REVIEW
by Prof. D.Sc. Virginia Kiryakova,
Institute of Mathematics and Informatics (IMI) – Bulgarian Academy of Sciences (BAS)

on the documents and publications, presented by
<u>Asso. Prof. D.Sc. Jordanka Paneva-Konovska</u>
as application to a competition for academic post of (Full) Professor
for the needs of IMI-BAS, in domain Higher education 4. Natural sciences,
mathematics and informatics, professional field 4.5. Mathematics, scientific speciality
"Mathematical analysis (Special functions)",
announced in SG, issue 52/ 02.07.2019

I am a member of the Academic Board on this procedure according to Order № 321 / 02.09.2019 of Director of IMI-BAS. At the first meeting of this Academic Board I was appointed as a Reviewer (Minutes № 1 / 16.09.2019).

I have been acquainted with the required documents and presented works of the only candidate on this competition – Asso. Prof. D. Sc. J. Paneva-Konovska, Checking them, I am convinced that the presented stuff and the candidate satisfy all the requirements of Ch. 3, Sect. IV of the Law Act for Development of Academic Staff in R. Bulgaria (abbrev. further as "Law", of 26.02.2019). She is a PhD (Diploma № 26323 /1999), and has also the next academic degree "Doctor of Science" (26.03.2018), with work experience as Docent (Asso. Prof.) for more than 10 years in Technical University Sofia (TUS) and 5 years in IMI-BAS.

All minimal science-metric indicators from Ch. 4 of the Regulations of IMI-BAS (update 19.07.2019) and Regulations of BAS for application of the Law (update 20.05.2019) are satisfied and essentially exceeded.

1. Short CV data for applicant

Mrs. Paneva-Konovska graduated from the High school of Mathematics and Natural Sciences in the town of Varna, then had her higher education in Mathematics from the Shoumen Pedagogical Institute (1977), with next specializations in IMI-BAS - in Mathematical Modelling Dept. (1979-1981); in Complex Analysis Dept. (1990, 1995), where she prepared and defended also the PhD thesis titled: „*Basicity and completeness of enumerable systems of functions and polynomials of Bessel*" (1999). She has the academic post of Asso. Prof. since 2008. In 2018, J. Paneva-Konovska defended in IMI-BAS a thesis "*Functions of Bessel and Mittag-Leffler and generalizations*" for the academic degree Doctor of Science (scientific speciality Mathematical Analysis).

She has been Associate member of IMI-BAS (2012-2014), and since от 2014 – on partial employment contract as Asso. Prof., in "Analysis, Geometry and Topology" Department.

The applicant has working experience as a lecturer and scientific researcher on mathematics speciality, successively as: assistant professor on mathematical analysis in Fac. of Natural and Mathematical Sciences at Shoumen University (1977-1987); assistant and senior assistant professor (1987-2008) in Fac. of Applied Mathematics and Informatics (FAMI) – Technical University Sofia (TUS), She is Asso. Prof. in FAMI-TUS since 2008, and since 2013 is a Vice-

Dean of FAMI. There she is also a member of the Central commission on university research projects (2014 -) and of the Faculty commission on educational quality (2008-2013).

Concerning the requirements of the Law, she has working experience as Asso. Prof. (Docent) for more than 10 years, and also for 5 years in IMI-BAS.

The research interests and contributions of D.Sc. Paneva-Konovska are in the field of Mathematical Analysis – complex analysis, special functions, integral transforms, fractional calculus and their applications in mathematical modeling, as well as in higher education in mathematics in universities, and applications of computer algebra systems. As a lecturer in TUS, she has taught courses (lectures and seminar hours) on: Mathematical analysis I and II, Complex analysis, Functional analysis, Field theory, Integral transforms, Selected chapters of mathematics, etc. (attached academic record from TUS for period 2015-2019). Under her guidance in TUS there have been prepared and defended 3 diploma theses (B.Sc., 2017, 2019, 2019) and 1 PhD thesis (as a consultant, 2011). In this field of higher education she is author of 2 textbooks and 2 guiding books for students in TUS.

In 2017, Paneva-Konovska received the *Award – Diploma for higher scientific achievements* in the competition of the Union of Scientists in Bulgaria, for her monograph published in 2016 by World Scientific – London, including some parts of her DSc thesis.

