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**	**PhD**	**Dimitar**	**Borisov**	**Borisov**	**UCTM**
№	academic position	scientific degree	name	middle name	last name	workplace

Scientific area:

5	**Technical Sciences**
code	name

Professional area:

5.13	**General Engineering**
code	name

Scientific specialty:

Environmental protection technologies and systems

The competition has been announced:

104	05.12.2025	**Engineering ecology**	**Faculty of Chemical and Systems Engineering**
in SG issue	date	for the needs of the Department	Faculty

The report was written by:

Professor	**PhD**	**Ivania**	**Nikolova**	**Markova-Deneva**	**pensioner**
academic position	scientific degree	name	middle name	last name	workplace

1. Report for the candidate:

Assistant Professor	PhD	Dimitar	Borisov	Borisov
academic position	scientific degree	name	middle name	last name

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 in the competition, Chief Assistant Dr. Eng. Dimitar Borisov Borisov for holding the academic position "Associate Professor" meets the requirements set out in the Regulations for Acquiring Scientific Degrees and Holding Academic Positions - PPNSZAD of the UCTM of Bulgaria, as well as the minimum national Requirements for the development of the academic staff in the Republic of Bulgaria", regulated in the PPZRASRB in the scientific field 5. Technical Sciences.

Dr. D. Borisov has published a total of **23 published works**, but participated in the competition with **19 publications**, **3 of which** are in journals with IF and/or SJR (Application 1z), one monographic work based on other 11 published works (Application 5g) and one published university textbook (Application 1j).

The points of the candidate for holding the academic position "Associate Professor" at the UCTM of Bulgaria under the individual indicators according to Application 1z are as follows:

Indicator 1: Dissertation work for awarding of the educational and scientific degree "doctor" - *total number of points under Indicator 1 - **50 points.***

Indicator 3: Habilitation work - a monograph based on no less than 5 publications in refereed publications, with which the candidate has not participated in previous procedures.

Monograph is presented by Dr. Dimitar Borisov on the topic "Effective methods for optimization and rational optimal decision-making, Academic Publishing House of IIIT - Plovdiv, 2025, p. 225. ISBN number: 978-619-91382-8-1. The monograph is based on 11 publications in refereed publications, with which the candidate has not participated in previous procedures.

*Total number of points under Indicator 3 - **100 points**.*

Indicator 7 and Indicator 8: The candidate participates in the competition with a total of **19 scientific publications**, which are evaluated with a **total number of 353.3 points**, including

- Scientific publications (articles and reports) published in editions that are referenced and indexed in world-renowned databases of scientific information: **3 scientific works**

have been published in journals with IF/SIF factor. ***Total number of points under Indicator 7 – 120 points.***

- Scientific publications (articles and reports) published in non-refereed journals, with scientific review or in edited collective volumes: ***16 scientific works*** have been published. ***Total number of points under Indicator 8*** – **233.3 points.**

Indicator 12 and Indicator 14:

Of the ***19 scientific publications*** submitted for participation in the competition, ***6 of them*** have found a response in world literature. ***9 citations*** of these 6 publications of the candidate were noted, which according to the requirements of the PPNSZAD are as follows:

• by Indicator 12 - **40 points** (10 points are require);

• by Indicator 14 - **10 points** (2 points are require).

Total number of points under both indicators **- 50 points**.

Indicator 18:

- Participation in a national scientific/educational project - ***40 participations*** are indicated. ***Total number of points*** **400 points.**

Indicator 19:

- Participation in an international scientific/educational project - ***7 participations*** are indicated. *Total number of points* **140 points.**

Indicator 20:

- Management of an international scientific/educational project - management of ***13 projects*** is indicated. *Total number of points 260 points.*

Indicator 24:

- Published university textbook or textbook used in the school network (according to Application 1j, *one textbook* has been published by Borisov, D. on the topic "Textbook for seminar exercises on Ecological Audit, Optimal Solutions and Data Processing in Environmental Protection", UCTM - Sofia, 2025, ISBN: 978-954-465-178-7). *According to Indicator 24*, *the total number of points is* **20 points.**

Summarized,

Total number of points *according the indicators 1, 3, 7, 8, 12, 14, 18, 19, 20, 24* - **1,373.3 points.**

In general: With a minimum number of required points by groups of indicators for holding the academic position of "associate professor" in the scientific specialty 5.13. General Engineering **400 points,** the candidate in this competition for the academic position of "associate professor" Dr. Dimitar Borisov Borisov has **1,373.3 points**.

