**REPORT**
to occupy the academic position:

| "Professor" | |
|---|---|
| "Associate Professor" | X |
| | one of the academic positions indicated shall be marked with the sign "X" |

**Candidates to occupy the position:**

| 1 | Chief Assistant Professor | Ph.D. | Stefan | Mihailov | Filipov | UCTM |
|---|---|---|---|---|---|---|
| № | academic position | scientific degree | name | middle name | last name | workplace |

**Scientific area**:

| 4 | Natural Science, Mathematics and Informatics |
|---|---|
| code | name |

**Professional area**:

| 4.6 | Informatics and Computer Science |
|---|---|
| code | name |

**Scientific specialty**:

| Informatics |
|---|

**The competition has been announced:**

| 34 | 11.04.2023 | "Informatics" | Faculty of Chemical and Systems Engineering |
|---|---|---|---|
| in SG issue | date | for the needs of the Department | Faculty |

**The report was written by**:

| Associate Professor | Ph.D. | Velika | Ilieva | Dragieva | University of Forestry, retiree |
|---|---|---|---|---|---|
| academic position | scientific degree | name | middle name | last name | workplace |

**1. Report for the candidate:**

| academic position | scientific degree | name | middle name | last name |
|---|---|---|---|---|
| Chief Assistant Professor | Ph.D. | Stefan | Mihailov | Filipov |

## 1.1. Meeting the minimum requirements under the Regulations:

| | | |
|---|---|---|
| A) The candidate meets the minimum requirements | 20 points | X |
| B) The candidate doesn't meet the minimum requirements | 0 points | |
| | | one of the answers given is marked with the sign "X" |

| |
|---|
| It must be filled in if answer B is marked. The publication activity of the candidate is analyzed. The response of the results achieved (quoted) is analyzed. |
| The candidate, Chief Assistant Professor Stefan Filipov, Ph.D., participated in the competition with one monograph; 6 publications (which, as an indicator of the NACID list, bring him 213 points), with 1 being in a journal with an impact factor and 5 being in journals referenced in world-renowned databases without an impact factor; 6 citations of two of the candidate's publications (which, as an indicator from the NACID list, bring him 64 points). The candidate has three teaching aids, as well as 6 monograph publications, marked m1 - m6, which do not earn him points as an indicator of the NACID list. Chief Assistant Professor Stefan Filipov, Ph.D., has indicated participation in 6 research projects, 3 of which he is the head of, funded by UCTM. The candidate has 12 conference and workshop papers, but no information is given about the publication of these papers. The three teaching aids, as well as the monograph the Chief Assistant Professor Stefan Filipov is the sole author, all other publications are co-authored, some of which Stefan Filipov is the lead author of. |

## 1.2. Relevance of scientific and / or applied research:

| | | |
|---|---|---|
| A) The research is relevant. Part of the research is pioneering (no results are known on the topic by other authors) | 8 points | X |
| B) Research is relevant. Results from other authors are known for each of the topics and / or applications studied. | 6 points | |
| C) Most of the research is relevant, but also some results are presented that have no scientific and / or applied value | 4 points | |
| D) The smaller part of the research is relevant | 2 points | |
| E) Research is not relevant | 0 points | |
| | | one of the answers given |

| | | is marked with the sign "X" |
| --- | --- | --- |

| The evaluation of the relevance of the research must be substantiated. |
| --- |
| The candidate's research work can be tentatively divided into two parts: (1) Construction of new metrics for measuring the closeness of functions and (2) Development of numerical methods for boundary value problems in some types of ordinary differential equations. Both directions are relevant due to the use of their results in applied mathematics, natural and engineering sciences, computer science. Also, some of the results in the first direction, such as the H1-seminorm minimization approach, are used as a basis for constructing the shooting-projection method presented in publications in the second direction. As usual, the results are based on/use pre-existing ones, but none are repeats of any of the previous ones. |

### 1.3. Objectives of the research:

| | | |
| --- | --- | --- |
| A) Realistic and of scientific and / or applied interest | 8 points | X |
| B) Realistic, but not of scientific and / or applied interest | 4 points | |
| C) Unattainable (unrealistic) | 0 points | |
| | | one of the answers given is marked with the sign "X" |

| Objectives must be specified. The type of the set objectives must be justified |
| --- |
| The main goal in the first part of the candidate's research, as we have already noted, is the construction of new metrics for measuring the proximity of functions of one and two variables and vector functions, as well as the comparison between these metrics. Namely:<br>- An application of the *H1*-seminorm as a measure of the proximity of two real functions of the same independent variable, as well as between functions of two variables and vector functions, is considered. The specific goal is to find functions that satisfy a given set of conditions and minimize the H1-based distance to a given function.<br>- The problem of measuring the difference between two functions by means of the so-called geometric difference, representing the L2-norm of the logarithm of the given functions ratio, is considered. The aim is to investigate the properties and application of this difference and to compare it with other metrics based on L2-norm and H1-seminorm of algebraic difference as well as H1-norm of geometric difference.<br>The objectives in the second area of the candidate's research are related to the methods of numerical solution of two-point boundary value problems of nonlinear ordinary differential equations of the second order, as well as of integro-differential equations. The main task under consideration is related to establishing a connection between the existing three such methods (finite difference, nonlinear shooting and linearization), which has not been done until now and is important both from a theoretical and an applied point of view.<br>And a study aimed at defining a stochastic method for predicting the eventual occurrence of a fatal event in a multi-component wear system modeled by a random walk with negative drift. |