2. Description of the presented publications and other materials:

Along with the works presented for application in the competition for academic post Professor and the rest required documents, the candidate J. Paneva-Konovska has provided for clarity also:

- **Full list of all published scientific works** and textbooks, as well a list of those published in last 10 years – after habilitation**.** This list includes also her monograph "*From Bessel to Multi-Index Mittag-Leffler Functions: Enumerable Families, Series in them and Convergence",* World Sci. Publ. – London, 2016, including partly results from the D.Sc thesis.
  - **The annotations (summaries) of the two her theses** (for PhD and for D.Sc) – for easier comparison with the publications/ results included there.
  - Copies of the **textbooks and teaching guidance books.**

The scientific works presented for application to this competition, that have not been used for previous academic procedures, are:
  - Monograph [1] – 1 item, 116 pp., 2019.
  - Scientific papers in reviewed journals – 10 items
  - Scientific papers in proceedings of international conferences – 15 items

Total – 25 published research papers, of which:
  - 13 items with IF / SJR: 3 items with IF (Q1, Q3, Q4) and 10 items with SJR
  - 7 items – in „other" publications indexed in bases as ZBLMath, etc.
  - 5 items – in not indexed proceedings of international conferences

All presented works are published in English, and all of them are single-authored with exception of 1 paper.

The presented scientific works, their citations and the activities on the indicators group Г, are accurately distributed and with assigned the respective evaluation points in a table (applicant's document № 17), corresponding to Table 2 of Regulations for minimal requirements for academic post Professor in BAS and IMI-BAS (which are higher than the national ones), and these data are also reflected in the academic system Sonix. **The table shows that all science-metric indicators are satisfied, and in groups Г, Д, Е are even essentially exceeded.**

Groups of indicators	Content	Minimal require-ments for Prof.	Applicant's values
А	Ind. 1: PhD	50	50
Б	Ind. 2: for other procedure	-	-
В	Ind. 3-4: Habil. thesis or equivalent publications	100	104
Г	Ind. 5-10: Other publications	220	314
Д	Ind. 11: Citations	140	342
Е	Ind. 12-20: Others	150	321.33
Total:		660 points	1131.33 points

3. Analysis of the scientific results and contributions in the works presented for the competition for academic post of Professor

The presented works are all in the field of Mathematical analysis / Special functions, which is a main subject of research interests and contributions of the applicant. The tools used there are mainly from: Complex analysis, Entire functions theory, Functional series, Fractional calculus, Integral transforms, and their applications.

The results are concentrated in the following closely related topics on the competition's speciality:

I. Inequalities, asymptotic formulas and 3D-graphics for special functions
([1], [2], [3], [4], [5], [6], [10])

For the Bessel functions and their generalizations with 2,3,4 indices (called as Bessel type functions) and for the Mittag-Leffler (M-L) functions and their extensions with 2 and 3 indices (called as M-L type functions) there are proposed new asymptotic formulas in the complex plane when the index $n \to \infty$, as generalizations of the classical formula for the Bessel function of I kind. These are also refined by estimations of the reminder term. In [1] there are presented also 3-dimensional graphs of the considered functions of Bessel type. These results are necessary and essentially used for deriving the results in next groups II, III.

II. Convergence of series in families of special functions in complex domain
([1], [2], [3], [4], [5], [7], [8], [9], [11], [12], [13], [14], [15], [16], [17], [18], [19], [20], [21], [23])

This group of results occupy a main place in the applicants' research of the recent years and are in an important topic of complex analysis, presented also in previous studies of the Bulgarian school (mainly P. Rusev): representation of holomorphic functions by means of series in special functions and their convergence, behavior on the boundary of convergence domain, overconvergence, etc. Some classical results are those for the Taylor and Neumann series, for series in some orthogonal polynomials (P. Rusev), the well-known Cauchy, Abel, Tauber, Litllewood, Hadamard and Ostrovsky theorems for the power series.

Paneva-Konovska develops successfully these results for representation of holomorphic functions by series in functions of Bessel and M-L type, she proposes a uniform theory for convergence of series in these families of special functions, and proves analogy with all mentioned results for the power series.

III.   Multi-index Mittag-Leffler functions ([10], [11], [24])

In an article of 2011 in C.R. Acad. Bulg. Sci. (which was used in the procedure to obtain D.Sc degree), Paneva-Konovska introduced multi-index M-L type functions with *3m* indices, in this way generalizing the Prabhakar functions (*m=1*), as well as the *2m*-index M-L functions of Kiryakova-Luchko. These are entire functions, whose numerous particular cases appear in the solutions of differential equations of fractional order. In the papers mentioned above and presented for this procedure, their properties related to representations of holomorphic functions in series by these special functions, and to their images under operators of fractional calculus, are studied.

