

## **Review**

regarding the competition for academic position "Professor"  
in the Professional domain 5.5. Transport, shipping and aviation,

Subject "Ecology of Transport machinery"

announced in State Journal Issue 56 from 19.07.2022

Candidate: Assoc. Prof. PhD Zdravko Dinchev Ivanov

Reviewer: Assoc. Prof. PhD Plamen Borisov Punov

### **1. General concerning and biographic information**

The candidate applied to the competition for academic position "Professor", announced by decision of the Academic Council of TU-Varna on 27.06.2022 and published in State Journal Issue 56 of 19.07.2022 and on the university's website is Assoc. Prof. PhD Zdravko Dinchev Ivanov. The candidate was graduated at secondary school "Yordan Yovkov" - Tervel in 1975 and was graduated in Master engineering in 1983 at VMEI - Varna, in specialty Internal Combustion Engines. From 1983 to 1988, he worked as an engineer. In 2004, he defended his PhD thesis entitled: "Investigation of the noise from combustion process of automotive diesel engines" in front of Specialized Scientific Council "Energy Technologies and Machines" at VAK in the same scientific domain. He started his academic career in 1988 at TU-Varna as an Assistant Professor in the Department of Transport Machinery and Technologies, since 2007 he has been an Associate Professor and since 2016 he has been nominated the Head of the Department. He is fluent in German and Russian and speaks English as well. The candidate has many years of organizational experience as a member and chairman of the Organizing Committee of the Scientific and Technical Conference with international participation "Transport, Ecology - Sustainable Development" EKO Varna. He is a member of the Regional Organization of Scientific and Technical Unions (NTS) - Varna and the Polish Scientific Society of Combustion Engines (PTNSS).

### **2. General description of the evaluated materials**

The candidate has presented for evaluation in the competition 42 scientific papers. Seventeen of them are referenced and indexed in the global databases Scopus and WoS. Ten of the referenced papers are presented as a Monography work according to indicator B.4 of the requirements, while the remaining 7 are counted in the indicator D.7. All 17 publications are published in scientific conference proceedings as 5 of them have a SJR of Scopus. The remaining 25 papers are published in non-refereed but reviewed proceedings according to indicator D.8. They are mainly presented in proceedings of national and international conferences as well as in the annual proceedings of TU-Varna. I accept that all submitted papers are in the scientific domain of the competition and do not repeat the results obtained in the PhD thesis and in the competition for the academic position "Associate Professor". Additionally, a reference with citations of the candidate's scientific articles including 27 citations in articles refereed and indexed in the Scopus database is presented. According to Scopus he has a "H index" - 3. Assoc. Prof. PhD Zdravko Ivanov supervised one successfully graduated PhD student and currently is the supervisor of three more PhD students. After his



nomination as "Associate Professor" he has participated in 3 national scientific projects and was the leader of another 11. The candidate is author and co-author of 3 books and 2 manuals for laboratory practices and course project. Apart from the evaluation materials, an abstract of his PhD thesis, a list of scientific papers related to the PhD thesis and a list of scientific papers for participation in the competition for the academic position of "Associate Professor" are presented. All necessary diplomas, references and declarations from the candidate are presented.

The fulfilment of the criteria according to the minimum requirements for the academic position "Professor" at TU-Varna is as follows:

№	Indicators	Minimum . points	Candidate's points
1.	Indicator A.	50	<b>50</b>
2.	Indicator B.	100	<b>120,67</b>
3.	Indicator Г.	200	<b>303.33</b>
4.	Indicator Д.	100	<b>270</b>
5.	Indicator E.	150	<b>390</b>
6.	Indicator Ж.	120	<b>1059</b>

According to the table above the all indicators required to be nominated on academic position "Professor" are fulfilled.

## 2. General information regarding the researches and applied scientific activity.

The candidate's research and applied scientific activity is in the field of internal combustion engines (ICE), automotive technology and the effective energy transformation from bio-products. It should be noted that a significant part of the researches are experimental. The studies in the articles (10), presented as a Monography work, can be classified in the following areas: management and study of the operation of fuel injectors for gasoline, diesel and gaseous fuel systems; experimental study of the influence of diesel fuel treated with additives and nanoparticles on the performance of ICE; technologies for extracting biofuels (biogas and biodiesel) from waste products and the possibility of their use as a fuel in ICE and studying the noise of diesel ICE operating in dual fuel mode by adding hydrogen in the intake system. I consider that the topic of studies in the articles presented as a Monography work is similar and correctly was summarized by the candidate under the title "**Research on the operation of ICE with alternative fuels with improved environmental characteristics**".