He participated in the competition with ***one monographic work, one university textbook and 19 publications***, *3 works* of which are referenced and indexed in the world databases of scientific publications with IF and SJR awarded, and *16 works* are published in non-referenced scientific specialized publications with reviewers.

The presented monograph is on the topic "Effective methods for optimization and rational optimal decision-making", Academic Publishing House of IIIT - Plovdiv, 2025, p. 225. ISBN number: 978-619-91382-8-1.

The candidate's *19 published works* are in the following scientific thematic areas: Optimization of technological objects and systems; Multi-criteria optimization and optimal decision-making in environmental protection; Application of neural networks and deep learning in environmental protection; Energy efficiency and sustainable development.

The candidate has *40 participations in national scientific and educational projects, 20 participations in international scientific and educational projects and leadership of 13 national scientific and educational projects.*

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.

In general, the scientific research is up-to-date, of high scientific and applied value. They could be summarized in <u>two groups</u>: 1) conducted research, the results of which are reflected in 11 publications, on which the Monographic work is based, and 2) other research on the competition, the results of which are reflected in 19 published works.

Specifically,

The presented Monograph presents results of conducted research, in which the following ***algorithms, mathematical models*** and ***innovative strategies*** *were developed*:

- A *new heuristic optimization algorithm* with accelerated convergence for searching for a maximum of one-dimensional, unimodal objective functions is proposed, representing a new combined order, which provides a much faster reduction of the uncertainty interval compared to the best combined order known in the literature so far. This is most pronounced for a large uncertainty interval and is much more effective than traditional strategies for one-dimensional extremum search.

- A *fast-converging combined algorithm* is proposed, which combines the positive qualities of the methods of random directions and random search with a randomness penalty. This method is universal and can be modified and applied both for optimization of ravine functions and for searching for a global extremum using a search from multiple random starting points.

- A *new accelerated algorithm* for multidimensional optimization for complex ravine objective functions is proposed, which gives 2 to 4 times faster convergence in finding the extremum compared to the classical Gelfand and Zetlin method under the same initial conditions for given starting points, desired accuracy, step parameters and size of the admissible search space.

- A *new algorithm for global optimization* is proposed, which borrows Price's idea of grouping and analyzing groups of points. In this method, groups of pairs of points are created, on the basis of which new points are calculated, which replace the worst ones. Also, the values of the worst result are constantly improved as the points are condensed

around the global maximum. From the research of the proposed new methods for searching for a global extremum, tested with representative complex test multi-extremum functions and from the results obtained, the faster convergence of the proposed four varieties of the new method is confirmed.

In the other scientific works presented in the competition, in general, the results of the conducted scientific and scientific-applied research have been published, namely:

- Approximate *mathematical models*, numerical data and graphical results of virtual planned experiments on a verified analytical mathematical model have been created.

- Two adequate approximating polynomial *mathematical models* have been developed that can be used to optimize the amount of produced metal and minimize the amount of industrial waste (slag) in pyrometallurgical processes of torch melting of sulfide copper raw materials.

- The influence of *two independent variables on the quality indicators of packing masses* used in the refractory lining of steel casting ladles in metallurgy has been determined. A statistical evaluation of the indicators of packing masses with three different Al_2O_3 contents has been performed. The optimal amount of clay substance (Al_2O_3) and the temperature of heat treatment of the inner lining of steel casting ladles have been determined.

- Regression *mathematical models* of the second full order have been obtained for six quality indicators (target parameters) for packing masses of the "Fosuk" type and the adequacy of the obtained regression equations for the quality indicators has been confirmed. The optimal values of the amount of clay substance Al_2O_3 (%) and the heat treatment temperature (°C) are determined.