IV.   Operators of fractional calculus for functions of Bessel and Mittag-Leffler type ([11], [24], [25], [26])

The applicant's results in this direction are provoked by a recent papers by our colleagues E. Bazhlekova and I. Dimovski on a differential relationship of *integer order* between the 2- and 3-parametric functions of M-L, as well as by the works of this reviewer (V. Kiryakova) on the generalized fractional calculus and *2m*-index M-L functions.

Paneva-Konovska proposed results for relationship between the 2- and 3-parametric M-L functions as well as images of the multi-index functions of Bessel by means of operators of differentiation and integration of *arbitrary (fractional) order* (classical fractional calculus).

These results have been extended for the multi-index M-L functions, and a relation has been found, as well as images under operators of generalized fractional calculus (multiple Erdelyi-Kober operators) between the *2m*-(Kiryakova-Luchko) and *3m*-(Paneva-Konovska) index M-L type functions.

V.   Integral transforms in higher education in Mathematics ([22])

In this article it is illustrated an approach in university education on the Laplace transform with usage of the computer algebra system "*Maple*", and on its application for solving of classes of integral equations, including also of fractional order.

VI.   Integral transforms ([1])

For the integral transforms of Laplace and Hankel, one of the classical problems in analysis is related to the distribution of their zeros, and this topic is also treated by the older Bulgarian school. In the monograph [1] part of the results are devoted to this problem for the finite Hankel transform, whose kernel is represented by the Bessel function. Specially, the applicant studies the asymptotic behavior of the zeros of a class of entire functions, defined by means of finite Hankel transformations, results analogical to these for finite Fourier transforms. Another result from [1], related to this integral transform, is the solution of a practical problem for a mathematical model of a nonstationary heat exchange in combustion chambers.

VII.   Textbooks and guidance educational books

The applicant is author and co-author of 2 textbooks and 2 teaching guidance books for students in Technical University Sofia, related to her courses on elements of mathematical analysis: on Complex analysis, on Laplace integral transform with applications "*Maple*", on Mathematical analysis 2 with "*Maple*".

4.   General description of the research and organizational activities of the candidate:

Additionally to the mentioned characterization of the presented publications and their international impact, let me mention also some other data for J. Paneva-Konovska' s activities:
- Currently she is a Vice-Dean of Fac. Applied Mathematics and Informatics – Technical University Sofia; member of university commissions on research projects and of faculty commission on educational quality;
- Membership in organization committees of more than 10 international mathematical conferences (organized by IMI-BAS or TUS), in 3 of them acting as co-chair;
- Member of editorial board of "*International Journal of Applied Mathematics*", indexed in Scopus with impact rang (SJR, in Q4);
- Participation in several research projects: 4 – with National Science Fund – Bulgaria (for 1 of them was also Coordinator for the TUS team); 2 – with IMI-BAS; 3 – with Research Branch of TUS; and 3 – on bilateral agreements of BAS with Serbian and Macedonian academies;
- Reviewer for several international mathematical journals;
- Secretary of "Mathematics" section of the Union of Scientists in Bulgaria (2005 – 2017) and its Vice-chair (2017-).

5.   Impact of candidate's results in works of other authors:

J. Paneva-Konovska has provided a detailed list (extracted from academy system Sonix) of the observed and checked 148 citations (without selfcitations) of all her publications (of them 70 are in journals with IF, 12 in journals and proceedings with SJR, 12 in monogrpahs and books). Her data for the Hirsh index are respectively:
h = 8 (Scopus), h = 7 (Web of Science), h = 12 (Google Scholar & Harzing's Publish or Perish),
   https://www.scopus.com/authid/detail.uri?authorId=25923588300   (V.K..: 18.10.2019)
   https://scholar.google.com/citations?hl=bg&user=PIFopjMAAAAJ (V.K.: 18.10.2019).
For the publications presented on this procedure for Professor only (26 items, not used in previous procedures), the numbers of citations are, resp.:   59 items, of which 55 items in publications with IF and/ or SJR (55 x 6 p. = 330 points) и 4 items in other (indexed) sources (4 x 3 p. = 12 points), i.e. for Indicator Д 11, instead of necessary 140 points, Paneva-Konovska has 342 points.
Most of the mentioned citations are in prestigious international publications and my foreign authors, for which an evidence is the great number of the sum of their IF's (> 130) + SJR.

