Appendix 12d

REPORT

to occupy the academic position:

''Professor''	**X**
''Associate Professor''	
	one of the academic positions indicated shall be marked with the sign "X"

Candidates to occupy the position:

1	Doz.	Dr.	Juliana	Javorova	Georgieva	UCTM
№	academic position	scientific degree	name	middle name	last name	workplace

Scientific area:

5.	Technical sciences
code	name

Professional area:

5.1.	Mechanical Engineering
code	name

Scientific specialty:

Applied mechanics (incl. tribology) with teaching in German

The competition has been announced:

39	27.05.2022	„Applied mechanics“	FMM
in SG issue	date	for the needs of the Department	Faculty

The report was written by:

Prof.	Dr.	Idilia	Alexandrova	Batchkova	UCTM
academic position	scientific degree	name	middle name	last name	workplace

1. Report for the candidate:

Doz.	Dr.	Juliana	Javorova	Georgieva
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.
Indicator A – 50 points with a minimum of 50 points (dissertation) Indicator C – 12 publications referenced in Scopus (**264 points by a minimum of 100 points**). Indicator D – 9 publications referenced in Scopus (117 points) and 33 publications in non-refereed journals (292 points) or a **total of 409 points by a minimum of 200 points**. Indicator D - 96 citations (45 in Scopus or WoS and 51 in journals or works with an editor - total 583 points) - **total 583 points by a minimum of 100 points**. Indicator E – 1 defended PhD student (40 points), participation in 4 projects under the NSF (40 points), in 3 international projects (60 points), head of 1 international project (40 points), 1 co-authored textbook (20 points) and 1 textbook (20 points), attracted funds for projects (25 points) - a total of **245 points with a minimum of 150 points**.

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	
B) Research is relevant. Results from other authors are known for each of the topics and / or applications studied.	6 points	**X**
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 thematic areas covered by the scientific research activity of Prof. Juliana Javorova are extremely relevant for the following reasons: 1) Modern aspects and problems in the field of hydrodynamic lubrication of sliding bearings, friction and wear of various tribological systems, physico-chemical and tribological

characteristics of various materials in the industry, which are of utmost importance for improving the efficiency and quality of the systems, are studied , using or producing these items and/or products; 2) Research is related to increased use of the latest and most advanced achievements of information and communication technologies; 3) Tools for modeling and simulation have been created, which enable the processing and analysis of large amounts of data to extract new knowledge and data mining; 4) A large part of the research is multidisciplinary and/or interdisciplinary in nature.

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 objectives of the research activity provided by the candidate are related to: 1. Modeling and research of hydrodynamic lubrication of sliding bearings; 2. Models in the field of Biotribology; 3. Study of friction and wear processes of various tribological systems; 4. Research of physico-chemical and tribological characteristics of various materials in the industry; 5. Modeling in the field of technical mechanics (kinematics, fluid dynamics and mechanics, damping characteristics); 6. Development and research of other current engineering problems.

1.4. Candidate research contributions:

A) With lasting scientific and / or applied response, they form the basis for new research and applications	20 points	
B) They are of significant scientific and / or applied interest, complete and / or summarize previous research	16 points	**X**
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.

Contributions are categorized by thematic areas:

A. HYDRODYNAMIC LUBRICATION OF SLIDING BEARINGS

Applies to publications with author numbers A3, A5, A6, A8, A9, A11, A12, C1, C2, C3, C6, C9, C14, C15, C18, C20, C21, C24

Scientific contributions:

• A modified nonlinear Reynolds equation for a finite-length bearing is derived for the case of a pseudoplastic or dilatant fluid described by a cubic model of a non-Newtonian lubricant (A9).

• A mathematical model of an EHD radial sliding bearing with finite dimensions, lubricated with a non-Newtonian fluid, described by Rabinovich's model - was created and validated (C14, A6).

• A mathematical model of a dynamically loaded sliding bearing with finite dimensions was created and validated, taking into account the inertial and turbulent effects of the lubricating fluid in the conditions of elastic contact (C3).

• When determining the stability limit of the system (according to modified criteria of Hurwitz and Lyapunov), the following equations were jointly solved: (1) generalized Reynolds equation for distribution of HD pressure in the fluid film; (2) equations of the theory of elasticity to determine the contact deformations of the antifriction coating; (3) differential equations of motion of a rigid balanced rotor at small displacements of the shaft center from the position of stable equilibrium (C2, C6, A3).

