

## REVIEW

by

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of the materials submitted for the participation on the competition for the academic position of “**Professor**” for the needs of **Department “Mathematical Analysis, Faculty of Mathematics and Informatics” (FMI) of Plovdiv University "Paisii Hilendarski" (PU)**,

**Scientific field:** 4. Natural Sciences, Mathematics and Informatics;

**Professional field:** 4.5. Mathematics;

**Scientific specialty:** Mathematics (Differential Equations)

The competition for “Professor” was announced in the State Gazette (SG), № 92/18.11.2022), and on the website of PU. The only candidate for participation in the competition is **Assoc. Prof. Dr. Atanaska Tencheva Georgieva** from the same department

For preparing this review I will follow the instructions of PU.

### 1. GENERAL PRESENTATION OF THE MATERIALS RECEIVED

By order № PD-21-338 of 15.02. 2023 of the Rector of the Plovdiv University I was appointed a regular member of the scientific jury of the competition for the above academic position. At the first meeting of the Scientific Jury I was chosen to prepare a review for this competition.

The set of materials presented by Assoc. Prof. Atanaska Georgieva on electronic media (duplicated on paper) is in accordance with the Regulations for the development of the academic staff of Plovdiv University "Paisii Hilendarski".

The candidate submitted a total of 23 scientific publications and two textbooks for participation in the competition. I accept all submitted materials for review because:

- They have not used in the preparation of the PhD thesis of the candidate for acquisition of the "Doctor" (2009);
- They have not used in the competition for the academic position "Associate Professor" (2012);
- They correspond to the field of higher education, the professional direction and the scientific specialty of this competition;
- The results obtained in the various scientific papers submitted for participation in the competition for "Professor" do not match;
- I have not noticed and have no doubts about appropriation of the results of other authors i.e., I have not detected the presence of plagiarism.

### 2. BRIEF BIOGRAPHICAL DATA

In the period 1986-1991, the candidate acquired the Master's degree in the Faculty of Mathematics and Informatics of Sofia University "St. Kliment Ohridski" with qualification "mathematician", and specialization "Complex analysis and topology". From 1996 to 1999, Atanaska Georgieva was a full-time PhD student, trained according to the doctoral program

"Differential Equations" in the Department of Mathematical Analysis of the FMI of PU. Scientific supervisor is Prof. DSc Stepan Kostadinov. The topic of the dissertation is:

*"L<sub>p</sub> - equivalence between impulse differential equations".*

The dissertation was defended on 02.06. 2009

In short, her professional experience is as follows: from 1993 to 2010 (with a three-year break) she worked as an assistant and chief assistant at the University of Food Technology. The interruption is in connection with her doctoral studies at PU. From 01.04. In 2010, she held the position of "Chief Assistant" in the Department of Mathematical Analysis of the FMI of PU. A. Georgieva held the next academic position "Assoc. Professor" in 2012 in the field of higher education 4. Natural sciences, mathematics and informatics, professional field 4.5. Mathematics (Mathematical Analysis).

Her main teaching activity is related to the preparation of the lecture material and the reading of lectures, as well as the conducting of seminars and laboratory exercises in several mathematical disciplines for students from various specialties at the PU. She was the head of the following lecture courses:

- "Mathematical analysis";
- "School course in analysis";
- "Applied Mathematics";
- "Ordinary differential equations";
- "Partial differential equations".

The dean of FMI, and the head of the "Mathematical Analysis" department in the submitted for participation in the competition: "Reference on classroom and extra-auditory activities of Assoc. Dr. Atanaska Georgieva" state the following (I quote):

*"Lectures and exercises led by Assoc. Prof. Atanaska Georgieva are at a high scientific and methodical level. Demonstrates high professionalism and responsibility in work, applies modern methods and techniques in teaching activities".*

I have no reason to disagree with the findings. The level and merits of the candidate's research work are determined most precisely and objectively by the results achieved in his scientific activity. The scientific work of Atanaska Georgieva can be found in a total of 69 scientific articles. Some of these articles are presented for:

- Acquisition of ONS "Doctor" (5 items);
- For the academic position "Assoc. Professor" (10 items);
- For participation in the competition for "Professor" (23 items);
- Registration in NACID without being used for other purposes (3 items);
- Have not been used (so far) for any reason (28 items).
- The journals in which the discussed articles were published are:
- With impact rank (SJR)—41 pcs.;
- With impact factor (IF)—16 pcs.

