematical Analysis and Differential Equations of FAMI, TU-Sofia. From 2012 Paneva-Konovska is an associate fellow of Section Analysis, Geometry and Topology of IMI-BAS, and she is Associate Professor there since 2014.

During her academic carrier Paneva-Konovska has occupied some administrative positions, the last one being Deputy Dean of FAMI since 2013. She is a member of the Union of Bulgarian Mathematicians and of the Union of Scientists in Bulgaria, where she served for a long time as secretary of Section Mathematics, and since 2017 she is Deputy Chair of the Section. She participated in the Organizing Committees of 11 international conferences, being twice Deputy Chair and once Co-Chair. She writes reviews for more than 10 international journals, and since 2013 is a member of the editorial board of the International Journal of Applied Mathematics.

D. Sci. Yordanka Paneva-Konovska participated in 5 international and 4 national research projects, as well as in 7 internal research projects (3 in IMI-BAS and 4 in TU-Sofia).

3 Teaching activity of the applicant

The teaching of Associate Professor Yordanka Paneva-Konovska includes courses in Mathematical Analysis Parts One and Two, Complex Analysis and Functional Analysis for the Bachelor degree students in Applied Mathematics and Informatics and Informatics and Software Sciences, as well as

courses on all basic mathematical subjects for the students in Engineering. For the Master degree students she reads the course Selected Topics in Higher Mathematics (Field Theory and Integral Transforms). Paneva–Konovska has been an adviser of the diploma works of three Bachelor degree students, as well as of one Ph. D. student, who acquired Ph. D. Degree in 2011.

Paneva–Konovska is an author of two textbooks and two lecture notes.

4 General description of applicant's publications

Associate Professor D. Sci. Yordanka Paneva–Konovska has deposited for the contest 26 publications: a monograph and 25 papers. She is the only author of 24 of these papers, and co-author in one of them. Ten of the papers are in journals and 15 in conference proceedings. Three papers are published in journals with impact factor (two in *Comp. Rend. Acad. Bulg. Sci* and one in *Fract. Calc. Appl. Anal.*). Ten of the papers are in issues with SJR.

The applicant has found 69 citations of 13 of the deposited for the contest publications. These citations are distributed as follows: three in monographs, one in a book; 37 in journals with IF; 8 in journals with SJR; 10 in journals indexed by WoS / Scopus (without IF /SJR); 4 in journals indexed by Zentralblatt and IEEE Xplore.

It is worth mentioning that the full list of the Applicant publications includes two monographs, two abstracts of Theses, 61 papers, and four textbooks and lecture notes. 13 of these papers are published in journals with IF (3 in Q1, 1 in Q2, 3 в Q3 and 6 in Q4) and 11 in issues with SJR. 23 of these papers are cited in 148 sources, with 70 citations in journals with IF and 12 in journals with SJR.

5 Analysis of the contributions in applicant's publications

The main scientific interest of Associate Professor Paneva–Konovska is in Complex Analysis, and more precisely in Special Functions. The birth of this branch of mathematics can be traced already in some papers of D. Bernoulli, L. Euler, C. Gauss and C. Jacobi. It is well-known that the classical orthogonal polynomials (of Jacobi, Laguerre and Hermite), the hypergeometric functions and the classical Bessel functions are solutions of homogeneous second order ODE. This is a very small part of the wide class of functions known as special functions. Among the reasons making these functions *special* and a subject of intensive study nowadays are their interesting analytic properties (e.g. asymptotic behavior, distribution and estimates of their zeros), the variety of identities between them, as well as their numerous applications in physics, mechanics and engineering. A modern recent trend is the study of the so-called q -analogues of the special functions, documented in a lots of publications, including several monographs.

The classical Bessel functions of the first kind and the closely related to them entire functions of Bessel–Clifford, which depend on one parameter, are a subject of numerous generalizations. Among these are the generalization proposed by Maitland (Wright), which involves a second parameter, and the one due to Pathak, who added a third parameter (index). These functions, known also as generalized functions of Bessel–Maitland (Wright), are complemented by the so called Lommel–Maitland, which depend on further two additional indices. The functions of Bessel type and various their generalizations are an object of investigation in a part of the papers deposited by Associate Professor Yordanka Paneva–Konovska.