Scientific and applied contributions:

• Combined spatial stationary or non-stationary tasks are solved with simultaneous consideration of various factors, such as: influence of inertial forces of the fluid and turbulent effects, non-Newtonian behavior of the lubricating fluid and micro-uniformities of the friction surfaces, as well as the influence of the contact deformations of the applied anti-friction coating on the sleeve (or shaft) for all of the effects listed here (A8, C1, C2, C6, C3, A3, C14, A6, A5, C9, A12, C15).

• The influence of the above-mentioned factors on the values and distribution of HD pressure in the fluid film, the thickness of the fluid film, and on the values of the main operating characteristics of the bearing, such as the bearing capacity coefficient of the fluid film (Sommerfeld number), the position of the center line (deviation angle) and the resultant friction force (or friction coefficient) (C1, C2, C3, C6, C9, C14, C15, C18, A3, A5, A6, A8, A12).

• Adaptive algorithms have been created for solving complex tasks, described above (C2, C3, C6, C9, C15, A3, A6, A5, A8).

• An overview of the state of the art in the field of the Hydrodynamic Theory of Lubrication was made (C21).

• An overview of the methods for solving the mathematical models of the lubrication of sliding bearings, including the inertial forces of the lubricating fluid was made (A11, C24).

Applied Contributions:

• An experimental bench of a sliding bearing with replaceable bushings with different physico-mechanical characteristics of the material was created in order to consider the effect of deformability of the anti-friction coating (C20).

• Program systems have been developed using Digital Visual Fortran and MathCAD according to the developed algorithms, which allow their use without the need for detailed knowledge of the mathematical apparatus.

• The database generated as a result of the computer simulation, containing the main bearing characteristics can be used for comparative analyzes and in engineering practice (C1, C2, C3, C6, C9, C14, C15, C18, A3, A5, A6, A8 , A12).

B. BIOTRIBOLOGY

Refers to publications with author number A4, C27

Scientific and applied contributions:

• A model for lubrication of the hip joint with hyaluronan solutions to the synovial fluid is proposed, considering the lubrication process of a non-Newtonian fluid (described by the

so-called power law model) between hard spherical surfaces, (A4).

C. FRICTION AND WEAR IN DIFFERENT TRIBOLOGY SYSTEMS

Applies to publications with author numbers A1, A2, A7, A10, C4, C7, C8, C10, C13, C16, C17, C30

Scientific and applied contributions:

• Tribological studies were carried out under conditions of dry reciprocating friction in a sphere-on-plane configuration of metallic materials (brass and bronze) compared to three different polymer composite materials (reinforced with microparticles Cu, Zn, Sn, SiO2 and MoS2) used for repair or restoration of worn or damaged brass and bronze metal parts (A1, A7, A10). It has been shown that: (1) adhesive wear is the dominant wear process for composite materials, while the main wear mechanism of brass and bronze is abrasive; (2) composite materials have significantly better tribological behavior, i.e. less wear, compared to metal ones (bronze and brass).

• Research was conducted on the wear resistance of a carbon-based nanocomposite coating (Ti/TiN/TiCN/nc-TiCN:aC/ncTiC:a-C/α-C), deposited on steel 1.2343, used for the production of injection molds (C16). The lowest wear intensity of the applied coating on hardened polished samples was proven compared to the composite coating on hardened ground components and resp. with the deposited carbon-based nanocomposite on unhardened ground surfaces.

• In the study of drilling tools of drilling machines in the mining industry with applied HVOF composite coatings of superalloys, it was confirmed that the wear resistance of the coatings is not a constant value with the time duration of friction and wear maintaining equal values of other parameters - nominal contact pressure, sliding velocity and environmental parameters (A2).

• It has been established experimentally that milling tools with an anti-wear composite coating applied to the cutting elements show less wear of the material compared to tools without coating (C8).

• A solution to the problem of determining the moment of friction (as a function of the angular velocity) in a bearing seal using the methods of calculus of variations is proposed (C17).