Additional information about the quality of the journals where the candidate has published can be obtained from the quartile classification of the journals:

- in quartile Q1 (4 pcs.);
- in quartile Q2 (5 pcs.);
- in quartile Q3 (1 pc.);
- in quartile Q4 (6 pcs.).

The creativity of A. Georgieva is complemented by three teaching aids, one of which was submitted for participation in the competition for “Associate Professor”, and the other two in the discussed competition for “Professor”.

In her scientific activity, we can also include:

- Participation with reports at 17 international scientific conferences;
- Participation in 1 national research project;
- She participated in 3 university research projects to the “Scientific Research Fund” at PU;
- She is the scientific supervisor of 2 successfully defended doctoral students at FMI;
- She is the academic supervisor of 7 successfully defended diplomas at FMI;
- She is a reviewer of 12 diploma theses at FMI.

The social work of the colleague is related to:

- Regular participation in committees for holding State exams and defenses of diploma theses at FMI;
- Regular participation in the PU candidate-student campaign;
- He is a member of the Society for Industrial and Applied Mathematics;
- He is a member of the American Mathematical Society;
- He is a referee for Mathematical Reviews (MatSciNet).

### **3. MAIN QUANTITATIVE AND QUALITATIVE INDICATORS OF THE ACTIVITY OF THE CANDIDATE SUBMITTED FOR PARTICIPATION IN THE COMPETITION**

**3.1. Publications for participation in the competition:** The list includes 2 university textbooks and 23 scientific articles.

The first of the two textbooks, entitled “*A Course in Ordinary Differential Equations*” has one author— Assoc. Professor A. Georgieva. It was published this year by Paisii Hilendarski University Publishing House. The content is a representative sample of the fundamentals of the theory of ordinary differential equations and is based on the author's experience in teaching this subject. The discussed topics correspond to the program for the study of bachelor degree students in the following majors:

- “Mathematics”, “Applied Mathematics”, and “Business Mathematics” in FMI of PU;
- “Mathematics and informatics”, “Mathematics, Informatics and Information Technologies”, and “Information Technologies, Mathematics and Educational Management” in Smolyan branch of PU.

In addition to theoretical material, the textbook also contains methods for solving some basic classes of ordinary differential equations.

The second textbook, entitled “*Mathematics*” is with three authors (one of whom is A. Georgieva). It was published in 2004 by ed. Blacom. The textbook contains lectures and appropriate tasks for exercises, which follow the curriculum of the discipline “Higher Mathematics” for the OCS bachelor of the Faculty of Technology at the University of Food Technologies - Plovdiv.

- We can divide the journals in which the scientific articles for participation in the competition were published as follows:
- with impact rank (SJR)—21 pcs. (9 of these publications are in AIP Conference Proceedings);
- with impact factor (IF) – 8 pcs.;

- quartiles in which Journal Citation Reports (JCR) of Web of Science groups scientific journals: Q1 – 1 item, Q2 – 3 items, Q3 – 4 items, Q4 – 4 items;
- referenced in Web of Science or Scopus – 21 items;
- referenced in Zentralblatt - 2 pcs.. (journals from this group are not referenced in Web of Science and Scopus).

I will note that the numerical data indicated above by me differ from the data that the candidate submitted in the “List of scientific works for participation in the competition”. Further, these differences are also reflected in the calculation of points for fulfilling the minimum requirements. More specifically, the differences are as follows:

- The author has published 20 publications in journals with impact rank (SJR). He missed the journal “Comptes Rendus de L'Academie Bulgare des Sciences”. Therefore, the publications with SJR are 21;
- Omitted to note that publications in Studies in Computational Intelligence are in the Q4 quartile. This applies to four of the author's publications submitted for participation in the competition;
- Assoc. Prof. Georgieva wrote that the journal "Applied Mathematics & Information Sciences" in 2013 (the year of publication in this journal) was in the Q1 quartile. A quick check shows that in the mentioned year, the journal is in the Q3 quartile;
- The author noted that the journal “Comptes Rendus de L'Academie Bulgare des Sciences” in 2013 was in the Q4 quartile. A quick check shows that in the mentioned year, the journal is in the Q2 quartile;
- A. Georgieva declared that the Journal of Inequalities and Applications in 2014 was in the Q2 quartile. A quick check shows that in the mentioned year the journal is in the Q3 quartile;
- The 2014 Electronic Journal of Qualitative Theory of Differential Equations is listed as being in the Q2 quartile. A quick check shows that in the year in question the magazine is in the Q4 quartile;
- The applicant has noted that the journal Mathematical Methods in the Applied Sciences is in the Q2 quartile. The journal in the year of publication of the scientific article is in two areas, one of which is in Q2 and the other in Q1. On this occasion, I quote a part of the Regulations for the Implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria:  
*“When reporting a journal publication that appears in more than one scientific field in the WoS database, the highest quartile for the corresponding journal for the year of publication is used”;*
- The author indicated that the journal Dynamic Systems and Applications in 2014 was in the Q4 quartile. A quick check shows that in the mentioned year, the journal is in the Q2 quartile.

According to the number of authors, the publications for participation in the contest can be distributed as follows:

- with one author – 1 issue;
- with two authors – 10 pieces;
- with three authors – 9 items;
- with four authors – 9 items;



In indicator D of Table 1, only 32 citations are reported, which are in journals referenced by Web of Science and Scopus. The remaining citations are not reported in the relevant reference. This is the candidate's decision.

Each of the minimum national indicators can be seen to be over-achieved (assuming that not all achievements are taken into account). I will note that (in total), the minimum required indicator points relating to "Professor" have been met by the candidate more than twice.

**3.4. Reference for the fulfillment of the minimum requirements of the FMI of PU:** The fulfillment of the minimum requirements of the FMI for occupying the academic position "professor" is shown in the following table:

| Additional FMI requirements  | Minimum number Indicators | Performance of the indicators by the candidate |
|--|---------------------------|--|
| Publications that have not been submitted for the acquisition of the ONS "Doctor" and for the occupation of the academic position "Assoc. Prof." | 20 articles               | 23 articles                                    |
| Journal publications   | 12 publications           | 23 publications                                |
| Publications in journals with an impact factor   | 8 publications            | 8 publications                                 |
| Study aids   | 1 teaching book           | 2 teaching books                               |
| Citations  | 20 citations              | 32 citations                                   |
| Defended PhD students  | 1 PhD students            | 2 PhD students                                 |

Table 2

Assoc. Prof. Atanaska Georgieva was the scientific supervisor of the doctoral students:

- Lozanka Trenkova, dissertation topic: "Abstract equations of Voltaire type and applications", successfully defended in 2014.
- Iva Yoncheva-Naidenova, dissertation topic: "Approximate solutions of some classes of fuzzy integral equations", successfully defended in 2022.

Table 2 shows that the additional minimum requirements of the FMI are fulfilled by the candidate for the academic position "Professor".

#### 4. GENERAL CHARACTERISTICS OF THE CANDIDATE'S SCIENTIFIC WORK

In this part of the review, I will use the numbering of the titles of the peer-reviewed scientific papers according to the List of Scientific Papers for participation in the competition (although I think this numbering is "slightly" strange and confusing). In general, the scientific results of the candidate for "professor" consist in completing, enriching and summarizing the scientific knowledge on specific topics of the mathematical theories of:

- Analytical solutions of fuzzy integral equations ([B4.1], [B4.2], [B4.3], [B4.4], [B4.5], and [D7.18]);
- Approximate solutions of fuzzy integral equations ([D7.9], [D7.10], [D7.11], [D7.13], [D7.14], [D7.15] and [D7.17]);
- Ordinary differential equations in Banach spaces ([D7.1], [D7.2], [D7.6] and [D7.12]);
- Ordinary differential equations in finite-dimensional spaces ([D7.3], [D7.4] and [D7.16]);
- Integral equations ([D7.5], [D7.7] and [D7.8]).

**4.1. Analytical solutions of fuzzy integral equations:** The research of fuzzy integral equations started with the works of O. Kalevala (1987) and S. Seikkala (1987) concerning

the fuzzy integral equations of Voltaire. The main tasks arising in the study of various classes of fuzzy integral equations (for example, of the Volterra type, etc.) are: existence, uniqueness, boundedness of the solutions, construction of numerical methods for their finding. The existing numerical methods for the fuzzy Volterra integral equations are based on various techniques: successive approximations and iterative methods, numerical analytical methods (such as Adomian decomposition), homotopy analysis, homotopy perturbation, Nystrum quadrature techniques, etc. The homotopy perturbation method proposed by He for solving differential and linear and nonlinear integral equations has been the subject of extensive research. The method has been widely used to solve a wide range of equations.