- A *new heuristic optimization algorithm* with accelerated convergence is proposed for searching for the maximum of one-dimensional unimodal objective functions, which is a combination of the dichotomy method, the Kiefer-Johnson method and the functional series of the fourth class. The proposed combined order gives a faster reduction of the uncertainty interval compared to the best known in the literature combined order 2–F.

- A *new heuristic optimization algorithm* with accelerated convergence for complex multidimensional objective functions of the ravine type is proposed with the main goal of combining the advantages of the method for random search from multiple random directions with a constant step for searching for the extremum of unimodal functions and the advantages of the Gelfand and Zetlin method.

- A *new heuristic algorithm* with accelerated convergence for one-dimensional optimization in unbounded space is proposed, which has a better convergence speed.

- *Three new strategies* for optimal decision-making are proposed, based on the developed generalized fractional-rational utility functions.

- *New types of strategies* for optimal decision-making are proposed, based on the generalized desirability functions. The variety of creating generalized desirability function includes various transformations of several objective parameters of linear, exponential and multiexponential type.

- A *comparative analysis* of three types of transformations (linear, exponential and double exponential) is made. The properties, efficiency of the methods and their sensitivity of the decisions made depending on the control parameters are studied using six types of generalized fractional-rational utility functions.

- A *new heuristic optimization algorithm* with accelerated convergence is proposed for searching for a global optimum of multidimensional, multimodal objective functions, which is based on the idea proposed by Price for grouping and cluster analysis. In the new method, as in the Price method, the values of the worst result are constantly improved and thus the points begin to condense around the global maximum.

- An *algorithm* is proposed for determining weighting coefficients of target indicators based on the opinions of decision-makers and/or experts, and the possibility of reducing the number of indicators by removing those with the lowest priority.

- *Three new innovative strategies* are proposed using generalized utility functions of additive, multiplicative and harmonic types, and three strategies of fractional-rational type, and their effectiveness is analyzed without and with their priorities. Decision-making procedures are part of almost all human activities. This applies to many areas of economics and technical-economic systems operating in real time, as well as to artificial intelligence systems and electronic leadership and optimal decision-making for their training.

- A *method* is proposed for improving the accuracy of a deep learning model for fire detection by pre-processing data (images collected from cameras). The accuracy of the proposed model reaches over 92%.

- A study of an object detection technique specifically designed for autonomous vehicles has been carried out. Object detection plays a vital role in enabling autonomous vehicles to accurately perceive and understand their surroundings, ensuring safe and efficient navigation. This technique combines speed, accuracy and efficiency, allowing for real-time detection of various objects in complex and dynamic driving scenarios. The approach is based on deep learning using convolutional neural networks, allowing for accurate identification and tracking of objects, including vehicles, pedestrians and road signs.

- A *method* for improving the accuracy of a deep learning model for detecting brain abnormalities based on computed tomography images has been investigated. A preprocessing method including a histogram equalization algorithm and a Gabor filter has been applied. A mutual information function selection (MIFS) algorithm has been used to optimize feature extraction. The final classification is performed using the SVM (Support Vector Machine Learning) machine learning model. To validate the effectiveness of the proposed model, it is compared with other popular deep learning models, including AlexNet. Experimental results have shown that the presented method achieves high accuracy.

In general, Chief Assistant Dr. D. Borisov has submitted for participation in the competition **one Monograph, oen textbook and 19 publications**, including 3 works in journals with IF and/or SJR award. Reviewers in these journals require from the authors a representative sample of the achievements in the literature on the topic. The literature references in each of the publications submitted for the competition, as well as the topics of his publications **give me reason to claim** that Chief Assistant Dr. D. Borisov knows in detail the achievements of other authors on the researched topics. In his scientific, applied and publication activities, Dr. Borisov analyzes, interprets, cites and creatively applies the results achieved by other researchers.

With his scientific and experimental research and the results obtained, he has contributed to the enrichment of theoretical knowledge and the accumulation of information in his scientific field, as well as to the improvement of practical activities in the relevant areas of general engineering, including in the field of Engineering Ecology and Environmental Protection.

