UNIVERZITET CRNE GORE

SENATU

CENTAR ZA DOKTORSKE STUDIJE

U prilogu akta dostavljam Odluke sa LXXVII sjednice Vijeća Prirodno-matematičkog fakuteta održane 15.02.2022. godine.

Dekan,
Prof. dr Predrag Miranović

Na osnovu člana 64 stav 2 tačka 8 Statuta, a u vezi sa članom 43 I 44 Pravila doktorskih studija Univerziteta Crne Gore, Vijeće Prirodno-matematičkog fakulteta na LXXVII sjednici održanoj dana 15.02.2022. godine, donijelo je

ODLUKU

I

Prihvata se Izvještaj komisije za ocjenu doktorske disertacije pod nazivom *"Reducibilnost u algebarskim hiperstrukturama"* kandidata Milice Kankaraš.

II

Predlažemo Senatu Univerziteta Crne Gore **da prihvati** disertaciju *"Reducibilnost u algebarskim hiperstrukturama"* kandidata Milice Kankaraš. i imenuje komisiju za odbranu doktorske disertacije u sastavu:

1. Dr Michal Noval, docent ETF-a Univerziteta Tehnologije u Brnu (Češčka Republika) (naučna oblast: Algebra);
2. Dr Svjetlana Terzić, redovni profesor PMF-a UCG (naučna oblast: Algebarska topologija);
3. Dr Biljana Zeković, redovni profesor u penziji PMF-a UCG, (naučna oblast: Algebra),predsjednik;
4. Dr Sanja Jančić- Rašović, redovni profesor PMF-a UCG (naučna oblast: Algebra) i
5. Dr Irina Elena Cristea, vanredni profesor Univerziteta Nova Gorica (Slovenija) (naučna oblast: Algebra), mentor.

III

Predlog se dostavlja Centru za doktorske studije i Senatu Univerziteta Crne Gore na dalju proceduru.

DEKAN
Prof. dr Predrag Miranović

UCG

OCJENA DOKTORSKE DISERTACIJE

OPŠTI PODACI O DOKTORANDU	
Titula, ime i prezime	MSc Milica (Mitar) Kankaraš
Fakultet	Prirodno-matematički fakultet, Podgorica
Studijski program	Matematika
Broj indeksa	1/2012
MENTOR/MENTORI		
Prvi mentor	Prof. dr Irina Elena Cristea	Centar za Informacione tehnologije i Primijenjenu matematiku, Univerzitet Nova Gorica, Slovenija
Drugi mentor		
KOMISIJA ZA OCJENU DOKTORSKE DISERTACIJE	
Prof. dr Svjetlana Terzić	Prirodno-matematički fakultet Univerziteta Crne Gore, Podgorica
Prof. dr Irina Elena Cristea	Centar za Informacione tehnologije i Primijenjenu matematiku, Univerzitet Nova Gorica, Slovenija
Prof dr. Sanja Jančić Rašović	Prirodno-matematički fakultet Univerziteta Crne Gore, Podgorica
Prof. dr Biljana Zeković	Prirodno-matematički fakultet Univerziteta Crne Gore, Podgorica
Prof. dr Michal Novak	Elektrotehnički fakultet Univerziteta Tehnologije u Brnu, Brno

Datum značajni za ocjenu doktorske disertacije	
Doktorska disertacija i Izvještaj Komisije dostavljen Biblioteci UCG	30.12.2021.
Javnost informisana (dnevne novine) da su Doktorska disertacija i Izvještaj Komisije dati na uvid	30.12.2021.
Sjednica Senata na kojoj je izvršeno imenovanje Komisije za ocjenu doktorske disertacije	9.11.2021.
Uvid javnosti	
U predviđenom roku za uvid javnosti bilo je primjedbi?	NIJE
OCJENA DOKTORSKE DISERTACIJE	
1. Pregled disertacije (bibliografski podaci o disertaciji i sažetak disertacije)	

1. Pregled disertacije (bibliografski podaci o disertaciji i sažetak disertacije)

The topic of this dissertation falls in the area of Hypercompositional Algebra, a well established branch of Abstract Algebra, born in 1934 when the French mathematician Frederic Marty introduced the concept of hypergroup during the 8th Congress of Scandinavian Mathematicians. Hypercompositional Algebra deals with structures endowed with multi-valued operations, called hyperoperations or hypercompositions. These are natural generalizations of classical operations with the property that the result of the hyperoperation is a subset of the carrier set, instead of a single element, as it happens in the classical algebraic structures endowed with operations. The algebraic structures endowed with multivalued operations have nowadays wide applications in many areas of mathematics – for example multivalued formal groups have important applications in algebraic topology, multivalued Lie groups in functional equations and integrable systems, join spaces in geometry, etc., but also in physics, chemistry, biology, social sciences. It is worth mentioning here the contributions of Alain Connes, winner of the Fields medal, in the theory of algebraic curves related to the theory of hyperfields.

The aim of this dissertation is to extend the concept of reducibility in hypergroups to the fuzzy case and also to hyperrings. The notion of reducibility in hypergroups was defined for the first time by James Jantosciak in 1990, during the 4th Congress on Algebraic Hyperstructures and Their Applications (by short, AHA Congress), held in Xanthi, Greece. Jantosciak noticed that sometimes the hyperoperation does not distinguish between a pair of elements of a set, because the elements play interchangeble roles with respect to the hyperoperation. In order to explain this property, he defined on a hypergroup three equivalences and called them fundamental relations. These relations are: the operational equivalence, the inseparability and the essential indistinguishability. Then he called a hypergroup to be reduced if the equivalence class of each its element with respect to the essential indistinguishable relation is a singleton. These concepts have been reconsidered after 24 years by Irina Cristea, who presented at the 12th AHA Congress the first approach on the extension of the reducibility concept to the fuzzy case. Her first results have been covered and extended by this thesis.

After an introductory part describing the main topic of the thesis and the state-of-the-art, as well as the detailed structure of the dissertation, the thesis continues with its five chapters and bibliography.

First chapter, the one containing the preliminaries, collects the basic definitions and results related to hypergroups, hyperrings and fuzzy sets. All important notions and results are supported by examples, that help the reader to better understand this topic. The first part of the chapter regards hypergroups, subhypergroups, fundamental relations, and homomorphisms of hypergroups. Several particular types of hypergroups, as B-hypergroups, Corsini hypergroups, join spaces and complee hypergroups are recalled. The second part of the first chapter covers essential results on hyperrings and presents all three types of hyperrings: Krasner hyperrings, multiplicative hyperrings and general hyperrings. This

chapter ends with some notions related to fuzzy setsand with the fundamental construction of a join space using fuzzy sets, defined by Piergiulio Corsini, combining the results published in two articles, one in 1994 and the second one in 2003. First he defined a join space starting from a fuzzy set and then he associated with a hypergroupoid a fuzzy set, called the grade fuzzy set. Iterating these two constructions, a sequence of join spaces and fuzzy sets is obtained, whose length is called the fuzzy grade.

The other approach of the connection between hypercompositional structures and fuzzy sets leads to the so called fuzzy hyperstructures, i.e., structures endowed with fuzzy hyperoperations. The fuzzy hypergroups are briefly recalled at the end of Chapter 1.

The reducibility concept in hypergroups is covered by **Chapter 2**, where first, the main results obtained by Jantosciak are recalled, together with the results concerning the reducibility of hypergroups associated with binary relations. The chapter continues with original results of the author related to the reducibility in canonical hypergroups, in hypergroups with partial scalar identities (known as i.p.s. hypergroups), in some cyclic hypergroups and in complete hypergroups. It is then proved that any i.p.s. hypergroup is reduced (see Theorem 2.2), while any proper complete hypergroup is not reduced (see Theorem 2.3). The second chapter ends with the study of the reducibility in Corsini hypergroups. Necessary and sufficient conditions for Corsini hypergroups to be reduced are determined (see Propositions 2.18, 2.19), as well as for the direct product of hypergroups (see Theorem 2.4).

Chapter 3 is dedicated to the study of fuzzy reducibility. For doing this, first, three new equivalences are defined (new in the sense that they are introduced by the author) on a crisp hypergroup endowed with a fuzzy set: the fuzzy operational equivalence, the fuzzy inseparability and the fuzzy essential indistinguishability. Based on them, the concept of fuzzy reducibility is similarly defined as the one of (crisp) reducibility. It is important to know that the fuzzy reducibility depends on the fuzzy set defined on the considered hypergroup. In this thesis it was considered only the grade fuzzy set. It was established also a connection between the reducibility and the fuzzy reducibility of a hypergroup with respect to the grade fuzzy set (see Corollary 3.1). Then the study focusses on the fuzzy reducibility of several types of hypergroups. Theorem 3.1 states that any proper complete hypergroup is not fuzzy reduced with respect to the grade fuzzy set. The same property holds also for I.p.s. hypergroups (see Theorem 3.2). More examples of fuzzy reduced hypergroups are given in Section 3.2: non-complete 1-hypergroups or single power cyclic hypergroups (see Proposition 3.3). The last type of hypergroups for which the fuzzy reducibility is studied in this thesis is the one of Corsini hypergroups. After presenting several new properties of the Corsini hypergroups related to the three fundamental relations, the main result of this subsection is stated in Theorem 3.6: any Corsini hypergroup is not fuzzy reduced with respect to the grade fuzzy set. It is worth mentioning here that Chapter 3 contains a high number of non-trivial examples.