6.   Approbation of the results:

The results of J. Paneva-Konovska in the presented works, as well as in the previous works, are published in prestigious journals and proceedings of international conferences, most of them indexed in the sources of the world bibliographic networks and are cited many times. They are also reported at several international mathematical forums both in Bulgaria and abroad (Serbia, Macedonia, Italy, China, Portugal, UAE), and at national seminars. These results are also essential

part of the working programs of some research projects (with National Science Fund, IMI-BAS, bilateral agreements of Bas, etc).

7. **Evaluation of the personal contributions of the candidate:**

Of all (26) publications presented for this procedure: 25 items are *single-authored* (1 monogrpah, 24 articles), 1 item is a joint paper (with Y. Nikolova, TUS).

Of all publications of the candidate: 57 are single-authored (2 monographs, 55 articles), 6 are joint papers.

It is evident fact for the presented works, as well as for all research of the candidate, that these are her own personal contributions. There is no plagiarism detected.

8. **Critical notes: None.**

Possible recommendation, as a perspective of the future research of D.Sc. Paneva-Konovska is to combine the use of computer algebra systems (as Maple) with her theoretical results in the field of complex analysis and special functions, for representation by means of graphical and numerical illustrations.

9. **Personal impressions:**

I have known Jordanka from the time of her first specialization in our "Complex Analysis" department in IMI (1990). In the period after 1994 she is actively working in our joint teams for research projects with National Science Fund (4 projects), on our institute's (IMI) projects (2), on projects on bilateral agreements of BAS with Serbian and Macedonian academies (3). Since 2012 she is associate member of IMI, and since 2014 – for 5 years already, is on partial employment contract in IMI-BAS, at our department "Analysis, Geometry and Topology".

Having this in mind, I know well her research and organizational activities in our institute and in a field very close to my own research. I have also impressions of her talks at international conferences and national forums, and how they have been evaluated by presented experts there, also for her administrative activities at TUS and IMI-BAS. So, my impressions are that the candidate is an established and well recognized author and expert, both in national and international levels, in the field of special functions and applied mathematical analysis, and actively participate in the research and life in IMI.

10. <u>Conclusion</u>:

The review of the presented publications and documents related to this procedure shows that Asso. Prof. D.Sc. Jordanka Paneva-Konovska is an internationally established expert in the field of mathematical analysis, and in particular - in special functions and their applications.

I can evaluate the contributions in her works as theoretical generalizations and development of a theory in a domain of mathematical analysis which is old classical but also currently extensively developed.

According to the Regulations of IMI-BAS (Ch. 2, 19.07.2019) and Regulations of BAS (20.05.2019) for application of the Law, all quantitative indicators for filling the academic post Professor in IMI-BAS are fulfilled and these are as follows:

1. Of all presented works on the case to have at least 10 items in publications with IF or SJR: she has presented (of these not used in previous procedures) 13 such papers (of them: with IF - 3 items, with SJR - 10 items);

2. All minimal requirements according to the Regulations on the Law of BAS an IMI-BAS are fulfilled, and for the indicators of the groups Г, Д, Е these are essentially exceeded: see Document № 17 presented by the candidate, and the summary table on page 3 of this review.

It is then evident that all requirements for occupation the academic post of (Full) Professor in BAS and in IMI-BAS are satisfied.

Let me note **the close relation and succession in the research of the candidate with the topics in mathematical analysis developed by now in "Analysis, Geometry and Topology" Department** (former "Complex Analysis"), also her collaborative role in the activities of this Department and of IMI-BAS, yet since 1990, and officially since 2012 first as associate member, and then as being on partial employment contract as Asso. Prof.

I confirm that in the presented works of candidate, which are very close as subject to my own research, there is **no detected plagiarism**.

Having all above said in mind, I can esteem that Asso. Prof D.Sc. Jordanka Paneva-Konovska satisfies all requirements of the Law (Law Act for Development of Academic Staff in R. Bulgaria) and of the Regulations of IMI and of BAS on this Law, as applicant for the academic post on this procedure.

I give my positive conclusion for the appointment of the candidate on the academic post of Professor in IMI-BAS.

I vote "For" (positively) the Academic Board on this procedure to propose to the Scientific Council of IMI-BAS to elect the candidate Asso. Prof. D.Sc. Jordanka Paneva-Konovska for the academic post of (Full) Professor in IMI-BAS.

October 21, 2019   Reviewer and member of the Academic Board:

                                                         (Prof. D.Sc. V. Kiryakova)