

## POSITION

on a competition for the academic post of Associate Professor in professional field "5.1. Mechanical Engineering", specialty "Materials Science and Technology"

Announced in State **Gazette No. 2, 05.01.2024,**

with candidate prof. as. Dr. Eng. Prof. Daniela Todorova Spasova

Member of the scientific jury Dimitar Petrov Donchev, professor, Ph.

### **1. General characteristics of the candidate's research and applied scientific activity.**

The works from the research activity of the head as. Dr. Eng. Daniela Todorova Spasova, presented at the competition for associate professor can be divided into the following areas:

1. Scientific publications in publications that are refereed and indexed in world-known databases with scientific information 11 pcs.
2. Scientific publications in non-refereed peer-reviewed journals or edited collective volumes 19 pcs.

First field ( I ), a total of 10 publications are combined as equivalent to a monographic work on the topic: "RESEARCH ON MATERIALS AND TECHNOLOGIES APPLICABLE TO EQUIPMENT IN THE MARINE AND EXTRACTIVE INDUSTRIES"- C.4.1, C.4.2, C.4.3, C.4.4, C.4.5, C.4.6, C.4.7, C.4.8, C.4.9, C.4.10;

The second strand (II) includes 20 publications, systematized in thematic papers, in the following scientific fields:

1. Development of new and improvement of existing methods and technologies for making foundry moulds and obtaining complex non-technological castings of various alloys (5 publications)- D.8.1, D.8.2, D.8.3, D.8.16, D8.18
2. Conducting research on technologies for production of composite materials and evaluation of their quality and properties (5 publications)- D.8.5, D.8.6, D.8.7, D.8.8, D.8.14
3. Research on the application of software products for automation of data processing and modelling of thermal processes (2 publications)- D.7.1, D.8.10
4. Increasing the strength and performance of structural materials by additionally applied technological processes (5 publications)- D.8.4, D.8.9, D.8.11, D.8.15, D.8.17, D.8.19
5. Conducting research, quality control and remediation activities on the operating condition of production sites (2 publications)- D.8.12, D.8.13

The topic of the candidate's works fully coincides with the topic (nomenclature) of the competition.

## 2. Evaluation of the candidate's pedagogical training and activity.

Teaching activity of the head as. Dr. Eng. Daniela Todorova Spasova consists of the lectures, according to the table:

Academic year	Discipline	Horarium academic hours
2020-2021	"Engineering Materials and Processing Technologies" for B.Sc. ZNBA, 2 k., part-time studies	15
2020-2021	"Materials Science and Technology of Materials" for Bachelor's degree programmes ID, IM, TPI, ZNBA, IE - 1 year, full-time studies	30
2020-2021	"Special Technologies in Metal Foundry" for the Master's degree, special. CM 1 course, CM-4- 2 course and TTOM-4- 2 course, part-time studies	15
2020-2021	"Materials Science and Technology of Materials" for the Master's degree, special. TVEI-6 - 1 year, part-time studies	15
2021- 2022	"Materials Science and Technology of Materials" for Bachelor's degree programmes ID, IM, TPI, ZNBA, IE - 1 year, full-time studies	30
2021- 2022	"Special Technologies in Metal Casting" for Master's degree, specialisation KM 1 course, KM-4- 2 course and TTOM-4- 2 course, part-time studies	15
2021- 2022	"Materials Science and Technology of Materials" for the Master's degree, special. TVEI-6 - 1 year, part-time studies	15
2022- 2023	"Materials Science and Technology of Materials" for "Bachelor" majors ID, IM, TPI, ZNBA, IE - 1 year, full-time study	30
2022- 2023	"Special Technologies in Metal Casting" for Master's degree, specialisation KM 1 course, KM-4- 2 course and TTOM-4- 2 course, part-time studies	15
2022- 2023	"Materials Science and Technology of Materials" for the Master's degree, special. TVEI-6 - 1 year, part-time studies	15
Total points for the applicant under indicator G.22.		195

From the teaching and pedagogical activities presented, the candidate exceeds the minimum required.