The second extension of the reducibility in hypergroups is proposed in **Chapter 4**, where the reducibility in hyperrings is introduced for the first time. As well explained at the beginning of the chapter, the reducibility has sense to be studied only in general hyperrings, where both addition and multiplication are multi-valued operations. Several relationships between the three fundamental equivalences (that help us to define a reduced hyperring) are presented in particular classes of hyperrings (see Proposition 4.2). Considering the hyperring of formal series R[[X]], it was proved that R[[X]] is reduced if and only if the general hyperring R of coefficients is reduced, too (Proposition 4.3). An example of non-reduced hyperring was given by using a hyperring with P-hyperoperations (see Proposition 4.4). Several examples involving hyperrings with P-hyperoperations and hyperrings constructed with Corsini hypergroups are illustrated.

Similarly to the construction of complete hypergroups, Mario De Salvo proposed a method to obtain a complete hyperring using two rings. Theorem 4.3 states that any complete hyperring is not reduced. Another type of general hyperrings for which the reproducibility property is studied in this dissertation is the one of (H,R)-hyperrings. The main result related to these hyperrings is covered by Proposition 4.6.

The conclusions of this thesis and some proposals to continue the study presented in the dissertation are mentioned in **Chapter 5**. They refer mainly to the reducibility of fuzzy hypergroups and the fuzzy reducibility of general hyperrings.

Bibliography contains 70 items, including publications in English, French and Italian, demonstrating a very good theoretical background of the PhD candidate on this theme. All relevant references are mentioned and also cited in the text.

2. Vrednovanje disertacije

    2.1.   **Problem** (navesti neriješena i kontraverzna mišljenja o istraživačkom problemu i dosadašnjim pokušajima rješavanja problema, rješenja do kojih su došli drugi autori, ocjenu osnove disertacije u skladu sa radovima i istraživanjima kandidata i način njihove veze sa samom disertacijom)

As already mentioned in the previous section, the concept of reducibility in hypergroups was introduced in 1990 by James Jantosciak. Then it was rediscovered 24 years later by Irina Cristea, who started the first attempt to extend it also to the fuzzy case. In this respect there are two possibilities: to define the fuzzy reducibility of crisp hypergroups, by considering new fundamental relations defined on a hypergroup endowed with a fuzzy set, or to define the reducibility of fuzzy hypergroups. The PhD candidate Milica Kankaraš, in this thesis, continues the previous studies, extending them for severalclasses of hypergroups, but also for hyperrings. The concept of reducibility in hyperrings is firstly proposed by her in the article "The reducibility concept in general hyperrings" jointly published with I. Cristea in the open access journal Mathematics, a Q1 journal indexed by Web of Science. Ms. Kankaraš also published a paper as a single author in "Analele Univ. Constanta-Seria Math.", a Q2 journal indexed by Web of Science, containing her results related to the reducibility in Corsini hypergroups. The third article that she published, jointly with I. Cristea, presents the results of this dissertation concerning the fuzzy reducibility of

hypergroups.

2.2. Ciljevi i hipoteze disertacije
The main objectives of this dissertation are the following ones:
1. To present an overview on the existing literature related to the concept of reducibility.
2. To study the reducibility of several classes of hypergroups: Corsini hypergroups, B-hypergroups, cyclic hypergroups, the direct product of hypergroups.
3. To extend the concept of reducibility of the hypergroups to the fuzzy case, by introducing and studying the concept of fuzzy reduced hypergroups.
4. To extend the concept of reducibility to the class of general hyperrings.

2.3. Bitne metode koje su primijenjene u disertaciji i njihovu primjerenost.
Ako je primijenjena nova ili dopunjena metoda, opišite šta je novo

The results obtained in this dissertation are based on classical methods used in solving problems in combinatorics and abstract algebra; in particular, 1 would mention here the method of induction or the method of reasoning by absurdity. All the results are clearly presented and all the basic involved notions are recalled in preliminaries, making the thesis self-contained. Several examples and counter-examples support the statements discussed in the thesis.

2.4. Rezultati disertacije i njihovo tumačenje
The main and new results of this thesis are covered in Chapters 2,3 and 4 and they bring a new contribution in the area of hypercompositional structures. On one hand, they offer concrete examples of hypergroups and hyperrings that are or not reduced, while on the other hand they open new lines of research in Hypercompositional Algebra.
Chapter 2 deals with the study of the particular types of hypergroups. It was proved that any i.p.s. hypergroup is reduced (Theorem 2.2), while any proper complete hypergroup is not reduced (Theorem 2.3). Furthermore, the reducibility concept was studied also for Corsini hypergroups and necessary and sufficient conditions for Corsini hypergroups to be reduced are determined in Propositions 2.18 and 2.19. The reducibility property is studied also for the direct product of B-hypergroups, proving that it is always a reduced hypergroup (Proposition 2.21). The results concerning the fuzzy reducibility are gathered in Chapter 3. A relationship between the reducibility of a hypergroup and its fuzzy reducibility with respect to the grade fuzzy set $\tilde{\mu}$ is stated by corollary 3.1, saying that a non reduced hypergroup is not fuzzy reduced with respect to $\tilde{\mu}$. Theorem 3.1 proves the not fuzzy reducibility of proper complete hypergroups, as stated in theorem 3.2. Examples of non-complete 1-hypergroups that are reduced and not reduced are presented in section 3.2, as well as examples of cyclic hypergroups. The fuzzy reducibility of Corsini hypergroups is discussed in Section 3.3, where among several properties of these hypergroups related to fuzzy reducibility it is shown that any Corsini hypergroup is not fuzzy reduced with respect to the grade fuzzy set $\tilde{\mu}$(Theorem 3.6). Chapter 3 ends with some results related with the direct product of hypergroups. Proposition 3.14 proves that the direct product of two non fuzzy reduced hypergroups with at least two elements is non fuzzy reduced, too, with respect to the grade fuzzy set $\tilde{\mu}$.
Chapter 4 contains all new results obtained on the reducibility of general hyperrings, in particular of some classes of hyperrings. Proposition 4.3 states that the hyperring of formal series R[[X]] with coefficientsin a general commutative hyperring R is reduced if and only if R is reduced. Then in Proposition 4.4 an example of non-reduced general hyperring with P-

hyperoperations is given and other examples of reduced and non- reduced general hyperrings with P-hyperoperations are illustrated. Another class of hyperrings considered here is the one obtained with Corsini hypergroups. A general hyperring having the additive part a B-hypergroup and the multiplicative one a Corsini hypergroup is always reduced (Proposition 4.5). The chapter continues with the study of the reducibility property of complete hyperrings and Theorem 4.3 proves that any complete hyperring is not reduced. The last class of investigated hyperrings is the one of (H,R)-hyperrings. Necessary and sufficient conditions to get a non-reduced (H,R)-hyperring are expressed in Proposition 4.6.

2.5. Zaključci (usaglašenost sa rezultatima i logično izvedeno tumačenje)
In the conclussive chapter of the dissertation the main results are emphasized and new lines of research are proposed, in order to continue this study. All the results are mathematically correct, very well explained, with all necessary steps, and supported by numerous examples. They show the maturity of the PhD candidate and her strong preparation on this topic.

3. Konačna ocjena disertacije
   3.1. Usaglašenost sa obrazloženjem teme
The dissertation of the doctoral candidate Milica Kankaraš is fully compliant with the theme, approved by the Senat of the University of Montenegro. The goals, hypothesis, and problems were all addressed with a rigorous style and correct mathematical methods.

3.2. Mogućnost ponovljivosti
It is very difficult to think of a repetition of a theoretical mathematical dissertation, as it is the thesis under discussion. Here a new basis was settled up and some types of hypergroups and general hyperrings have been considered. A similar study could be conducted also for other types of algebraic hypercompositional structures, but they are not considered as a repetition of the results of this thesis.

3.3. Buduća istraživanja
The reducibility concept belongs to the area of algebraic structures endowed with multivalued operations. Thuis it can be studied not only for hypergroups or general hyperrings, as in this thesis, but also for hyperfields or different types of ordered hyperalgebras, as BCK-hyperalgebras, MV-hyperalgebras, etc. The other direction of study suggested by this diddertation is the one offered by the fuzzy case. It was explained in the thesis that this can happen in two directions: considering the fuzzy reducibility, or the reducibility of fuzzy structures. The second direction has not been investigated by now and could offer new lines of research.

3.4. Ograničenja disertacije i njihov uticaj na vrijednost disertacije
Since the topic of this dissertation is represented by a theoretical study in Algebra, the limitations of the dissertation are very few, or better they cannot be considered as limitations, but could represent new research lines. It is clear that a doctoral thesis cannot cover all types of hypergroups or general hyperrings, but here the candidate chose the ones that are more representative in this area. Besides, it was very well explained in the thesis that the concept of fuzzy reducibility depends on the fuzzy set that the hypergroup/hyperring is endowed with. That is why the studies presented in this thesis regard only the grade fuzzy set.

Orginalni naučni doprinos

(dati pojašnjenje: originalnost (originalnost (sasvim nova saznanja, dopuna/proširenje postojećeg znanja ili pobijanje postojećeg znanja), uticaj rezultata disertacije na napredak naučne oblasti, uticaj rezultata na struku (direktno, indirektno))

Without any doubt, this thesis is original. In the first part, the one related to hypergroups, the concept of reducibility and fuzzy reducibility is investigated, for the first time, for some particular important classes of hypergroups, as Corsini hypergroups, B-hypergroups, cyclic hypergroups. The second part is based on the original idea to define, again for the first time, the concept of reducibility for general hyperrings. Besides, most of the examples presented in the thesis are the original work of the candidate, examples being one powerful tool in abstract algebra to illustrate the use of the new theorems.
With these results, a new step forward in the theory of algebraic hypercompositional structures has been done, first by preparing a complete survey on the theory of reducibility of hypergroups and hyperrings, and secondly by opening new lines of research in this area.