Another class of functions studied by the Applicant consists of various generalizations of the Mittag–Leffler functions. Unlike the Bessel functions, whose appearance is motivated by problems in mechanics and astronomy, the Mittag–Leffler functions were introduced in the beginning of the last century in problems related to analytic continuations, i.e., for purely theoretical reasons. The situation changes about a century later when Luchko and Kiryakova introduced the multi-index (involving $2m$ indices) generalization of the Mittag–Leffler functions, which put together the classical Mittag–Leffler functions and their generalization proposed by Prabhakar in the seventies,

the Bessel functions and their generalizations. In 2011 Paneva–Konovska in turn put into consideration $3m$ -parametric functions of Mittag–Leffler, which encompass the 3-parametric extension of Prabhakar and the $2m$ -index functions of Mittag–Leffler.

Below is a brief description of the problems considered and the results obtained by Associate Professor D. Sci. Yordanka Paneva–Konovska in the papers deposited for the contest:

- **Asymptotic formulae.** For the elements $j_n(z)$, $n \in \mathbb{N}_0$, of various classes of functions of the Bessel and Mittag–Leffler type asymptotic representations are obtained of the form

$$j_n(z) = p(z; n)(1 + \theta_n(z)),$$

where $p(z; n)$ is the main term (a monomial of z), and $\theta_n(z) \rightarrow 0$ as $n \rightarrow \infty$ is a holomorphic function of z in the complex plane. Estimates for the modulus of the remainder $\theta_n(z)$ are established.

- **Convergence of series of special functions.** For series defined by means of different Bessel- or Mittag-Leffler-type functions, analogues of the classical Cauchy- Hadamard theorem and Abel-type theorems for points on the boundary of the convergence domain are proved. The behavior of such series is investigated, and analogues of the classical theorems of Tauber and Littlewood are established, as well as of the Ostrovski overconvergence theorem and its inverse.
- **Integrals and derivatives of arbitrary (fractional) order.** The “fractional” integration is understood in the sense of the Riemann–Liouville integral, and the “fractional” derivative is a composition of a derivative of integer order and integral of fractional order. The fractional calculus is applied to show that the n -th derivatives of the functions of Bessel–Maitland with two indices are expressed in terms of the generalized Bessel–Maitland functions with 3 indices. For some special cases of fractional integrals and derivatives interesting connections between the functions of Bessel–Maitland are established. Similar connections are obtained for some multi-index Mittag-Leffler functions.
- **Integral transforms and applications.** The distribution of the zeros of entire functions defined by integral transforms was studied for the first time by D. Pólya. The Bulgarian mathematical school represented by L. Chakalov, N. Obreshkov, L. Iliev, E. Bozhorov, K. Dochev, P. Rusev, etc., has a significant contribution to this topic. In Chapter 5 of the monograph [1] Paneva–Konovska studies the asymptotic behavior of the zeros of a class of entire functions of exponential type, defined by finite Hankel transforms (integral transforms with a kernel given by a Bessel function of the first kind). The results obtained here are similar to those for finite Fourier transforms. In Chapter 6 of [1] a finite Hankel transform has been applied for the investigation of a mathematical model of non-stationary heat convection of power-plant of non-piloted flying devices. In another paper ([22]) the Laplace transform is applied along with Maple for the solution of a class of integral equations (including integrals of fractional order).

6 Conclusion

The documents submitted for the Contest by Associate Professor D. Sci. Yordanka Paneva–Konovska clearly show that the Applicant research competencies and pedagogical experience comply with the Contest specificity. Her results are known and cited many times by the experts in Special Functions, to the community of which she undoubtedly belongs. In compliance with the prescriptions of the Development of Academic Staff in the Republic of Bulgaria Act (DASRBA) and the Rules for its application, I declare my conviction that the results claimed by the Applicant in her publications are achievements of the author, and did not find any plagiarism.

On the basis of the analysis made above I conclude that the Applicant meets in full the requirements of the Development of Academic Staff in the Republic of Bulgaria Act (DASRBA) and the Rules for its implementation, the relevant Rules of the Bulgarian Academy of Sciences well as the specific requirements of the Institute of Mathematics and Informatics of BAS, for occupying position *Professor* in *Professional Field 4.5 Mathematics*.

All this gives me the reason to give my positive assessment to the applicant and recommend to the respected Academic Board to prepare a report-proposal to the Scientific Council of the Institute of Mathematics and Informatics of BAS for the election of Associate Professor D. Sci. YORDANKA PANEVA–KONOVSKA for the academic post PROFESSOR in IMI–BAS in Area of Higher Education 4. Natural Sciences, Mathematics and Informatics, Professional Field 4.5 Mathematics, Scientific Specialty Mathematical Analysis (Special Functions)

Date: 25.10.2019

Reviewer Signature:

(G. Nikolov)