## 3. Main scientific and applied contributions.

## Scientific and applied contributions

1. An engineering software based on DPs has been developed for the calculation of stresses and strains in pre-insulated connected pipe systems for heat transfer networks, which, although elementary, reduces the design effort by automating data processing. - F.7.1
2. A mathematical model of the thermal interaction between the matrix and the nucleating phase forming MMCs has been developed, which reveals the underlying mechanisms that control the formation of complex structures in the construction of cast metal composites by the capillary moulding method. - F.8.10
3. A vacuum pulse casting technology has been developed that allows the production of thin-walled, dense castings with complex relief and significantly reduced production costs compared to conventional technologies. - D.8.1, D.8.2
4. A methodology has been developed for the production of a ceramic shell on an electrically conductive wax model, which accurately replicates the model block due to a chemical method of creating an electrically conductive layer, and makes it possible to control the thickness of the shell formed, depending on the technological requirements of the foundry mould.
5. A methodology has been developed for forming a surface layer between two liquid phases (casting mould cladding and melt) of castings of aluminium and copper alloys, due to the formation of a temperature field ensuring contact of the melt with the cladding while both are in the liquid state, thus forming the surface of the casting on the liquid phase, providing a lower roughness.
6. The possibility of applying the "capillary moulding" method in the manufacture of two-layer moulds (using different coatings) on fusible patterns to obtain castings of low roughness from non-ferrous alloys has been established.- D.8.18
7. An innovative production method for the preparation of metal matrix composites (MMCs) has been developed, with controllable geometry of the annealing phase and the metal matrix, which leads to an increase in the mechanical and performance properties of the resulting materials; - C.4.1, C.4.2, C.4.5
8. In the preparation of MMSs with a metal strengthening phase, interaction of the liquid metal matrix with the strengthening phase has been found, resulting in the formation of new phases and structures, leading to an increase in mechanical properties, which cannot be obtained by conventional casting methods - C.4.1.
9. Different types of polymer matrix composite materials have been developed, suitable for fabrication of equipment operating in marine environment, with mechanical properties similar to metallic materials and with significantly lower density.
10. A simulation model has been developed for the selection of the operating mode and the determination of the durability of materials tested to cyclic fatigue, which is used to calculate the natural resonance frequency of the tested materials and the approximate number of load cycles - C.4.6.
11. A methodology has been developed to establish the modes of crack development depending on the chemical and technological conditions during cyclic fatigue loading and subsequent failure of the tested specimens. C.4.6, C.4.7, C.4.8

## **Applied contributions**

1. Extending the functionality of the software system for calculating stresses and elongations in insulated pipe systems, which takes into account the change in length, by adding: dimensioning of expansion joints; linear elongations in tees; dimensioning of the number and length of shims, and other calculations.
2. The thickness and type of membranes used in vacuum pulse moulding have been validated to obtain practically maximum mould pressurisation, thereby increasing the mould fill rate by a factor of about two.- D.8.1, D.8.2.
3. It has been found that the application of the "capillary moulding" method for making two-layer moulds on fusible patterns lowers the heating temperature of the casting mould by several hundred degrees, which results in a lower energy consumption of the process and also in obtaining a crack-free mould, in contrast to the conventional method of casting on fusible patterns. Г.8.18
4. The developed method for the production of MMSs with a ceramic grouting phase, applicable in the mining industry, provides a stable mechanical bond between the matrix and the reinforcing phase, due to the forced infiltration of the melt into the capillary spaces of the grouting phase, which helps to overcome the surface tension of the melt and ensures good wetting of the reinforcing phase.
5. A technology has been developed for adhesive bonding of two types of PMCs with a matrix composed of different resins, which leads to an increase in the complex properties of standard PMCs by combining the better properties of the two matrices.
6. The causes of failure of materials used in the engineering and mining industries have been experimentally determined, based on which recommendations to the manufacturer for quality control of the production process have been made. - C.4.8, C.4.10

## **4. Significance of contributions to science and practice.**

The candidate's scientific works submitted for the competition are individual and collective. It can be assumed that in each of them the candidate has at least equal participation in the research conducted, the analyses performed, the results obtained and the contributions formulated.

The compliance of the indicators of the scientific activity of the head as. Dr. Eng. Daniela Todorova with the minimum required points for the groups of indicators for the academic position "Associate Professor" are as follows:

- **Group A:** Dissertation for the award of educational and scientific degree "PhD" - 50 points.
- **Group B:** Scientific publications submitted, from which 239 points shall be obtained against the required 100 points.
- **Group D:** Total for Group D - 215 points with 200 points required.

- **Group E:** Total for Group E - 100 points with 50 points required.

From the above comparisons, it is concluded that Asst. Dr. Eng. Daniela Todorova fulfils the minimum requirements for the groups of indicators for the academic position of Associate Professor.

## **5. Critical comments and recommendations.**

I have no critical remarks to the candidate's scientific works.

I express the following recommendations:

1. To intensify the publication activity in refereed and indexed journals in world-known databases of scientific information.
2. To prepare and participate in project proposals for competitions funded by the National Research Fund or European programmes.
3. To establish and build links and scientific relationships with internationally recognised scientists and institutions.

## **CONCLUSION**

Based on the presented scientific works, their significance, quality, scientific and applied contributions contained in them and the results achieved, I give a positive assessment of the candidate's activity.

On the basis of my acquaintance with the presented scientific works I find it justified to propose the head. as. Dr. Eng. Daniela Todorova Spasova to take the academic position of Associate Professor in the professional field 5.1. Mechanical Engineering, in the specialty "Materials Science and Technology of Materials".

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**JURY M**

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