Mainly three methods are applied in the papers assigned to this research group:

- Adomian decomposition;
- Homotopy perturbation method;
- Method of homotopy analysis.

Objects of the above methods are equations of the form:

- Fuzzy functional integral equation of the Volterra type with two variables;
- Nonlinear two-dimensional fuzzy Volterra-Fredholm integral equation;
- Nonlinear two-dimensional fuzzy Volterra-Fredholm integral equation of partial integrals;
- Fuzzy Volterra-Fredholm integro-differential equation.

The main results are related to:

- Existence of analytical solutions;
- Uniqueness of decisions;
- Approximate solutions;
- Convergence of iteration procedures;
- Error assessment.

**4.2. Approximate solutions of fuzzy integral equations:** In this group of studies, iterative procedures for finding successive approximations of unique solutions of several classes of integral equations have been adapted and applied. The main methods in the research group are used:

- Fuzzy quadrature and cubature formulas (rectangles, trapezoids, Simpson-type formulas);
- Fuzzy arcs of Haar, etc.;
- The solutions that are analyzed and used for the following classes of equations:
- Two-dimensional fuzzy integral equations;
- Fuzzy functional-integral equations of Hammerstein;
- Fuzzy functional-integral equations of Urison-Volterra;
- Non-linear two-dimensional fuzzy functional-integral equations of Fredholm;
- Non-linear two-dimensional fuzzy functional-integral equations of Hammerstein-Fredholm.

Sufficient conditions are found for:

- Existence and uniqueness of decisions;
- Convergence of iteration procedures;

- Error estimates;
- Robustness of the methods regarding the choice of the first approximation, etc.

**4.3. Ordinary differential equations in Banach spaces:** In my opinion, the candidate's strongest results are in this group of publications. I will describe two of these studies in more detail. For this purpose, I will use the following notations:  $X$  is a Banach space, and  $L(X)$  is the space of bounded linear operators depicting  $X \rightarrow X$ .

In [D7.2], a linear inhomogeneous equation is studied

$$\frac{dx}{dt} = A(t)x + f(t) \quad (i)$$

and the corresponding linear homogeneous equation

$$\frac{dx}{dt} = A(t)x, \quad (ii)$$

where  $A: R^+ \rightarrow L(X)$  is a continuous linear operator, and the function  $f: R^+ \rightarrow X$  possess certain qualities. Let  $RL(X)$  be a space of all invertible bounded operators in  $L(X)$ , and  $\psi(\cdot): R^+ \rightarrow RL(X)$  is a continuous operator-function. The commented article expands the concept of  $\psi$  - dichotomy for arbitrary Banach spaces. Moreover, the operator-function  $\psi$  is an arbitrary bounded invertible operator, not a diagonal non-negative matrix (we mean the finite-dimensional case). More precisely, equation (ii) has  $\psi$  - exponential dichotomy on  $R^+$ , if there exists a pair of mutually dissupplementing projectors  $P_1$  and  $P_2 = I - P_1$ , as well as positive constants  $N_1, N_2, \nu_1, \nu_2$ , such that:

$$\begin{aligned} \|\psi(t)V(t)P_1V^{-1}(s)\psi^{-1}(s)\| &\leq N_1e^{-\nu_1(t-s)}, \quad 0 \leq s \leq t; \\ \|\psi(t)V(t)P_2V^{-1}(s)\psi^{-1}(s)\| &\leq N_2e^{-\nu_2(s-t)}, \quad 0 \leq t \leq s. \end{aligned}$$

where  $V(t)$ ,  $t \in R^+$  is a Cauchy operator for the solution of (ii). If in the above inequalities holds  $\nu_1 = \nu_2 = 0$ , then the equation (ii) possess  $\psi$  - simple dichotomy on  $R^+$ . The main result is to find the sufficient conditions under which from  $\psi$  - exponential dichotomy of equation (ii) explores the existence of  $\psi$  - bounded solutions of the inhomogeneous equation.