Mišljenje i prijedlog komisije

(dati mišljenje i prijedlog)

The PhD thesis elaborated by Milica Kankaraš brings new and significant results in the theory of algebraic hypercompositional structures, by deepening the study of the reducibility property in hypergroups and extending it into two different directions: the first one regards the fuzzy case of the property, while the second one, proposed for the first time by the PhD candidate, is in the class of general hyperrings. The thesis is well structured, the style of the presentation is clear and pleasant, the results are not banal and they are mathematically correct, being strongly motivated and supported by numerous examples. The results obtained by the author (both in amount and quality) are sufficient for the PhD level. They have a good potential for being developed in some further research, as mentioned in the conclusive part of the thesis. The stated aims of the dissertation have been fulfilled.
The bibliographic list shows that the candidate consulted all relevant publications related to the topic of the dissertation, that offered her a solid background for research. The original results are included in 3 articles, 1 of them as single author, published in recognized international journals, indexed by Web of Science in the first two categories. These articles are:

1. Fuzzy reduced hypergroups, Kankaraš M., Cristea I., Mathematics, 2020, 8(2), 263

2. Reducibility in Corsini hypergroups, Kankaraš M., Analele Stiintifice ale Universitatii Ovidius Constanta, Seria Matematica, 2021, 29(1), 99-109

3. The reducibility concept in general hyperrings, Cristea I., Kankaraš M., Mathematics, 2021, 9(17), 2037.

Concluding, we consider that this thesis fulfills the conditions requested by a doctoral thesis, thus it can be publicly discussed and we warmly propose to grant the title of doctor in Mathematics to the doctoral student Milica Kankaraš.

Izdvojeno mišljenje	
(popuniti ukoliko neki član komisije ima izdvojeno mišljenje)	
	Ime i prezime

Napomena		
(popuniti po potrebi)		
KOMISIJA ZA OCJENU DOKTORSKE DISERTACIJE		
Prof. dr Svjetlana Terzić, Prirodno-matematički fakultet Univerziteta Crne Gore, Crna Gora		*C. Terzić*
Prof. dr Irina Elena Cristea, Centar za Informacione tehnologije i Primijenjenu matematiku, Univerzitet Nova Gorica, Slovenija		*Cristea*
Prof dr. Sanja Jančić Rašović, Prirodno-matematički fakultet Univerziteta Crne Gore, Crna Gora		*S. Jančić Rašović*
Prof. dr Biljana Zeković, Prirodno-matematički fakultet Univerziteta Crne Gore, Crna Gora		*B. Zeković*
Prof. dr Michal Novak, Elektrotehnički fakultet Univerziteta Tehnologije u Brnu, Češka		*Michal Novak*

Datum i ovjera (pečat i potpis odgovorne osobe)
U Podgorici 10.02.2022.
MP   DEKAN

To the Council of the Faculty of Science and Mathematics
and the Senate of the University of Montenegro

Referee's report of the PhD thesis
"Reducibility in algebraic hyperstructures"
written by PhD student Milica Kankaraš

The undersigned dr. Michal Novak, associated professor at Brno University of Technology, Czech Republic, dr. Svjetlana Terzić, professor at University of Montenegro, dr. Biljana Zeković, professor at the University of Montenegro, dr. Sanja Jančić Rašović, professor at the University of Montenegro, and dr. Irina Cristea, associated professor at the University of Nova Gorica, Slovenia, nominated with the Decision 03-350/4 from 9.11.2021 of the senate of the University of Montenegro as members of the doctoral committee of the public defense of the doctoral thesis "Reducibility in algebraic hyperstructures" elaborated by the doctoral student Milica Kankaraš, present the following referee report.

The topic of this dissertation falls in the area of Hypercompositional Algebra, a well established branch of Abstract Algebra, born in 1934 when the French mathematician Frederic Marty introduced the concept of hypergroup during the 8th Congress of Scandinavian Mathematicians. Hypercompositional Algebra deals with structures endowed with multi-valued operations, called hyperoperations or hypercompositions. These are natural generalizations of classical operations with the property that the result of the hyperoperation is a subset of the carrier set, instead of a single element, as it happens in the classical algebraic structures endowed with operations. The algebraic structures endowed with multivalued operations have nowdays wide applications in many areas of mathematics – for example multivalued formal groups have important applications in algebraic topology, multivalued Lie groups in functional equations and integrable systems, join spaces in geometry, etc., but also in physics, chemistry, biology, social sciences. It is worth mentioning here the contributions of Alain Connes, winner of the Fields medal, in the theory of algebraic curves related to the theory of hyperfields.

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After an introductory part describing the main topic of the thesis and the state-of-the-art, as well as the detailed structure of the dissertation, the thesis continues with its five chapters and bibliography.

First chapter, the one containing the preliminaries, collects the basic definitions and results related to hypergroups, hyperrings and fuzzy sets. All important notions and results are supported by

examples, that help the reader to better understand this topic. The first part of the chapter regards hypergroups, subhypergroups, fundamental relations, and homomorphisms of hypergroups. Several particular types of hypergroups, as B-hypergroups, Corsini hypergroups, join spaces and complee hypergroups are recalled. The second part of the first chapter covers essential results on hyperrings and presents all three types of hyperrings: Krasner hyperrings, multiplicative hyperrings and general hyperrings. This chapter ends with some notions related to fuzzy setsand with the fundamental construction of a join space using fuzzy sets, defined by Piergiulio Corsini, combining the results published in two articles, one in 1994 and the second one in 2003. First he defined a join space starting from a fuzzy set and then he associated with a hypergroupoid a fuzzy set, called the grade fuzzy set $\tilde{\mu}$. Iterating these two constructions, a sequence of join spaces and fuzzy sets is obtained, whose length is called the fuzzy grade.

The other approach of the connection between hypercompositional structures and fuzzy sets leads to the so called fuzzy hyperstructures, i.e., structures endowed with fuzzy hyperoperations. The fuzzy hypergroups are briefly recalled at the end of Chapter 1.

The reducibility concept in hypergroups is covered by **Chapter 2**, where first, the main results obtained by Jantosciak are recalled, together with the results concerning the reducibility of hypergroups associated with binary relations. The chapter continues with original results of the author related to the reducibility in canonical hypergroups, in hypergroups with partial scalar identities (known as I.p.s. hypergroups), in some cyclic hypergroups and in complete hypergroups. It is then proved that any I.p.s. hypergroup is reduced (see Theorem 2.2), while any proper complete hypergroup is not reduced (see Theorem 2.3). The second chapter ends with the study of the reducibility in Corsini hypergroups. Necessary and sufficient conditions for Corsini hypergroups to be reduced are determined (see Propositions 2.18, 2.19), as well as for the direct product of hypergroups (see Theorem 2.4).

Chapter 3 is dedicated to the study of fuzzy reducibility. For doing this, first, three new equivalences are defined (new in the sense that they are introduced by the author) on a crisp hypergroup endowed with a fuzzy set: the fuzzy operational equivalence, the fuzzy inseparability and the fuzzy essential indistinguishability. Based on them, the concept of fuzzy reducibility is similarly defined as the one of (crisp) reducibility. It is important to know that the fuzzy reducibility depends on the fuzzy set defined on the considered hypergroup. In this thesis it was considered only the grade fuzzy set $\tilde{\mu}$. It was established also a connection between the reducibility and the fuzzy reducibility of a hypergroup with respect to the grade fuzzy set (see Corollary 3.1). Then the study focusses on the fuzzy reducibility of several types of hypergroups. Theorem 3.1 states that any proper complete hypergroup is not fuzzy reduced with respect to the grade fuzzy set. The same property holds also for I.p.s. hypergroups (see Theorem 3.2). More examples of fuzzy reduced hypergroups are given in Section 3.2: non-complete 1-hypergroups or single power cyclic hypergroups (see Proposition 3.3). The last type of hypergroups for which the fuzzy reducibility is studied in this thesis is the one of Corsini hypergroups. After presenting several new properties of the Corsini hypergroups related to the three fundamental relations, the main result of this subsection is stated in Theorem 3.6: any Corsini hypergroup is not fuzzy reduced with respect to the grade fuzzy set. It is worth mentioning here that Chapter 3 contains a high number of non-trivial examples.

The second extension of the reducibility in hypergroups is proposed in **Chapter 4**, where the reducibility in hyperrings is introduced for the first time. As well explained at the beginning of the chapter, the reducibility has sense to be studied only in general hyperrings, where both addition and multiplication are multi-valued operations. Several relationships between the three fundamental equivalences (that help us to define a reduced hyperring) are presented in particular classes of hyperrings (see Proposition 4.2). Considering the hyperring of formal series $R[[X]]$, it was proved that $R[[X]]$ is reduced if and only if the general hyperring R of coefficients is reduced, too

(Proposition 4.3). An example of non-reduced hyperring was given by using a hyperring with P-hyperoperations (see Proposition 4.4). Several examples involving hyperrings with P-hyperoperations and hyperrings constructed with Corsini hypergroups are illustrated.

Similarly to the construction of complete hypergroups, Mario De Salvo proposed a method to obtain a complete hyperring using two rings. Theorem 4.3 states that any complete hyperring is not reduced. Another type of general hyperrings for which the reproducibility property is studied in this dissertation is the one of (H,R)-hyperrings. The main result related to these hyperrings is covered by Proposition 4.6.

The conclusions of this thesis and some proposals to continue the study presented in the dissertation are mentioned in **Chapter 5**. They refer mainly to the reducibility of fuzzy hypergroups and the fuzzy reducibility of general hyperrings.

Bibliography contains 70 items, including publications in English, French and Italian, demonstrating a very good theoretical background of the PhD candidate on this theme. All relevant references are mentioned and also cited in the text.