The scientific contribution of the candidate, presented in the article not selected as a Monography work, are in the field of: environmental problems of ICE and noise emitted from the combustion process; experimental study of the combustion process and the periods of the combustion in ICE; kinematics and dynamics of the crankshaft mechanism, cylinder block and driveline; characterization and technical inspection of electromagnetic valves, electromagnetic fuel injectors and development of a system for mixing the gaseous fuels; assessment the fuel consumption in a hybrid car and investigation of braking dynamics; study the operation of diesel ICE in transient operation mode.



A significant part of the candidate's studies is result of his participation and management of a number of research projects (14) with national and university funding. As a result of these projects, considerable experience was obtained in the field of testing and management of ICE, moreover the test facilities in the department were modernized. There is no evidence that any of the developed test benches is protected by means of a patent.

### **3. Evaluation of the academic activities.**

The candidate has many years of teaching experience at TU-Varna, where he has successively held the positions of Ass. Prof., Chief Ass. Prof. and Assoc. Prof. He is a leading professor in the following course: Computer technologies in transport machinery, Dynamics and vibration of ICE and transport machinery, Ecology of transport machinery, Testing and control of transport machinery, Indicating the ICE, Testing ICE and automotive machinery, CAD systems in automotive industry, Vibration and foundation of ICE, Environmental characteristics of ICE, Driveline dynamics in automotive machinery and etc. from the curriculum of the specialties: Transport Machinery and Technologies ("Bachelor" and "Master" degrees), Automotive Technology ("Bachelor" degree) and ICEAT (Professional Bachelor degree). The number of held classes by the candidate in the last three years at TU-Varna significantly exceeds the minimum. Over the years, he has been involved in the improvement and development of new curriculums in various degrees of study, as well as in the development of new doctoral programs. As a Head of department, he participated in the university's program accreditation in various professional domains. Proof of the active pedagogical work is the supervision of more than 70 graduates and the students' involvement in the research projects led by him. He is the author of three academic books and two manuals. He has supervised 4 PhD students, one of whom successfully defended his PhD thesis in 2016 while the others are still PhD students. Assoc. Dr. Zdravko Ivanov has completed two mobilities under the Erasmus+ program, which helped him to face new teaching methods and techniques.

### **4. Scientific and applied scientific contributions.**

After my evaluation of the presented scientific articles, I generally accept the most of the defined by the candidate scientific, applied scientific and applied contributions, considering them to be personal contributions or together with the other co-authors in the articles. The main contributions in papers equivalent to a Monography work are:

- The influence of commercial additives and nanoparticles to the diesel fuel, as well as the addition of biodiesel and hydrogen on the performances and the combustion process of diesel ICE was experimentally evaluated [B.4-2], [B.4-3], [B.4-7], [B.4-10];
- The possibility of producing biofuels from waste products in rice industry has been assessed. [B.4-8], [B.4-9];
- A method for studying the periods of fuel injection based on the vibration measurement on the housing of the fuel injector from a "Common Rail" fuel system has been developed [B.4-4].
- A system for modelling the composition of the fuel when using biogas as fuel for ICE was developed. [B.4-6].

The first two contributions can be attributed to the group of proving with new means the essential new aspects of already existing scientific fields, problems, theories, hypotheses while the third and fourth contributions can be attributed to the creation of new classifications, methods, constructions, technologies.

The main contributions from the papers non-considered a part of the Monography work, which can be attributed to the group of proving with new means of the essential new aspects of already existing scientific fields, problems, theories, hypotheses are:

- A method for determination and analysing the natural frequencies of the dynamic models of discrete oscillating systems, based on the solutions of chain fractions through iterations in a converging sequence was developed. [Г.8-17], [Г.8-18];
- A methodology for the pre-processing of data arrays from processes registered by ADC, aiming smoothing the curves and enabling the analysis of processes with derivatives of a higher degree was created. [Г.8-2], [Г.8-3], [Г.8-4], [Г.8-5], [Г.8-21];
- A new method for analysing the factors and defining the boundary conditions determining the rate of exhaust gas recirculation and evaluating their impact on the emissions of NO<sub>x</sub> and PM was proposed. [Г.8-24];
- A new method for determining the fuel injection parameters as well as the injection variability by analysing acceleration and the needle lift of electromagnetic fuel injectors was created and verified. [Г.8-8], [Г.8-15], [Г.8-21];
- A methodology to study the influence of the parameters of the control signal on the operation of low-impedance fuel injectors for spark ignition engine was created. [Г.7-3], [Г.8-1];