I believe that attention should be paid to work [G7.12]. We consider a linear inhomogeneous momentum differential equation in a Banach space with fixed momentum moments that (in absolute value) grow without limit, i.e.

$$\frac{dx}{dt} = A(t)x + f(t), \quad t \neq t_n; \quad x(t_n^+) = Q(x(t_n)) + r_n, \quad t = t_n, \quad (iii)$$

where  $A: R \rightarrow L(X)$  is a continuous linear operator,  $Q_n \in L(X)$ ;  $f: R \rightarrow X$ ;  $r_n \in R$ ;  $t_0 = 0$ ,  $t_n < t_{n+1}$ ,  $\lim_{n \rightarrow \pm\infty} t_n = \pm\infty$ . The authors of the publication noted that this type of equations is closely related to the controllable systems of equations in Banach spaces, with control at the place of inhomogeneity - the function  $f(t)$ . Another remarkable thing: the control is not only in the continuous part of the solution, but also in the magnitude of the



impulse disturbances  $\{r_n\}$ . Together with the above inhomogeneous equation, the authors consider the corresponding homogeneous equation:

$$\frac{dx}{dt} = A(t)x, t \neq t_n; \quad x(t_n^+) = Q(x(t_n)), t = t_n. \quad (\text{iv})$$

Under certain conditions, the homogeneous equation (iv) possesses a Cauchy operator  $V(t)$ ,  $t \in R$ , by which his solution (for which  $x(s) = \xi$ ) can be represented in the elegant form:  $x(t) = V(t)V^{-1}(s)\xi$ . The following considerations assume the presence of the so-called  $(h, k)$  - dichotomy of the solutions of the homogeneous equation (introduced by the Chilean scientists M. Pinto and R. Naulin). More precisely, the authors stated sufficient conditions for the existence of a solution to (iii) under the assumption that the solution to (iv) holds  $(h, k)$  - dichotomy. The concept  $L_p(h, k)$  - solution is introduced. The main result in the article concerns the existence of  $L_p(h, k)$  - solution of (iii). A certain ambiguity (for me) causes the definitional equality of space  $L_\infty$ .

**4.4. Ordinary differential equations in finite-dimensional spaces:** In this group of articles, properties of special (exotic) classes of differential equations are investigated. I will look at the best result in my opinion.

In article [D7.3], the main object of research is an initial problem for a nonlinear differential equation with maxima of the form:

$$\frac{dx}{dt} = f\left(x, \max_{s \in [t-r, t]} x(s), p\right), t \geq t_0; \quad x(t) = \varphi(t - t_0), t \in [t_0 - r, t_0], \quad (\text{v})$$

Where function  $f: R^n \times R^n \times R^m \rightarrow R^n$ , parameter  $p \in R^m$ , and initial function  $\varphi: [-r, 0] \rightarrow R^n$ ,  $r = \text{const} > 0$ . In some real processes, the development and management of the studied (changing) quantity depends on its maximum deviation. An adequate mathematical apparatus by means of which such processes are modeled are differential equations that contain a maximum operator on the right-hand side. Furthermore, a fundamental task in the theory of differential equations of arbitrary type (including equations with maxima) is stability with respect to a parameter. The commented publication is dedicated to the mentioned quality problem. The research was carried out on the basis of a number of specific concepts and methodological approaches, of which I will pay attention to the following:

- Lyapunov functions;
- Derivative of a function along the trajectory of the studied equation (v);
- Razumikhin's method;
- Comparative scalar differential equation; constant equilibrium of equation (v) (I will remind that  $\xi^* \in R^n$  is a constant equilibrium of equation (v) at  $p = p^* \in R^m$ , if  $f(\xi^*, \xi^*, p^*) = 0$ );
- Two measures of sustainability (one measure  $h_0$  is used to measure the initial quantitative information, and the other measure  $h$  - for the current and future

quantitative information). We will note that with the help of the two measures, the range of applicability of the methods for proof of sustainability is significantly increased;

- Robustness with respect to two measures, i.e.  $(h_0, h)$  - resistance to the constant equilibrium;
- Parametric and uniform parametric robustness with respect to two measures, etc.