Conclusions

The PhD thesis elaborated by Milica Kankaraš brings new and significant results in the theory of algebraic hypercompositional structures, by deepening the study of the reducibility property in hypergroups and extending it into two different directions: the first one regards the fuzzy case of the property, while the second one, proposed for the first time by the PhD candidate, is in the class of general hyperrings. The new results obtained by the candidate are covered in Chapters 2,3,and 4 of this dissertation. One one hand, they offer concrete examples of hypergroups and hyperrings that are or not reduced, while on the other hand they open new lines of research in Hypercompositional Algebra. Among several results, we stress here that it was proved that any i.p.s. hypergroup is reduced (Theorem 2.2), but not fuzzy reduced with respect to to the grade fuzzy set (Theorem 3.2), while any complete hypergroup is neither reduced (Theorem 2.3) or fuzzy reduced (Theorem 3.1). The reducibility and fuzzy reducibility property is studied also for Corsini hypergroups (Propositions 2.18, 2.19, and Theorem 3.6). Chapter 4 contains all new results obtained by the candidate on the reducibility of general hyperrings: Proposition 4.3 states that the hyperring of formal series R[[X]] with coefficients in a general commutative hyperring R is reduced if and only if R is reduced. Proposition 4.4. illustrates a construction of a non-reduced general hyperring with P-hyperoperations. Besides, it was proved in Proposition 4.5 that a general hyperring having the additive part a B-hypergroup and the multiplicative one a Corsini-hypergroup is always reduced. Theorem 4.3. proves that any complete hyperring is not reduced. Finally, necessary and sufficient conditions to get a non-reduced (H,R)-hyperring are expressed in Proposition 4.6. This study opens also new lines of research: the study of the reducibility can be conducted also for fuzzy hypergroups and fuzzy hyperrings, but also the fuzzy reducibility of hyperrings appears an interesting topic in this theory.

The thesis is well structured, the style of the presentation is clear and pleasant, the results are not banal and they are mathematically correct, being strongly motivated and supported by numerous examples. The results obtained by the author (both in amount and quality) are sufficient for the PhD level. They have a good potential for being developed in some further research, as mentioned in the conclusive part of the thesis. The stated aims of the dissertation have been fulfilled.
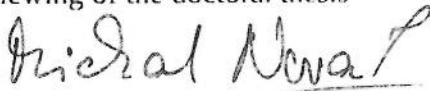
The bibliographic list shows that the candidate consulted all relevant publications related to the topic of the dissertation, that offered her a solid background for research. The original results are included in 3 articles, 1 of them as single author, published in recognized international journals, indexed by Web of Science in the first two categories. These articles are:

1. Fuzzy reduced hypergroups, Kankaraš M., Cristea I., Mathematics, 2020, 8(2), 263
2. Reducibility in Corsini hypergroups, Kankaraš M., Analele Stiintifice ale Universitatii Ovidius Constanta, Seria Matematica, 2021, 29(1), 99-109
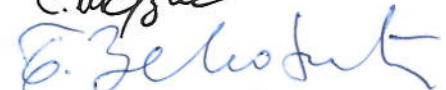3. The reducibility concept in general hyperrings, Mathematics, 2021, 9(17), 2037.

Concluding, we consider that this thesis fulfills the conditions requested by a doctoral thesis, thus it can be publicly discussed and **we warmly propose to grant the title of doctor in Mathematics to the doctoral student Milica Kankaraš.**
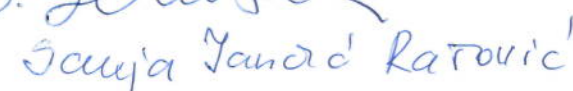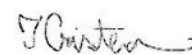
23.12.2021

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N/r dekanu

Prof. dr Predrag Miranović

Poštovani profesore Miranoviću,

U prilogu ovog akta dostavljamo Vam doktorsku disertaciju mr **Milice Kankaraš** pod naslovom "**Reducibilnost u algebarskim hiperstrukturama**" koja je u skladu sa članom 42 stav 3 Pravila doktorskih studija dostavljena **Centralnoj univerzitetskoj biblioteci** 30. 12. 2022. godine, na uvid i ocjenu javnosti.

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S poštovanjem,

DIREKTOR

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OBAVJEŠTENJE

Doktorska disertacija mr Milice Kankaraš, pod naslovom „Reducibilnost u algebarskim hiperstrukturama" i Izvještaj o ocjeni doktorske disertacije stavljaju se na uvid javnosti.

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2. Dr Svjetlana Terzić, redovni profesor Prirodno-matematičkog fakulteta Univerziteta Crne Gore (naučna oblast: algebarska topologija)

3. Dr Biljana Zeković, redovni profesor Prirodno-matematičkog fakulteta Univerziteta Crne Gore (naučna oblast: algebra)

4. Dr Sanja Jančić Rašović, redovni profesor Prirodno-matematičkog fakulteta Univerziteta Crne Gore (naučna oblast: algebra)

5. Dr Irina Elena Cristea, vanredni profesor Univerziteta Nova Gorica (Slovenija) (naučna oblast: algebra)

Pregled doktorske disertacije i Izvještaja se može obaviti u roku od 30 dana od dana objavljivanja ovog obavještenja u Centralnoj univerzitetskoj biblioteci Univerziteta Crne Gore.

Vážený pan

RNDr. MICHAL NOVÁK, Ph.D.

nar. 4. července 1975
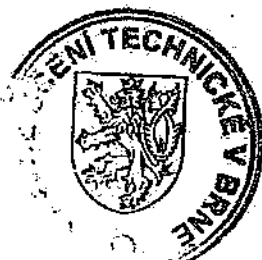
Na návrh Vědecké rady Fakulty strojního inženýrství Vysokého učení
technického v Brně, podle § 71 zákona č. 111/1998 Sb., o vysokých školách
a o změně a doplnění dalších zákonů
(zákon o vysokých školách)

Vás jmenuji
s účinností od 7. prosince 2018

DOCENTEM

pro obor

APLIKOVANÁ MATEMATIKA

V Brně dne 7. prosince 2018
Č.j. 68/90230/2018

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Deputy Department Head (2010 – 2021)

Professional specialization

theory of hypercompositional structures (algebraic hyper-structures) and their applications: MSC 2020 codes 20N20 (Hypergroups), 16Y20 (Hyperrings), 06Fxx (Ordered structures), 68Q70 (Algebraic theory of languages and automata), 20M35 (Semigroups in automata theory, linguistics, etc.)

Scientific activities in the last 5 years related to the topic of the project proposal
a) Research results:

- 10 papers in journals with impact factor (Web of Science), additional 1 accepted for publication in 2021
- 2 conference papers indexed by Web of Science, additional 3 conference papers indexed by SCOPUS
- 1 book chapter indexed by Web of Science
- 2 papers in peer-review journals and 1 conference paper unindexed by Web of Science or SCOPUS

b) Projects:

- Team member of FEKT-S-17-4225: *Dynamics of systems with the focus also on their algebraic and topological structure* (2017-2019)

c) Membership in editorial boards:

- Italian Journal of Pure and Applied Mathematics (SCOPUS), since December 2020
- Journal of Intelligent and Fuzzy Systems (IF WoS: Q3), since January 2019

d) Reviews for scientific journals:

- *Indexed by Web of Science or SCOPUS:* European Journal of Combinatorics; Soft Computing; Open Mathematics; International Journal of Biomathematics; Turkish Journal of

Mathematics; Symmetry; Kragujevac Journal of Mathematics; Discrete Mathematics, Algorithms and Applications; Applied Mathematics and Information Sciences
- *Other:* Mathematical Reviews; Southeast Asia Bulletin of Mathematics; Cogent Mathematics and Statistics; Mathematical Sciences Letters;

e) Research stays and mobilities:
- University of Nova Gorica (Slovenia): 10 stays
- Eastern Macedonia and Thrace University of Technology (TEI Kavala) (Greece): 2 stays

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Na osnovu člana 75 stav 2 Zakona o visokom obrazovanju (Sl.list RCG br. 60/03) i člana 18 Statuta Univerziteta Crne Gore, Senat Univerziteta Crne Gore, na sjednici održanoj 25.03.2010. godine, donio je

O D L U K U
O IZBORU U ZVANJE

Dr SVJETLANA TERZIĆ bira se u akademsko zvanje **redovni profesor** Univerziteta Crne Gore za predmete: Uvod u geometriju i Algebarska topologija na osnovnom studijskom programu Matematika i Uvog u diferencijalnu geometriju na osnovnom studijskom programu Matematika i računarske nauke na **Prirodno-matematičkom fakultetu.**

R E K T O R

Prof.dr Predrag Miranović

<u>Biografija: Svjetlana Terzić</u>

Datum i mjesto rodjenja: 17.09.1970, Podgorica, Crna Gora;

Državljanstvo: Crna Gora;

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Oblasti istraživanja: Algebarska topologija, Diferencijalna geometrija

Akademski obrazovanje:

- Diplomirani matematičar – Univerzitet Crne Gore, 09. 1993., srednja ocjena 9,96 od ukupno 10.
- Magistar matematike – Univerzitet u Beogradu, 06. 1996., srednja ocjena 10 od ukupno 10. Magistarska teza "Karakteristične klase hiperkompleksnih vektorskih raslojenja", mentor Prof. Novica Blažić

- Doktor matematike – Moskovski državni univerzitet "M. V. Lomonosov", 02. 1996 – 07. 1998, srednja ocjena 5 od ukupno 5
  Doktorska disertacija "Realne kohomologije i karakteristične klase uopštenih simetričnih prostora ", menotor Prof. Yuri P. Solovyov, 06. 1998.
- Postdoktorska pozicija, 08. 2000- 08. 2002, Ludwig Maximillians University, Minhen, Njemačka