Applied Contributions:

• A database was created of the variations of the coefficient of friction, linear wear, volume parameters of wear, profilometric studies with SEM surface morphologies of the traces of wear of the investigated three composite materials (A10). This allows their classification according to their tribological behavior.

D. RESEARCH OF PHYSICO-MECHANICAL AND TRIBOLOGICAL CHARACTERISTICS OF MATERIALS IN INDUSTRY

Applies to publications with author numbers B2, B3, B5, C5, C19, C22, C25, C26, C28, C33

Scientific and applied contributions:

• It was established that the addition of small amounts of nanodiamonds in elastomeric mixtures (rubber compounds and their vulcanizates) containing dehydrogenated hydrocarbons leads to an improvement of the elastohysteresis properties of the vulcanizates (B2).

• A methodology was established to conduct an experiment to measure the rheological parameters for transmission oils, using four cones of different geometries to a rotational viscometer type cone-plate for medium to high strain rate measurements. (C19).

• A detailed state of the art is presented for the theoretical and experimental studies of oils with viscosity-index improvers (C22).

• When studying mineral oils (C25) with a viscosity-index polymer thickening additive in different concentrations, it was found that they have a typical non-Newtonian behavior of a pseudoplastic liquid. The effect of increasing the concentration of the additive is expressed in an increase in shear stress and viscosity. The tested lubricants have typical thixotropic properties.

Applied Contributions:

• By means of dilatometric analyses, studies were carried out to identify the temperatures of the critical points in the phase transformation of samples of several types of two-phase

steels. Some strength-strain characteristics have been determined by tensile testing for two-phase low-manganese steels. (B5, C28, C33).

E. RESEARCH IN THE FIELD OF TECHNICAL MECHANICS

Applies to publications with author numbers B1, B4, C12, C23, C32

Scientific contributions:

• A mathematical model of the flight of sports balls (for golf and soccer) was created, including the equations of kinematics, dynamics and fluid mechanics (C23, B4).

Scientific and applied contributions:

• The differential equations (describing the general motion of a sports ball) of highly nonlinear systems are solved numerically by means of original programs created in the Matlab-Simulink environment (C23, B4). Based on the analysis of the results, the recommended values of the initial parameters for successful corner and direct free kicks in football have been found.

• Damping characteristics of a polymer concrete outrigger were investigated based on the inhomogeneous differential equation for transverse vibrations of the console beam. The created model allows identification of the modulus of elasticity of the beam material (B1).

Applied Contributions:

• A detailed solution of two specific tasks from theoretical mechanics using modern software products is presented. A detailed algorithm for solving a planar, statically determinable joint-rod structure (truss) in matrix form has been developed, and a numerical solution of a truss with specific dimensions and load is also shown (C12). A solution to the problem of determining the kinematic characteristics of a point of a disc rolling without sliding on a horizontal plane is proposed (C32).

F. STUDIES OF OTHER CURRENT ENGINEERING PROBLEMS

Applies to publications with author numbers B6, B7, B8, B9, C29, C31

Scientific and applied contributions:

• New or modified topologies of high-tech energy converters as elements of RES systems (solar photo-voltaic) and chargers for electric vehicles are presented. On this basis, models were developed in the Simetrix software environment, and the comparative analysis of the computer simulation results demonstrates the advantages of the proposed topologies and their corresponding models (B6, B7, B9, C29, C31).

Applied Contributions:

• On the basis of conducted statistical procedures for assessing the correspondence between measurements of several parameters (according to real data from the industry), carried out by different methods in different laboratories, it has been confirmed that statistics is a powerful tool for analyzing data from measurements and has a significant role in engineering practice (B8).

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"

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.

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
The assessment of the activity of the candidate - Associate Professor Javorova amounts to 74 points. Based on the assessment of the research and teaching activities of the candidate, the relevance and significance of the contributions in the submitted works, I consider it reasonable to propose to the Honorable Jury on the announced competition (SG No. 39 of 27.05.2022) to submit report to the Faculty Council of the Faculty of Metallurgy and Materials Science, Assoc. Prof. Dr. Juliana Javorova Georgieva to take the academic position **PROFESSOR** at UCTM-Sofia in the professional area 5.1. "Mechanical engineering", in the scientific specialty "Applied mechanics (incl. tribology) with teaching in German".

07.09.2022	The report was written by:	
date		signature