## 1.4. Candidate research contributions:

| | | |
|---|---|---|
| A) With lasting scientific and / or applied response, they form the basis for new research and applications | 20 points | X |
| B) They are of significant scientific and / or applied interest, complete and / or summarize previous research | 16 points | |
| C) They are of scientific and / or applied interest | 12 points | |
| D) Lack of significant contributions | 8 points | |
| E) Lack of contributions | 0 points | |
| | | one of the answers given is marked with the sign "X" |

| |
|---|
| Contributions must be specified. The type of results achieved must be justified. |
| The results obtained by the candidate, Chief Assistant Professor Stefan Filipov and his co-authors, in solving the set goals and tasks, are important contributions from both a theoretical and a practical point of view. They could be summarized as follows: <br><br> 1. When examining the *H1*-semi-norm of two different real functions of the same variable, it is shown that the smaller the distance based on this semi-norm, the closer the behavior of the considered functions, even if they are distant in the Euclidean sense. Practically, the problem is solved in a closed form for functions defined on a network, as the Lagrange method of the undefined coefficients is used. <br> 2. The results of applying *H1*-based metrics to vector functions and functions of two variables are applied to solving 3D two-point boundary value problems, as well as to solving Poisson and Laplace partial differential equations. <br> 3. When studying the properties of the geometric difference, it is shown that, given a positive target function, the function that satisfies the given conditions and minimizes the geometric difference is also positive. This is a very important property of the geometric difference from a practical point of view, and for such tasks it makes it more suitable than the arithmetic difference in metrics based on the *L2*-norm and the *H1*-semi-norm. A general solution is again derived for the case of network functions, the procedure for solving the resulting nonlinear system being a combination of the simple iteration method and Newton's method. <br> 4. When researching the methods for numerical solution of the considered type of differential equations, the candidate and his co-authors are the first to show an existing close relationship between the three main such methods that we have already mentioned (of finite differences, nonlinear shooting and linearization). More precisely, it is proved that the linearization of the boundary value problem with the subsequent application of the method of finite increments is equivalent to the discretization of the boundary value problem by the method of finite increments with subsequent linearization of the resulting system. This result has a substantial contribution in working with shooting methods and replacing them with each other or with another procedure, depending on which is more suitable in the particular case, especially from a practical point of view. |
| The developed stochastic method for predicting fatal events in a multi-component system |

with wear is a novel Monte Carlo simulation method, with possible applications in various systems whose components wear out from randomly wandering with a negative drift.

## 1.5. Participation of the candidate in the achievement of the presented results:

| | | |
|---|---|---|
| A) The candidate has at least an equal participation in the submitted papers | 8 points | X |
| B) The candidate has at least an equal participation in most of the submitted papers | 7 points | |
| C) The candidate has a secondary participation in most of the submitted papers | 4 points | |
| D) The candidate participation is unnoticeable | 0 points | |
| | | one of the answers given is marked with the sign "X" |

| |
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| Critical notes must be provided if one of the items C or D is marked. |

## 1.6 Pedagogical activity:

| | | |
|---|---|---|
| A) The candidate has effective and sufficient pedagogical activity at the university. The textbooks issued are modern and useful (they meet the requirements of the Regulations). The work with undergraduate and doctoral students is at a high professional level. | 8 points | X |
| B) The candidate has sufficient pedagogical activity at the university. The textbooks issued satisfy the requirements of the Regulations. | 6 points | |
| C) The pedagogical activity and / or textbooks issued are insufficient (do not meet the requirements of the Regulations) | 0 points | |
| | | one of the answers given is marked with the sign "X" |

| |
|---|
| Critical notes must be provided if one of the items B or C is marked. |
| |

## 1.7. Critical notes:

| | | |
|---|---|---|
| A) Lack of critical notes | 8 points | X |
| B) Critical notes of a technical nature | 7 points | |

| C) Critical notes that would partially improve the results achieved in a small part of the research | 5 points | |
| D) Critical notes that would partially improve the results achieved in most of the research | 3 points | |
| E) Significant critical notes | 0 points | |
| | | one of the answers given is marked with the sign "X" |

| Critical notes must be provided if one of the answers C, D or E is marked. |
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| |

## 1.8. Conclusion

| A) The evaluation of the candidate's activity is **POSITIVE** | This evaluation is assigned to a total number of at least 50 points | X |
| --- | --- | --- |
| B) The evaluation of the candidate's activity is **NEGATIVE** | This evaluation is assigned to a total number below 50 points | |
| | | one of the answers given is marked with the sign "X" |

| To be filled in if requested by the member of the scientific jury |
| --- |
| I categorically vote "YES" the candidate, chief assistant, Stefan Mihailov Filipov  to occupy the academic position "Associate Professor" in scientific area 4. Natural sciences, mathematics and informatics, professional area 4.6. Informatics and computer science, scientific specialty Informatics. |

| **13.08.2023** | The report was written by: | |
| --- | --- | --- |
| date | | signature |