Akademska zvanja:

- 1993 -2000 – saradnik u nastavi, Univerzitet Crne Gore
- 2000-2005 – Docent, Univerzitet Crne Gore
- 2005-2010 – Vanredni profesor, Univerzitet Crne Gore
- 2010- Redovni profesor, Univerzitet Crne Gore
- 2011 –Vanredni član Crnogorske akademije nauka i umjetnosti
- 2018 – Redovni član Crnogorske akademije nauka i umjetnosti

Odabrana predavanja po pozivu:

1. Contemporary Geometry and Related Topics, Belgrade, Serbia and Montenegro, May 2002;
2. Kolmogorov and Contemporary Mathematics, Moscow, Russia, Jun 2003;
3. Mathematical, Theoretical and Phenomenological Challenges Beyond Standard Models, Vrnjačka Banja, Serbia and Montenegro, September 2003;
4. Algebraic models for topological spaces and fibrations, Tbilisi, Georgia, September 2004
5. XI congress of mathematicians of Serbia and Montenegro, Petrovac, Serbia and Montenegro , September 2004, plenary talk;
6. Topology, analysis and applications to mathematical physics, Moscow, Russia, February 2005;
7. Contemporary Geometry and Related Topics, Belgrade, Serbia and Montenegro, July 2005;
8. Toric Topology, Osaka, Japan, May, 2006;
9. Differential Equations and Topology, in commemoration of the 100th anniversary of L.S. Pontryagin, Moscow, Russia, Jun 2008;
10. New horizons in toric topology, Manchster, UK, July 2008;
11. Geometry, Dynamics, Integrable systems, Belgrade, Serbia, September 2008;
12. Multidisciplinarnost i jedinstvo savremene nauke, University of East Sarajevo, Pale, May 2009;
13. Geometry, topology and algebra, dedicated to 120th anniversary of Boris Delone, Steklov Mathematical Institute, Russian Academy of Science, Moscow, Russia, August , 2010;
14. Geometry, Dynamics, Integrable Systems, Belgrade, Serbia, September, 2010;
15. Toric topology and automorphic functions, Khabarovsk, Far eastern branch of Russian academy of science, September, 2011
16. International topological conference "Alexandroff readings, Moscow state university "M. V. Lomonosov", May 2012, plenary talk
17. The second mathematical conference of the Republic of Srpska, Trebinje, Jun, 2012, plenary talk
18. Geometric structure on manifolds and their applications, Castle Rauischholzhausen, Marburg, July, 2012.
19. XVII geometrical seminar, Zlatibor, Serbia, August, 2012.

21. International conference "Algebraic topology and Abelian function" in honor of Victor Buchstaber on occasion of his 70th birthday, Moscow, June, 2013.
22. Geometry and analysis of metric structures, Sobolov institute of mathematics, Russian Academy of Sciences, Novosibirsk, December, 2013.
23. Topology of torus actions and its applications to geometry, Satelite conference of ICM, Daejeon, Korea, August, 2014.
24. International conference "Torus actions in geometry, topology and applications, Skolkovo, Moscow, February, 2015.
25. . The fifth mathematical conference of the Republic of Srpska, Trebinje, Jun 2015.
26. International Chinese-Russian conference " Torus actions: topology, geometry and number theory, Beijing, China, October, 2015.
27. Aspects of Homotopy Theory, Southampton, UK, December 2015.
28. XIX Geometrical Seminar, Zlatibor, Serbia, September 2016
29. Mini conference celebrating of 30 years of CGTA seminar, Belgrade, Serbia, September 2016, plenary talk
30. The Princeton-Rider Workshop on the Homotopy Theory of Polyhedral products, Princeton and Rider University, Princeton, USA, May-June, 2017.
31. Symposium on mathematics and it applications, Belgrade, Serbia, November 2017.
32. International conference "Algebraic topology, Combinatorics and Mathematical Physics" in honor of Victor Buchstaber on occasion of his 75th birthday, Moscow, May, 2018.

33. International conference "Modern algebra and Analysis and their Applications, Academy of Sciences and Arts of Bosnia and Herzegovina, Sarajevo, September, 2018.

34. Susret matematičara Srbije i Crne Gore, Budva, Oktobar, 2019.

35. Toric topology 2019 in Okayama, Okayamo, Japan, Novembar, 2019.

36. Deseti simpozijum Matematika i primene, Beograd, Decembar, 2019

37. Workshop on Torus actions in Topology, Fields Institute, Toronto, Kanada, May, 2020, via zoom.
38. Workshop on toric topology, geometry and related subjects, Moscow, November , 2020, via zoom

Predavanja na seminarima:

- September 2002., Erwin-Schroedinger institute, Vienna, Austria, talk in the framework of the program Aspects of foliation theory;
- April 2005, SANU, Belgrade, talk at the na Mathematical Colloquium SANU;
- Jun 2006, Osaka City University, Japan, talk at the Topology seminar;
- Jul 2006, University of Aberdeen, UK, talk at the Topology seminar
- January 2007, University of Oxford, UK, talk at the Topology seminar, mini course for phd topology students on the rational minimal model theory;
- February 2007, University of Manchester, UK, talk at the Topology seminar;
- November 2007, Mathematical Institute SANU, Belgrade, talk at the Geometry seminar;
- April 2009, MFO (Oberwolfach), Germany , talk at the "Workshop on homotopy theory of function spaces and related topics";
- September 2009, Faculty of Mechanics and Mathematics, MSU "M. V. Lomonosov", Moscow, Russia, talk at the seminar for Geometry, topology and mathematical physics, chaired by V. M. Buchstaber and   S. P. Novikova , talk at the Chair seminar of   A. T. Fomenko;
- Mart 2010, Laboratori J. A. Dieudonne, Universite de Nica Sophia Antipolis, France, talk at the seminar for Algebra, topology and geometry;
- Jun 2010, International School for Advanced Studies SISSA, Trieste, Italy, talk at the seminar for Geometry and Physics chaired by B. A. Dubrovin;
- December 2011, SANU, talk at the seminar Mathematical methods of mechanics.
- September 2013, University of Southampton, talk at Topology seminar
- December 2013, SANU, talk at the seminar Mathematical methods of mechanics
- October 2016, Faculty of Mechanics and Mathematics, MSU "M. V. Lomonosov", Moscow, Russia, talk at the seminar for Geometry, topology and mathematical physics, chaired by V. M. Buchstaber and S. P. Novikov
- May 2017, University of Southampton, UK, talk at Topology seminar
- December 2018, University of Southampton, UK, talk at Topology seminar

- November 2019, talk at One day topology seminar in Osaka, Osaka, Japan
- Oktobar 2020, University of Southampton, talk at Topology seminar, via zoom
- Novembar 2020, Princenton University, talk at International Polyhedral Product seminar, via zoom

Odabrane nagrade i grantovi:

1. Nagrada 19. decembar za najboljeg studenta u generaciji 1991.
2. Plaketa Univerziteta Crne Gore za najboljeg diplomiranog studenta generacije, 1993.
3. Nagrada Crnogorske akademije nauka i umjetnosti za naučna dostignuća, 2003.
4. Grant Evropskog udruženja matematičara za učešće na IV Evropskom kongresu matematičara, Stokholm, Švedska, 2004
5. WUS-Austria 2-nedjeljna posjeta Jelene Grbić Podgorici, Crna Gora, April, 2007.
6. Oxford Colleges hospitality scheme, 1-mjesečna posjeta Univerzitetu u Oxford-u, Januar, 2007.

7. Grant Evropskog udruženja matematičara za učešće na V Evropskom kongresu matematičara, Amsterdam, Holandija, 2008.
8. Grant of the Medjunarodne matematičke unije za učešće na Svjetskom kongresu matematičara, Hyderabad, Indija, 2010.
9. Bilateralni projekat sa Univerzitetom u Ljubljani, Slovenija, 2012-2013.
10. Glavni istraživač na projektu Ministarstva nauke Crne Gore, 2012-2015.
11. Glavni istraživač na medjunarodnom projektu instituta SISSA, Trst, 2008-2010.
12. Spoljni istraživač na projektu 174020 Ministarstva nauke Srbije, 2011-2015.
13. Istraživački grant London Mathematical Society sa Jelenom Grbić, 2-nedjeljna posjeta Univerzitetu u Southampton-u, 2013.
14. Grant za istraživanje u parovima sa Jelenom Grbić, 3-nedjeljna posjeta Matematičkom institute Oberwolfach, 2014.
15. Grant Medjunarodne matematičke unije za učešće na Svjetskom matematičkom kongresu Rio de Janeiro, Brazil, 2018.

Neke naučno istraživačke posjete:

Mehaniko-matematički fakultet, Moskovski državni univerzitet, Matematički institut Steklova, Ruska akademija nauka — 1999, 2003, 2005, 2006, 2008, 2009, 2012, 2013, 2015, 2016, 2018; SISSA Trst 2010; Mathematički Fakultet, Ljubljana, 2012, 2013; Matematički fakultet, Univerzitet u Southampton-u, 2013, 2015, 2017; Univerzitet u Aberdeen-u, 2006; Univerzitet u Mančester-u, 2007 . Fildsov Institu za matematiku, Toronto, Kanada, 2020.

Nastava i mentorstvo:

Predavala kurseve na različitim nivoima studija na Prirodno-matematičkom fakultetu Univerziteta Crne Gore: Uvod u geometriju, Uvod u diferencijanu geoemtriju, Algebarská topologija, Diferencijalna geomatrija na mnogostrukostima, Geometrija, Napredna algebra.