The following contributions can be attributed to the creation of new classifications, methods, constructions, technologies group:

- A test system to study the pollutant emissions of car engines was created. [Г.8-6], [Г.8-7].
- A model to study the influence of support compliance on the oscillatory processes of crankshafts was developed. [Г.8-9].
- An algorithm for forming frequency bands of arbitrary relative width and determining their parameters when processing experimental sound pressure data in time windows with arbitrary boundaries was developed. [Г.8-14].
- A new approach to the energy assessment of hybrid vehicle based on the assessment of fuel consumption during long-term vehicle operation in real conditions was proposed. [Г.7-2].
- The noise emission factor of a car diesel engine was determined experimentally, by means of that characteristic level of emitted noise can be predicted at the whole engine operation range. [Г.8-22].
- A test bench for experimental study of torsional oscillations and strain measurement of longitudinal vibrations of engine crankshafts in order to evaluate the effectiveness of newly developed dampers regarding motor vibration forms was developed. [Г.8-10], [Г.8-11].



- The main factors for the noise emissions emitted from internal combustion engines were analysed as well as the approaches to reduce sound pressure levels was proposed. [Г.8-19].

The following contributions can be attributed to the group obtaining corroborating facts:

- An analytical and experimental investigation of the vibration forms of a multi-cylinder engine cylinder block by impulse force testing was carried out. [Г.8-13], [Г.8-16].
- An analysis of the methods for experimentally determining the torsional resistance of crankshafts was performed. [Г.8-23].

### **5. Impact of the contributions to the science and practice.**

The use of ICE as a propulsion for passenger cars faces several significant challenges, the most important of which are environmental and CO<sub>2</sub> emission legislations. The candidate's main contributions aimed specifically at resolving or improving the ecological performances of ICE by means of implementation of alternative fuels (biofuels, hydrogen, additives), study the fuel injection, combustion processes and noise formation, hybridization and optimization of ICE design. Moreover, it can be said that the scientific articles were cited 27 times in the Scopus database, which indicates that the candidate's scientific work represents a significant interest to other researchers in the field of environmental problems of ICE. All minimum indicators are met while some of them are significantly exceeded according to the Regulations on the terms and conditions for obtaining academic positions at TU-Varna.

All this gives me a reason to consider his contributions to be significant both for science and practice.

### **6. Remarks and advices.**

I have no critical remarks to the candidate, as I believe that with his scientific, teaching and public activities over the years he has established himself as an outstanding researcher and teacher. I would like recommend to him in the future strives to publish the most significant studies in prestigious international journals with Impact Factor, this will lead to even greater international recognition. I also recommend to strengthen its international activity by participating in joint research projects with foreign scientists and universities.

### **7. Reviewer personal impressions and opinion.**

I know Ass. Prof. PhD Zdravko Ivanov from the scientific conferences trans&MOTAUTO, EKO Varna, BulTrans and the annual conference of University of Ruse. In all these common participations in scientific forums, he was distinguished by his professionalism and personal dedication in the organizational work of the scientific conference EKO Varna. Professionally, he has been always responsive by providing useful advices on problems related to the experimental study of ICE and has been always opened to proposals for joint collaboration in scientific projects. He makes serious efforts to maintain and improve the test equipment of the department and to involve the business partners in the scientific work.

## CONCLUSION

After my acquaintance with the candidate's scientific and academic activity, I can say that he can well motivate his scientific studies and to use the proper approaches to achieve significant scientific results. He has demonstrated that he can conduct meaningful studies in common research collectives and successfully supervise PhD students. I do believe that the scientific papers have a sufficient number of contributions which leads to serious interest within the scientific society and fully meet the requirements of the Law for the Development of the Academic Staff in the Republic of Bulgaria.

**In conclusion, I find it reasonable to propose to the respected scientific jury that Assoc. Prof. PhD Zdravko Dinchev Ivanov to be appointed on academic position "Professor" in professional domain 5.5 "Transport, shipping and aviation", subject "Ecology of transport machinery".**

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**REVIEWER:**

/Assoc. Prof. PhD Plamen Punov/