The main result is a set of conditions guaranteeing parametric stability and uniform parametric stability of the solutions of the initial problem for the equation with maxima. I will not refrain and note the exceptional precision and logical consistency of the statement in the commented study, as well as the serious technical work on the proofs of the results. Illustrative examples bring the necessary calmness to the work of the (sometimes worried and puzzled) reader.

**4.5. Integral equations:** Among the publications in this direction, I would single out work [G7.5], where the fundamental theory of specific abstract generalizations of integral equations and the second order Volterra inequalities is constructed:

$$f(x) = p(x) + \int_{M_x} Q(x, y, f(y)) d\mu_y; \quad g(x) = p(x) + \int_{M_x} Q(x, y, g(y)) d\mu_y, \quad (\text{vi})$$

where  $\Omega$  is a complete metric space with a metric function  $\rho: \Omega \times \Omega \rightarrow R^+$ ;  $B$  is a Banach space with corresponding norm; the operator  $Q: \Omega \times \Omega \times B \rightarrow B$ ;  $\mu: B_\Omega \rightarrow R^+$  is a Borel measure;  $B_\Omega \subset 2^\Omega$  is  $\sigma$ -algebra, consisting of Borel subsets of  $\Omega$ ; the image  $M: \Omega \rightarrow 2^\Omega$ , which at each point  $x \in \Omega$  matches a subset  $M_x$ ,  $M_x \subset \Omega$ ;  $f, g, p \in C(M_x, B)$ . One of the merits of the research is the appropriate formulation of the research object, giving opportunities to achieve specific results. As the authors noted, even in finite-dimensional spaces, finding the type and structure of reasonably accurate estimates for inequalities depends on the number of variables and the geometry of the integration set. Moreover, establishing the inequalities requires a specific and geometry-specific technique of the integration sets. In the work, the idea of Prof. A. Mishkis is further developed, namely establishing constraints that guarantee that the solutions of the equation written in (vi) is an upper bound of all solutions of the corresponding inequality. Another interesting idea in this work is finding a set  $M^\mu$ , consisting of subsets of  $\Omega$ , i.e.  $M^\mu = \{M_x^\mu\} \subset 2^\Omega$ , which satisfies the following requirements:

- The elements (sets  $M_x^\mu$ ) of  $M^\mu$  have qualitatively better integration properties than elements (sets  $M_x$ ) of  $M$ ;
- For each element  $M_x \in M$ , there exists element  $M_x^\mu \in M^\mu$ , such that  $\mu((M_x^\mu - M_x) \cup (M_x - M_x^\mu)) = 0$ ;
- Both sets  $M_x$  and  $M_x^\mu$  are "close" in a metrical sense.

This allows the two integration sets to be interchanged. The main results in the discussed work are the finding of sufficient conditions for the existence of solutions of integral equations of the Volterra type (see (vi)) and applications of the obtained results for integral inequalities.

**4.6. Conclusion:** The submitted scientific works significantly exceed the national and university requirements for both quantity and quality, which is necessary to hold the academic position of "Professor" in a prestigious higher education institution. The main contributions of the author can be defined as theoretical, which have a direct bearing on applications. The research and the results obtained are:

- Significantly original in relation to the specific topics and objects studied;
- They fill “vacancies in scientific knowledge” and seriously expand preliminary research in individual scientific fields;
- Enable the continuation of scientific research in the directions of the author's research activity;
- They are provoked by the need to study real tasks, or at least other authors can use what they have achieved to solve practical problems;
- In the papers presented, mathematical models are considered, through which the theory is further clearly understood, the achieved results are analyzed, and different approaches are compared.

## **5. ASSESSMENT OF THE CANDIDATE'S PERSONAL CONTRIBUTION**

Almost all scientific works and teaching aids submitted for participation in the discussed competition are co-authored (only one publication and one textbook are independent). I definitely consider that the noted fact “**is not a minus**” for the candidate. On the contrary, just the opposite:

- First of all, with the participation of more than one author in a given scientific study, the results are more reliable, more diverse and deeper;
- Second, in modern science, the time of individual scientists seems to be passing. This is necessary due to the use of huge amounts of source information, the possession of which is often beyond the power of one person;
- When obtaining results that border on several scientific fields, the participation of specialists in each of the relevant fields is a mandatory initial condition when starting the research.