Mentor za preko 20 specijalističkih radova i 4 magistraske teze, komentor doktorske disertacije na Matematičkom fakultetu, Univerzitet Nica Sophia Antipolis, član komisija za odbranu doktorskih disertacija na Univerzitetu u Beogradu , Univerzitetu u Istočnom Sarajevu, Univerzitetu u Southmpton-u, Univerzitetu Crne Gore.

Ostalo:

* Urednik:
  1. Sarajevo Journal of Mathematics, izdaje Akademija nauka i umjetnosti Bosne i Hercegovine
  2. Matematički Vesnik, izdaje Društvo matematičara Srbije

* Recenzent za časopise : Publication de l'Institute Mathematique, Contemporary Mathematics, Proceedings of the Steklov Institute of Mathematics, Annali di Matematica Pura ed Applicata, Mathematica Slovaka, Mathematische Zeitschrift, Sbornik;Mathematics, Algebraic and Geometric Topology, Homology, Homotopy and Applications, Morrocan Journal of Pure and Applied Analysis

* Prodekan za medjunarodnu sardanju na Prirodno-matematičkom fakultetu Univerziteta Crne Gore, 2004 – 2007.

Publication list for Svjetlana Terzić

1. Svjetlana Terzić, *Real cohomology and Pontryagin characteristic classes of generalised symmetric spaces*, (Russian) Vsesojuzni Institut Nauchnoj i Tehnicheskoj Informacii, VINITI, V-1034, Moscow, 1998, 1-94.

2. Svjetlana Terzić, *Generalised symmetric spaces and their topology*, (Russian) Mathematica Montisnigri 11 (1999), 139-150.

3. Svjetlana Terzić, *Characteristic classes of hypercomplex vector bundles*, Montenegrin Academy of Sciences and Arts, Proceeding of the Section of Natural Sciences, 13 (2000)

4. Svjetlana Terzić, *Cohomology with real coefficients of generalized symmetric spaces*, (Russian) Fundamentalnaya i Prikladnaya Matematika, Vol. 7, (2001), no. 1, 131-157.

5. Svjetlana Terzić, *Pontryagin classes of generalized symmetric spaces*, (Russian) Matematicheskie Zametki, Vol. 69, (2001), no.4, 613-621; English transl. in Mathematical Notes, Vol. 69, (2001), no. 4, 559-566.

6. D. Kotschick and S. Terzić, *On formality of generalised symmetric spaces*, Mathematical Proceedings of Cambridge Philosophical Society, 134 (2003), 491-505.

7. S. Terzić, *Rational homotopy groups of generalised symmetric spaces*, Mathematische Zeitschrift, 243 (2003), 491-523.

8. S. Terzić, *On rational topology of four manifolds*, Proceeding of the Workshop Contemporary Geometry and Related Topics, World Scientific 2004, 375-389.

9. Svjetlana Terzić, *Rational topology of gauge groups and of spaces of connections*, Compositio Mathematicae, 141 (2005), no.1, 262-270.

10. Svjetlana Terzić, *On geometric formality*, Proceedings of the Workshop devoted to 25th anniversary of the Faculty of Natural Sciences and Mathematics, University of Montenegro, Contemporary mathematics, physics and biology, (2006), 208-215.

11. Victor M. Buchstaber and Svjetlana Terzić, *Equivariant complex structures on homogeneous spaces and their cobordism classes*, Advances in the Mathematical Sciences, Geometry, topology and mathematical physics, Translations 2, 224 (2008), 27 – 57, American Mathematical Society

12. D. Kotschick and S. Terzić, *Chern numbers and the geometry of partial flag manifolds*, Commentarii Mathematici Helvetici, 84 (2009), no.3, 587 – 616.

13. Jelena Grbić and Svjetlana Terzić, *The integral Pontryagin homology of the based loop space on a flag manifold*, Osaka Journal of Mathematics 47 (2010), no 2, 439 – 460.

14. Svjetlana Terzić, *Integral loop homology of complete flag manifolds* (joint with Jelena Grbić), Oberwolfach reports 19/2009, Homotopy Theory of Function Spaces and Related Topics, European Mathematical Society Publishing House, 1038 – 1040.

15. D. Kotschick and S. Terzić, *Geometric formality of homogeneous spaces and of biquotients*, Pacific Journal of Mathematics, 249 (2011), no 1, 157 – 176.

16. Svjetlana Terzić, *On real cohomology generators of compact homogeneous spaces*, Sarajevo Journal of Mathematics, Vol. 7 (20) (2011), No. 2, 277 – 287.

17. Svjetlana Terzić, *Toric genera on homogeneous spaces and related problems*, Proceedings of the international conference "Toric topology and automorphic functions", Far-Eastern Branch of the Russian Academy of Sciences, Pacific National University, 2011, 97 – 104.

18. Jelena Grbić and Svjetlana Terzić, *The integral homology ring of the based loop space on some generalised symmetric spaces*, Moscow Mathematical Journal, Volume 2012, Issue 4, Oct. – Dec. 2012, pp 771-786.

19. Victor M. Buchstaber and Svjetlana Terzić, *Toric genera of homogeneous spaces and their fibrations*, International Mathematics Research Notices, Vol. 2013, 1324-1403.

20. Svjetlana Terzić, *On cohomology ring of partial flag manifolds*, Proceedings of the Second Mathematical Conference of the Republic of Srpska, 2013, 11 - 17. (ISBN 978 – 99938 – 47 – 52 – 6)

21. Svjetlana Terzić, *Rational minimal model theory on compact homogeneous spaces*, Scripta Scientiarum Naturalium, Proceedings of the Faculty of Natural Sciences and Mathematics, University of Montenegro, Vol. 3, 2013, 3 – 17. (ISSN 1880 – 8356)

22. Victor M. Buchstaber and Svjetlana Terzić, *"(2n,k)-manifolds and applications"*, Report No 27/2014, Mathematisches Forschung Institut (25–31 May 2014), Oberwolfach, Germany, 2014, 11–14.

23. Victor M. Buchstaber and Svjetlana Terzić, *Topology and Geometry of the Canonical Action of T^4 on the complex Grassmannian $G_{4,2}$ and the complex projective space CP^5*, Moscow Mathematical Journal, Vol. 16, Issue 2 (2016), 237-273.

24. Svjetlana Terzić, *Geometric formality of rationally elliptic manifolds in small dimensions*, Glasnik of the Section of Natural Sciences, Montenegrin Academy of Sciences and Arts, 20 (2014), 131-145.

25. Svjetlana Terzić, *The rational homology ring of the based loop space of the gauge group and the spaces of connections on a four manifold*, Fundamentalnaya i Prikladnaya matematika (in Russian), Vol. 21, No.6, (2016) 206-216.

26. Svjetlana Terzić, *On geometric formality of rationally elliptic manifolds in dimensions 6 and 7*, Publications de l'Institute Mathematique (Belgrade), Issue 103 (117), (2018), 211-222.

27. Svjetlana Terzić, *Rational Pontriagin homology ring of the based loop space on some homogeneous spaces*, Sarajevo Journal of Mathematics, Vol. 14, No. 2, (2018), 275-285.

28. Victor M. Buchstaber and Svjetlana Terzić, *The foundations of (2n, k)-manifolds*, Sbornik Mathematics, 210:4 (2019), 41 – 86.

29. Victor M. Buchstaber and Svjetlana Terzić, *Toric topology of the complex Grassmann manifolds*, Moscow Mathematical Journal, 19:3 (2019), 397-463.

30. Dragana Borović and Svjetlana Terzić, *On rational Pontryagin homology ring of the based loop space on a four-manifold*, Matematički Vesnik, Vol 71, Iss 1-2, (2019), 90-103.

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Датум, _25.12. 2003 г._

Ref: _____

Date, _____

Na osnovu člana 97. Zakona o Univerzitetu ("Sl.list RCG", br. 27/92 i 6/94) i člana 94. Statuta Univerziteta Crne Gore, Naučno-nastavno vijeće Univerziteta Crne Gore, na sjednici održanoj 25.12.2003.godine, donijelo je

O D L U K U
O IZBORU U ZVANJE

Dr BILJANA ZEKOVIĆ bira se u zvanje redovnog profesora Univerziteta Crne Gore za predmete: Algebra i Matematika na nematičnim fakultetima na Prirodno-matematičkom fakultetu u Podgorici.

R E K T O R,

Prof.dr Ljubiša Stanković

1 Algebra sa primenama (2005-2007)
2. Neke algebarske strukture (2008-2011)
3. Algebarske strukture sa primenama (2012-2014)

Aktivni istraživač na projektu Algebra i logika sa primenama (2000-2005)

Biografija

Rođena sam 7.2.1955. u Gajdobri, opština Bač. Palanka. U Prištini sam završila osmogodišnju školu i gimnaziju prirodno-matematičkog smera 1974. godine oba puta kao nosilac Vukove diplome. Diplomirala sam na PMF-u 1978. godine. Postdiplomske studije sam upisala u jesen te iste godine na PMF-u u Prištini i Skoplju (integrisane postdiplomske studije) i za dve godine položila sve ispite predviđene planom i programom postdiplomskih studija. Magistarski rad sam odbranila na PMF-u u Prištini 1.10.1982. pod nazivom "S-disjunktivni elementi semigrupa sa posebnim osvrtom na neke klase semigrupa."

Školsku godinu 1987/88. provela sam na usavršavanju na MGU u Moskvi, gde sam sa naučnim rukovodiocem V.A.Artamonovim radila na nekim problemima iz oblasti Univerzalne algebre, što je rezultiralo izradom doktorske disertacije, koju sam pod nazivom "Prilog teoriji n-polugrupa i (2,n)-prstena", odbranila 2. marta 1990. godine na PMF-u u Skoplju pod rukovodstvom prof. dr G.Čupone. Kasnije, u okviru saradnje Moskovskog državnog univerziteta-MGU i Univerziteta Crne Gore, bila sam više puta na studijskom boravku na MGU im. M.V. Lomonosava.