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 research goals set by the candidate for participation in the competition for the academic position of "associate professor" are *realistic and represent scientific and applied interest.* The candidate's research and scientific interests are generally aimed at developing effective methods for optimization and rational optimal decision-making. The published monograph is also in this scientific field. Specifically, the candidate's research and scientific interests have the ***following goals***: - Analysis of the effectiveness of existing optimization methods - Development of one-dimensional optimization methods with accelerated convergence - Development of multidimensional optimization methods with accelerated convergence of unimodal objective functions - Creation of accelerated algorithms for multidimensional optimization for complex objective functions - Development of strategies for multicriteria optimization.

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.
A total of ***9 scientific and applied scientific contributions*** *of the results obtained* from the conducted research are indicated, which I fully accept. They can be summarized as follows: ***development of methods and algorithms for optimization and strategies for finding optimal solutions.***

- *New combined methods* with accelerated convergence for optimization are proposed, based on the dichotomy, the golden section and the Kiefer-Johnson method.

- A *new heuristic algorithm* with accelerated convergence for one-dimensional optimization in an unbounded space is proposed and studied.

- A new stochastic random search method and an algorithm for multidimensional optimization with accelerated convergence are proposed, three new modifications of it are proposed.

- A new accelerated algorithm for multidimensional optimization for complex ravine objective functions is proposed.

- A *new accelerated algorithm* for multi-extreme optimization is proposed, based on the Price method.

- *New fractional-rational generalized strategies* for finding an optimal solution with and without the use of weighting coefficients are proposed, which are investigated with real technological examples.

- A *method for improving the accuracy* of a deep learning model for fire detection by pre-processing images collected from cameras with an accuracy of over 92% is proposed.

- An object detection technique specifically designed for autonomous vehicles is investigated.

- A *method for improving* the accuracy of a deep learning model for detecting brain anomalies based on high-precision computed tomography images has been studied.

Summary: **Scientific research is related to solving important general engineering and environmental problems, including environmental protection**. The contributions of the candidate participating in the competition have a lasting scientific and applied impact and constitute the basis for new areas of research and applications, mainly in the professional field of "General Engineering", respectively, the creation of new methods and algorithms for optimizing processes in unlimited space.

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"

When examining the attached Monograph, with which Chief Assistant Dr. Eng. Dimitar Borisov presents himself in the competition for "associate professor", I came to the conclusion that *in the cited 11 publications* on which the Monograph is based, he

*participated as the sole author in **8 articles**, in **2 articles** he is *the lead author* and in *one article* he is in **second place**.

For participation in the competition, the candidate has submitted 19 more scientific papers, **in 13 papers** he is *the sole author*, in *2 papers* he is the lead author, in *one paper* he is in **second place**, and in the remaining *3 papers* he is **in third and fourth place**. The works in the team have an approximately constant composition. Due to the lack of distribution protocols between the authors, it can be assumed that the candidate has at least an equal participation in the presented works in the team.

His competence is also confirmed by the **13 scientific projects** developed under his leadership, funded by the Research Sector of the UCTM, as well as by other funding organizations.

He participated in scientific teams in developing a **total of 47 national and international contracts.**

He participated in scientific sessions, including those for young scientists, students and doctoral candidates in the UCTM, with 11 reports.

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"

The lecture courses taught by Chief Assistant Dr. Eng. Dimitar Borisov Borisov at the University of Chemical Technology and Metallurgy (UCTM) – Sofia in the last three academic years are:

I. To students of the Bachelor's Degree Program:
1. Environmental Audit and Optimal Solutions in Environmental Management, Specialization "Engineering Ecology and Environmental Protection", III year, Bachelor's Degree Program.
2. Environmental Monitoring II, Specialization "Engineering Ecology and Environmental Protection", III year, Bachelor's Degree Program.

3. Simulation of the Distribution of Pollutants, Specialization "Engineering Ecology and Environmental Protection", IV year, Bachelor's Degree Program.

