STATEMENT REPORT

on the procedure for defense of a dissertation thesis entitled:

"Codes and Designs in Polynomial Metric Spaces"
for obtaining the scientific degree "Doctor" (educational and scientific)
by Konstantin Vassilev Delchev

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

Professional field: **4.6. Informatics and Computer Sciences,**

Ph. D. program **"Informatics",**

Section: **Mathematical Foundations of Informatics,**

Institute of Mathematics and Informatics (IMI),

Bulgaria Academy of Sciences (BAS),

The statement report has been prepared by: Associate Professor **Maya Miteva Stoyanova**, Ph.D., Deputy Dean (Academic staff) of Faculty of Mathematics and Informatics, Sofia University "St. Kliment Ohridski", in my capacity as a member of the scientific jury for the defence of this dissertation according to Order № 48/26.03.2021 of the Director of the IMI, BAS.

1. General characteristics of the dissertation thesis and the presented materials

The dissertation thesis investigates the structure of codes and designs with small number of distances in some polynomial metric spaces. With linear programming techniques and combinatorial properties, new bounds on the cardinality of such codes and designs have been obtained, as well as upper bounds for the energies of spherical designs with cardinality close to the Delsart-Gottals-Seidel bounds. Constructions of q-ary codes with two adjacent or two (close) distances are also presented.

The Ph.D. thesis contains 84 pages consisting of an introduction (chapter 1), four chapters (from 2 to 5) and a bibliography containing 100 titles. Konstantin Vassilev Delchev has presented all required documents and materials that concern the procedure. The documents show that the applicant fully meets the minimal national requirements according to the Act on Development of the Academic Staff in the Republic of Bulgaria as well as the Regulations for the conditions and rules for acquiring Ph.D. Degree of the Institute of Mathematics and Informatics and Bulgaria Academy of Sciences.

2. Short CV and personal impressions of the candidate

I have known Konstantin Delchev since he received his master's degree in Algebra, Geometry and Topology, Faculty of Mathematics and Informatics, and I was a reviewer of his master's thesis in 2015. After graduating, he joined the leadership of Prof. Peter Boyvalenkov to the scientific group in Bulgaria that investigates different classes of codes and designs in polynomial metric spaces. I am also a part of this group and that's why I know his Ph.D. work well. I have listened to presentations on the results obtained together with his supervisor and I have a good impression of the candidate's knowledge.

3. **Content analysis of the scientific and scientific-applied achievements of the candidate, contained in the presented dissertation thesis and the publications to it, included in the procedure**

The research in this PhD thesis is on the main characteristics of finite sets of points (codes) on the unit sphere in the n-dimensional Euclidean space, as well as on the q-ary codes in the Hamming space H (n, q), considered as polynomial metric spaces. The first chapter (introduction) presents the basic concepts of coding theory, the known results, as well as the main tasks explored in the thesis.

In the second chapter antipodal spherical codes are considered. For those, new bounds for the cardinality of such codes with small number of distances are obtained with methods of linear programming and combinatorial properties. Lloyd-type results for the rationality of inner products are also obtained.

In Chapter three, new upper bounds are obtained for the energies of spherical designs with a cardinality close to the Delsart-Gothals-Seidel bounds.

Chapters four and five examine q-ary codes in the two-distance Hamming space. Constructions of such codes with two adjacent distances as well as two distances are presented. Bounds on the cardinality of families of such codes based on connections with classical objects such as equidistant codes, etc, are obtained.

At the end of the dissertation the scientific contributions of the candidate, a list of the author's publications on the topic of the Ph.D. thesis and a list of their citations so far are presented. The work outlined in the thesis is clearly presented, easy to follow and cited promptly.

4. **Approbation of the results**

All the results described in the dissertation have been published in 6 scientific publications, two of them with impact factor, two others are SJR, one is referred to in IEEE Xplore and one is in a volume of the international conference ACST'2018.

The publications have been cited 4 times so far, and 3 of these citations are in Web of Science or Scopus.

All (six) scientific publications of Konstantin Delchev are co-authored by his scientific supervisor Prof. Dr. Peter Boyvalenkov, 4 of them are co-authored by V. Zinoviev and D. Zinoviev, and one of the publications is co-authored by M. Jourdian. I believe that the contribution of Konstantin Delchev is equal.

The presented references show that the scientific works categorically meet and repeatedly exceed the minimum national requirements (under Art. 2b, para. 2 and 3 of the according to the Act on Development of the Academic Staff in the Republic of Bulgaria as well as the Regulations for the conditions and rules for acquiring Ph.D. Degree of the Institute of Mathematics and Informatics and Bulgaria Academy of Sciences for acquiring the educational and scientific degree

"Doctor" in Professional field 4.6. Informatics and Computer Sciences. The obtained results are original and there is no proven plagiarism.

5. Qualities of the abstract

The abstract is 26 pages long, prepared according to all requirements and correctly reflects the content of the dissertation and the scientific contributions of the doctoral student.

6. Critical notes and recommendations

The small technical (spelling) mistakes I noticed do not essentially change my good impressions of the dissertation and the scientific knowledge of the candidate on the topic of the dissertation.

7. Conclusion

Having become acquainted with the dissertation thesis presented in the procedure and the accompanying scientific papers and on the basis of the analysis of their importance and the scientific and applied contributions contained therein, **I confirm** that the dissertation presented and the scientific publications to it, as well as the quality and originality of the results and achievements presented in them, meet the requirements of the Act on Development of the Academic Staff in the Republic of Bulgaria as well as the Regulations for the conditions and rules for acquiring Ph.D. degree of the Institute of Mathematics and Informatics, and of the Bulgaria Academy of Sciences for acquisition by the candidate of the scientific degree "Doctor" in the Scientific area "Informatics" and, in the Scientific field: 4. Natural Sciences, Mathematics and Informatics, Professional field: 4.6. Informatics and Computer Science. In particular, the candidate meets the minimal national requirements in the professional field and no plagiarism has been detected in the scientific papers submitted for the competition.

Based on the above, **I strongly recommend** the scientific jury to award **Konstantin Vassilev Delchev** the scientific degree „Doctor" (educational and scientific) in the Scientific field 4. Natural Sciences, Mathematics and Informatics, Professional field: 4.6. Informatics and Computer Sciences (Informatics).

Date: May 15, 2021   Signature: ....
                                                     Assoc. Prof. Maya Stoyanova, Ph.D.