Od 1.10.1978. do 1.10.1982. godine radila sam na PMF-u u Prištini, gde sam u zvanju asistenta držala vežbe iz Algebre i Matematičkih predmeta na Tehničkim fakultetima kao i na Ekonomskom fakultetu. Od 1.10. 1982. godine radim na PMF-u u Podgorici, gde sam držala vežbe iz Algebre i Matematičkih predmeta na Tehničkim fakultetima u zvanju asistenta sve do izbora u zvanje docenta 27.2.1991. Od tada sam na Odseku za fiziku držala predavanja i vežbe iz Diferencijalnog i integralnog računa I i II i Linearne algebre i analitičke geometrije, predavanja iz Matematike na Arhitekturi, Matematike I i II na Metalurškom fakultetu, predavanja i vežbe iz Algebre na Odseku za matematku i računarske nauke (smer C), predavanja iz Agebre II (smer A i B) i Algebre III (smerA).

U zvanje vanrednog profesora izabrana sam 5.10.1998, a u zvanje redovnog profesora 25.12.2003. godine.

REFERENCE

1. B. Zeković, S-disjunctive elements of a Rees matrix semigroup over a monoid, Matematički Vesnik 36, 1984, 251-254

2. B. Zeković, Universal enveloping rings and their radicals, Vestn. MGU, ser.I, 1989., N 6, 14-17 (in Russian)

3. B. Zeković, Universal enveloping rings of simple general rings, Vestn. MGU, ser.I, Matem. Meh. 1990., N 3, 100-103 (in Russian)

4. B. Zeković, V.A.Artamonov, n-group rings and their radicals, Abelian Groups and Modules, Tomsk, 11, 1992, 3-7 (in Russian)

5. B. Zeković, V.A.Artamonov, Fundamental ideal of n-group ring and divisors of zero, Mathematica Montisnigri IV., 1995, 103-108 (in Russian)

6. B. Zeković, S - disjunctive elements of the (2,n) – rings, Prilozi, Odd. Mat. teh. nauka, MANU, XIX, 1-2 (1998), s. 1-9,

7. B. Zeković, V.A.Artamonov, Connections between some properties of n-group rings and group rings, Mathematica Montisnigri XI, 1999., 151-158 (in Russian)

8. B. Zeković, V.A.Artamonov, n-group rings (regularity, involutions and property FC), Mathematica Montisnigri, XIII, 2001, 83-88 (in Russian)

9. B. Zeković, V.A.Artamonov, On two tasks for n-group rings, Mathematica Montisnigri, XV, 2002, 79-85 (in Russian)

10. B. Zeković, Frobenius n-group algebras, Discussiones Mathematicae, General Algebra and Applications 22(2002) 153-159

11. B. Zeković, On n-ary bialgebras (I), Tchebyshev sbornik, 4, N 3 (7), 2003, 65-73 (in Russian)

12. B. Zeković, On n-ary bialgebras (II), Tchebyshev sbornik, 4, N 3 (7), 2003, 73-8 (in Russian)

13. B. Zeković, Ternary Hopf algebras, Algebra and Discrete mathematics, 2005., N.3, 96-106

14. B. Zeković, n-ary (co) modules over n-ary co(algebras), Alg.and Disc. Math, N. 4, 2008. pp. 80-89.

15. B. Zeković, V. A. Artamonov, The antiautomorphisms of simple finite-dimensional ternary algebras, Math. Maced. Vol. 8 (2010), 61-68.

16. B. Zeković, V.A.Artamonov, Universal enveloping algebras for n-ary algebras, Akad. nauka i umetnosti Republike Srpske, Spomenica, Knj. VIII, Odj. Pr.mat. i teh. nauka, Knj.15, Banja Luka, 2011. str. 59-68.

17. B. Zekovićh, Example of n-ary bialgebra, Days of Diffraction 2012, 250-253.

18. B. Zeković, Relations between n-ary and binary comodules, Quasigroups and Related Systems, 23 (2015), 325-332

Radovi prezentovani na naučnim konferencijama i pripremljeni za štampu

19. B. Zeković, (Ko) Инварианты n-арных (ко) алгебр и тензорные произведения n- арных биалгебр, pripremljen za štampu, a prezentovan na The Ninth International Seminar "Mathematical Models & Modeling in Laser-Plasma Processes and Advanced science technologies", Petrovac, Montenegro, 28. maj - 4. jun, 2011.

20. B. Zekovich, **Some properties of the algebra** $R(C)$ **and Morita equivalence,** The Thirteenth International Seminar "Mathematical Models & Modeling in Laser - Plasma Processes and Advanced Science Technologies", Petrovac, Montenegro, 2015.

21. B. Zekovich, **The properties of tensor-products of the irreducible moduls over n-bialgebras,** Fourteenth International Seminar "Mathematical Models & Modeling in Laser-Plasma Processes and Advanced Science Technologies", Moscow, Russia, 1-12 July, 2016.

22. B. Zekovich, **Initial consideration about tensor product of irreducible modules over n-bialgebras,** Mathematical and Informational Technologies, MIT-2016

23. B. Zekovich, V. A. Artamonov, **Decomposition of tensor-products of irreducible modules over n-bialgebras and one-dimensional modules,** The Fifteenth and the Sixteenth International Seminar "Mathematical Models & Modeling in Laser-Plasma Processes and Advanced Science Technologies", Petrovac, Montenegro, 2016. and 2017.

24. B. Zekovich, V. A. Artamonov, **Semisimple n-ary bialgebras and one-dimensional module,** The Fifteenth and the Sixteenth International Seminar "Mathematical Models & Modeling in Laser-Plasma Processes and Advanced Science Technologies", Petrovac, Montenegro, 2017.

25. B. Zekovich, V. A. Artamonov, **Semisimple** n**-ary bialgebras and their actions over decomposition of bialgebra** $H^{(n-1)}$, Rusko-indijska konferencija iz Algebre, teorije brojeva i diskretne matematike, Moskva, Rusija, 2017.

26. B. Zekovich, V. A. Artamonov, **Pierce decomposition of semisimple n-ary bialgebras,** The Seventeenth International Seminar "Mathematical Models & Modeling in Laser-Plasma Processes and Advanced Science Technologies", Budva, Montenegro, 2018.

27. B. Zekovich, **On tensor-products of irreducible moduls over n-bialgebras,** Međunarodna algebarska konferencija na mehaničko-matematičkom fakultetu, posvećena 110-godišnjici rođenja prof. A.G. Kuroša

28. B. Zekovich, V. A. Artamonov, **Antipode in n-ary bialgebra,** The Eighteenth International Seminar "Mathematical Models & Modeling in Laser-Plasma Processes and Advanced Science Technologies", Petrovac, Montenegro, 2019.

29. B. Zekovich, V. A. Artamonov, **Coinvariant elements and connection with antipode,** pripremljen za štampu

30. B. Zekovich, **Some consideration about semisimple decomposition of tensor products of irreducible modules over** n**-bialgebras,** Moskva, Rusija, 2019.

Spisak objavljenih knjiga

1. B. Zeković, V.A.Artamonov, Zbirka rešenih zadataka iz Algebre (prvi deo), PMF, Podgorica 2003.

2. B. Zeković, V.A.Artamonov, Zbirka rešenih zadataka iz Algebre (drugi deo), (recenziran)

Rukovodilac naučnih projekata:

Broj / Ref ОЗ - 1337

Datum / Date 19 04. 20 19

Na osnovu člana 72 stav 2 Zakona o visokom obrazovanju („Službeni list Crne Gore" br. 44/14, 47/15,40/16,42/17,71/17 55/18 i 3/19) i člana 32 stav 1 tačka 9 Statuta Univerziteta Crne Gore, Senat Univerziteta Crne Gore, na sjednici održanoj 19. aprila 2019.godine, donio je

O D L U K U
O IZBORU U ZVANJE

Dr SANJA JANČIĆ-RAŠOVIĆ bira se u akademsko zvanje redovni profesor Univerziteta Crne Gore za oblast Matematika (Algebra 1) na Prirodno-matematičkom fakultetu Univerziteta Crne Gore i (Matematika 3 i Matematika sa informatikom) na nematičnim fakultetima, na neodređeno vrijeme.

SENAT UNIVERZITETA CRNE GORE
PREDSJEDNIK

Prof.dr Danilo Nikolić, rektor

BIOGRAFIJA I BIBLIOGRAFIJA

SANJA JANČIĆ RAŠOVIĆ

I OBRAZOVANJE:

- BSc Matematika, Univerzitet Crne Gore, Prirodno-matematički fakultet, GPA: 9.52/10.00, 1997.
- Sc Matematika, Univerzitet Crne Gore, Prirodno-matematički fakultet GPA: 10.00/10.00, 2002.
- PhD Matematika, Univerzitet Crne Gore, Prirodno-matematički fakultet, Doktorska disertacija: Asocirani hiperprsteni I hiperskoro-prsteni,2007.

II PODACI O RADNIM MJESTIMA:

- 2013-.... Vanredni profesor na Univerzitetu Crne Gore.

- 2008-2013 Docent na Univerzitetu Crne Gore

- 1997- 2007 Asistent u nastavi na Univerzitetu Crne Gore

III STUDIJSKI BORAVCI:

- Jun 2007- Department of Algebra, Johannes Kepler University, Linz, Austrija
- Jun 2008 –Department of Mathematics, Udine University, Italija
- Jun 2010 – Katedra za Algebru Mehanicesko-matematickog fakulteta, Moskovski državni Univerzitet " M.V. Lomonosov", Rusija
- jun 2011 - Department of Mathematics, Udine University, Italija
- maj 2015 –Department of Discrete Mathematics and Geometry,Vienna University of Technology, Austria.