II. To students of the Master's Degree Program:

4. Information Technologies in Environmental Protection, Specialization "Ecology and Environmental Protection", Master's Degree Program.

5. Informatics – Part I, speciality "Chemical and Biochemical Engineering (with teaching in French)", I year, Master's Degree.

6. Informatics – Part II, speciality "Chemical and Biochemical Engineering (with teaching in French)", I year, Master's Degree.

7. Electrical Engineering and Electronics, speciality "Chemical and Biochemical Engineering (with teaching in French)", II year, Master's Degree.

Chief Assistant Dr. D. Borisov was the supervisor of two theses for the acquisition of the Bachelor's Degree, which were successfully defended. He was also a consultant for one thesis for the Bachelor's Degree and the Master's Degree.

The main activities of the candidate Chief Assistant Dr. Eng. D. Borisov *are teaching and research activities*. Dr. D. Borisov has unexceptionable, sufficient and successful pedagogical activity with students and graduates in higher education institutions, mainly in the Department of Engineering Ecology at the University of Chemical Technology and Metalurgy (UCTM). His work with students is at a high professional level. The published textbook (Borisov, D., "Textbook for Seminar Exercises on Ecological Audit, Optimal Solutions and Data Processing in Environmental Protection", University of Technology - Sofia, 2025, ISBN: 978-954-465-178-7) is modern and useful and meets the requirements of the Regulations of the UCTM.

<u>In general</u>, I believe that the pedagogical activity of Chief Assistant Dr. Eng. D. Borisov fully meets the Regulations for the Acquisition of Scientific Degrees and Holding Academic Positions (PPNSZAD) of the University of Chemical Technology and Metalurgy.

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.

I have **no critical remarks** about the work and performance of Chief Assistant Dr. Eng. Dimitar Borisov in the competition for "associate professor". The documents are perfectly completed, the requirements for the individual indicators are met and significantly exceeded.

I have **no remarks** that cast doubt on the contributions in the presented works.

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

Based on the materials submitted by the sole candidate, Chief Assistant Dr. Dimitar Borisov, in the competition for the academic position of "Associate Professor" in the scientific specialty "Environmental Protection Technologies and Systems", professional field 5.13. General Engineering, field of higher education 5. Technical Sciences, announced by the University of Chemical Technology and Metallurgy-Sofia and published in the State Gazette, issue 104 of 05.12.2025, *I confidently confirm* that he is a well-established scientist who maintains high standards of scientific and pedagogical activity. Dr. D. Borisov fully meets the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria and the Rules of the University of Chemical Technology and Metallurgy for the academic position of "Associate Professor", for which *my assessment of his activities is positive* and I set the maximum total point asset of **79 points** (according to Point 1.1. to Point 1.7 by this REPOR). With a minimum number of required points by groups of indicators for the academic position of "associate professor" in the scientific specialty "Environmental Protection Technologies and Systems" **400 points** (Application 1z), the candidate in the competition for the academic position of "associate professor" has over **1,000 points (1,373.3 points).**

Based on the analysis of the monographic work, publications and achieved results, based on my assessment of his teaching activities and in connection with the fact that the minimum requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), the Regulations for the Implementation of ZRASRB (PPZRASRB) and the Regulations for Acquiring Scientific Degrees and Holding Academic

Positions (PPNSZAD) of the University of Chemical Technology and Metallurgy-Sofia are met, ***I confidently give a positive assessment of the activities*** of Dr. D. Borisov and I take the liberty of proposing to the Honorable Scientific Jury ***to accept and positively evaluate the candidacy*** of Chief Assistant Dr. Eng. Dimitar Borisov for occupying the academic position of "Associate Professor" in the Department of Engineering Ecology of the University of Chemical Technology and Metallurgy-Sofia in the scientific specialty "Environmental Protection Technologies and Systems", professional field 5.13. General Engineering, Scientific Area 5. Technical Sciences according to the competition announced by UCTM and promulgated in the State Gazette, issue 104 of 05.12. 2022.

15.03.2026	The report was written by:	
date	**Ivania Nikolova Markova-Deneva**	signature