Specifically, among the documents for participation in the competition, there are no declarations from the authors of the scientific works submitted for review, in which the degree of participation of each of them is determined. By the way, I consider “composing such declarations, distribution protocols and the like” offensive and unworthy. The content of such documents is located far from academic norms. The absence of such “dubious documents” greatly eases my work. I am convinced that the participation of Associate Professor Dr. Atanaska Georgieva is equivalent to the other co-authors. I don't think the “ranking” of authors in a given collective publication is relevant to the degree (or importance) of their contribution.

## **6. CRITICAL REMARKS AND RECOMMENDATIONS**

I have no critical notes. In addition, it is easy to see that the scientific articles of the competition have been published in reputable scientific journals or have been reported in authoritative international scientific forums. Therefore, they have received preliminary, specialized, positive reviews.

I am convinced that Assoc. Prof. A. Georgieva will acquire the academic position she desires. I think it is strange and uncollegial to give advice and recommendations about the future scientific work of a "professor", so I will refrain.

All documents related to the competition have been carefully and conveniently prepared for the reviewer, following the established rules in the FMI of PU.

It seems to me that the scientific results obtained by the candidate (I mean not only those with which he participated in the discussed competition) should be systematized in several monographs. I would like to draw the author's attention to the following titles of "required" future monographs:

- "Approximate solutions of fuzzy integral equations";
- "Lp - equivalence between impulse differential equations".

Without a doubt, the monographs will arouse serious interest among the scientific community, not only in our country.

## **7. PERSONAL IMPRESSIONS**

In 2012, I participated in a scientific jury for a competition of "Associate Professor", which was won by Dr. Atanaska Georgieva. In the opinion prepared by me on the mentioned competition for "Associate Professor" I have written i.e., I quote myself":

"I have known Atanaska Georgieva for more than ten years (as of now more than twenty years - reviewer's note). Our first meetings are related to her participation in several consecutive conferences on mathematics, held for nearly twenty years (every year in August) at TU - Plovdiv. I believe that she is dedicated to research work and possesses a serious competence in the field of her research. Combined with her hard work, these qualities are the basis for both the achieved results and the upcoming ones, in the realization of which I am fully convinced."

I see no reason why, ten years later from the time when the above lines were written, I should not fully agree with them. Of course, since then, Atanaska has continued her development and established herself as an accomplished research mathematician and university lecturer in mathematics with extensive experience. I get a good impression from the fact that she shared her knowledge and research skills with the PhD students who defended under her supervision.

## **CONCLUSION**

The comments made above in the review give me reason to draw the following conclusions:

1. The textbooks (2 copies) presented for participation in the competition are useful for students. They reflect the modern trends in education in the relevant academic disciplines. Demonstrate the candidate's educational and methodological skills;
2. Scientific works contain new theoretical research in the field of real and functional analysis, differential and integral equations, as well as in approximate methods for solving such equations. The obtained results develop and enrich mathematical knowledge. They are an original contribution of the candidate for the scientific title "Professor";
3. The research has been published in reputable journals that are reflected in the WoS and Scopus databases, and some of them have an impact rank (SJR) and an impact factor (IF);
4. Assoc. Prof. Dr. A. Georgieva was the supervisor of two successfully defended doctoral students;

5. Through the established multiple citations (without self-citations), I conclude that the research is of scientific interest to scientists in the relevant scientific field at home and abroad;
6. Assoc. Prof. A. Georgieva has presented study aids and scientific works published after the defense of the doctoral dissertation for the award of the ONS "Doctor" in 2009 and after occupying the academic position of "Associate Professor" in 2012. Therefore, we indisputably reach the conclusion that the reviewed materials have not been used so far for the academic growth of the candidate;
7. The achievements in the educational literature and scientific publications of the candidate meet (and in some indicators exceed many times) the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (LDASRB) and the Regulations for the Implementation of the LDASRB regarding the occupation of the academic position "Professor";
8. The presented educational and scientific materials satisfy the specific minimum requirements of the FMI of the PU;
9. I have not detected plagiarism.

**Finally: I declare my positive assessment** and recommend the Scientific Jury to prepare a report-proposal to the FMI of PU for the election of Assoc. Prof. Atanaska Tencheva Georgieva for the academic position of "Professor" in the Department of "Mathematical Analysis" of the same Faculty of Professional field: 4.5. Mathematics (Differential Equations).

10/04/2023

Reviewer .....

(Prof. DSc Angel Dishliev)