IV STRUCNI RAD:

1. Stalni recenzent za matematičku bazu MathSciNet Američkog društva matematičara od 2012.godine.
2. Učešće u realizaciji međunarodnih i nacionalnih naučno-istraživačkih projekata :
   - (2005-2007) "Algebra sa primjenama", projekat je podržan od strane Ministarstva prosvjete i nauke Crne Gore.
   - (2008-2011) "Neke algebarske strukture", projekat je podržan od Ministarstva prosvjete i nauke Crne Gore.
   - (2006-2007) " Teaching methods in Mathematics" project. No. 204/2006, WUS-Austria Project.

- (2012-2014) "Algebarske strukture sa primjenama" projekat je podržan od Ministarstva nauke Crne Gore.
- (2010-2013) TEMPUS IV Project No. 158644-JPCR, Development of Regional Interdisciplinary Mechatronics Studies –DRIMS.
- (2018-2020) "Svojstva hiperskoro- prstenova", bilateralni projekat sa Slovenijom podržan od Ministarstva prosvjete i nauke Crne Gore.
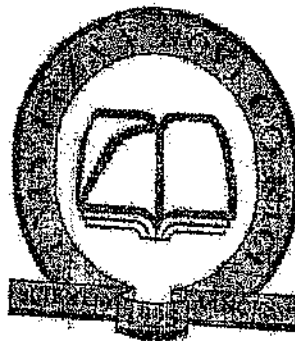
3. Učešće u radu komisija Ispitnog centra Crne Gore (2012-...)

V UNIVERZITETSKI UDŽBENICI:

- Radoje Sćepanović, Sanja Jančić Rašović: *Matematika 3 za studente građevinskog i mašinskog fakulteta*, Univerzitet Crne Gore 2012.godine, ISBN 978-86-7664-103-1
- Radoje Sćepanović, Sanja Jančić Rašović: *Matematika za studente arhitekture*, Univerzitet Crne Gore 2009.godine, ISBN 978-86-7664-067-6
- S. Duborija, M, Mosurović, G. Šuković, S. Jančić: *Diferencijalni i integralni račun : Zbirka ispitnih zadataka*, Univerzitet Crne Gore,1999.godine, ISBN 86-81039-43-1.

VI NAUCNI RADOVI

1. **Sanja Jančić Rašović**, Irina Cristea, *Hypernear-rings with a defect of distributivity*, Filomat, Niš, Volume 32(4), (2018), pp.1133-1149, ISSN:0354-5180. (SCI Expanded)

2. **Sanja Jančić Rašović**, Irina Cristea, Division hypernear-rings, *Analele Stiintifice ale Universitatii Ovidius Constanta, Seria Matematica* , Romania, Volume XXVI (3), (2018),pp.109-126, ISSN: 1224-1784, (SCI Expanded).

3. Irina Cristea, **Sanja Jančić-Rašović**, Operations on fuzzy relations : A tool to construct new hyperrings, *Journal of Multiple-Valued Logic and Soft Computing*, Vol.21,183-200,Philadelphia, USA, ISSN: 1542-3980, (2013) (SCI Expanded).

4. **Sanja Jančić-Rašović**, Vučić Dašić, Some new classes of (m,n)-hyperrings, *Filomat*, Niš, Srbija, ISSN:0354-5180, Vol.26,Issue 3, 585-596 (2012) (SCI Expanded).

5. 5.Irina Cristea, **Sanja Jančić-Rašović**, Composition Hyperrings, Analele Stintifice Ale Universitatii Al I Cusa Din Iasi-serie Noua-Matematica, vol.21(2) 81-94, Iasi, Romania, ISSN: 1221-8421, (2013), (SCI Expanded).

6. **Sanja Jančić Rašović**, Vučić Dašić, On generalization of division near-rings, *Italian Journal of Pure and Applied Mathematics*, Udine, Italy, No-40, pp.1-8, ISSN: 2239-0227,(SCOPUS)

7. **Sanja Jančić Rašović**, On hyperrings associated with binary relations on semihypergroups, Italian Journal of Pure and Applied Mathematics-No.30-(2013),279-288, Udine, Italy, ISSN: 2239-0227, (SCOPUS).

Številka: 55-3/2017

Na osnovi odločitve Senata Univerze v Novi Gorici, ki jo je v skladu z 47. in 74. členom statuta sprejel na svoji 79. seji dne 20 septembra 2017, rektor v okviru svojih pristojnosti, določenih v statutu in 20. členu Pravil o pogojih in postopku za pridobitev nazivov raziskovalnih sodelavcev, visokošolskih učiteljev in sodelavcev Univerze v Novi Gorici, sprejme naslednji ugotovitveni

SKLEP

Doc. dr. Irini Eleni Cristei se podeli naziv izredna profesorica za področje "Matematika".

Naziv velja z dnem izdaje tega sklepa za obdobje petih let.

V Novi Gorici, 22. 9. 2017

Rektor:

Prof. dr. Danilo Zavrtanik

Prejmejo:
- prof. dr. Irina Elena Cristea,
- personalna mapa,
- rektor,
- dekan Fakultete za naravoslovje,
- arhiv.

Name and surname: Irina Elena Cristea

Date and place of birth: 05.04.1978, Bacau (Romania)
Address: street Cormor, 48/a, 33010 Tavagnacco (Udine), Italy

Education:

- PhD in Mathematics, University of Constanta, Romania, 2007
- M.Sc. in Algebra and Geometry, University "Al.I.Cuza" Iasi, Romania, 2003
- B.Sc. in Mathematics, University "Al.I.Cuza" Iasi, Romania, 2001

Scientific title: associate professor (since 22.9.2017)
Work experience:

- 2017-..., University of Nova Gorica, School of Science, School of Environmental Sciences and School of Engineering and Management and Center for Information Technologies and Applied Mathematics- associate professor
- 2012-2017 University of Nova Gorica, School of Science, School of Environmental Sciences and School of Engineering and Management- assistant professor of mathematics
- 2009-2011, University of Udine, Italy, Faculty of mechanics - lecturer of the course "Linear Algebra" and within Department of biology and agro-industrial economy: development of computational and mathematical methods from Cluster Analysis theory for some Agro-industrial Economical problems.
- 2005-2011, University of Udine, Department of Mathematics and Informatics: development of algebraic hyperstructures theory and their applications and within Faculty of Engineering- assistant for the subjects "Linear algebra", "Calculus 1" and "Calculus 2".
- 2003-2007, University of Iasi, Romania, Faculty of mathematics- Teaching assistant

Management positions:

- Deputy head of the Center for Information Technologies and Applied Mathematics, 10.2017-present
- Deputy head of the Center for System and Information Technologies, 03.2017-10.2017, 03.2015-03.2016.

Awards: "Young scientist 2008 bet paper prize" for Mathemtics, awarded by University of Udine, Italy, for the paper "On the fuzzy grade of Hypergroups", published in Fuzzy Sets of Systems, 159(2008).

Projects and grants:

- Principal investigator of the Bilateral project Slovenia-Montenegro (ARRS-MS-BI-ME-JR) 2018-2020
- Principal investigator of the regional project "Borsa regionale-settore agricolo, agro-alimentare e veterinario Friuli Venezia Giulia, L.R. 2/2006 commi 54-57", University of Udine, 01.2009-09.2011
- Principal investigator of the Italian project (assegno di ricerca) "Hyperstructures, Fuzzy Sets, Rough Sets", University of Udine, Italy, 04.2007-11.2008
- Pedagogical mentor of the project "Po kreativni poti do znanja-After a creative way to knowledge", University of Nova Gorica, 03.2017-06.2017.

- Coordinator and pedagogical mentor of the project "Po kreativni poti do praktičnega znanja-After a creative way to practical knowledge", University of Nova Gorica, 04.2014-08.2014.
- Member of the project "European regional funds–Creative Cores" Active and Healthy Aging - Molecular Mechanisms, Nutrition and Targeted Delivery with Nanoparticles (AHA-MOMENT), University of Nova Gorica, 03.2015-05.2015.
- Member of the project 23/3.09.2007 of Romanian Accademy "Hipergroups and Abelian groups. Applications", University of Iasi, Romania, 09.2007-12.2007, 05.2008-10.2008.
- Member of the project CEX 05D11-11/2005 of the Romanian Ministry of Education and Science, "Combinatorical, algebraic, topological methods in Algebra and Geometry", University of Constanta, Romania, 2005-2008.

Management positions:
Head of the Center of Information Technologies and Applied Mathematics, University of Nova Gorica, 03.2017-03.2018, 03.2015-03.2016

Supervisions:

- B.Sc. Theses (University of Nova Gorica): Karolina Koren (2014), Tanja Abram (2014)
- M.Sc. Theses (University of Nova Gorica): Tamara Hohannisyan (2015)

Expert work:

- 2007- to date reviewer for more than 40 SCI mathematical journals and Mathematical Reviews

- member of the editorial board of the international journals:

1. The Scientific World Journal ISSN 1537-744X, 2013-2016
2. Italian journal of pure and applied mathematics ISSN 2239-0227, 2010-...
3. Ratio matematica ISSN 1592-7415, 2013-...
4. Population dynamics: analysis, modelling, forecast ISSN 2335-2566, 2012-...
5. Journal of advances in applied & computational mathematics ISSN 2409-5761, 2014-...
6. Journal of Hyperstructures ISSN 2251-8436, 2012-...

- International evaluator of the PhD thesis "On the study of automata and languages based on fuzzy sets, fuzzy multisets and rough sets" by Binod Kumar Sharma, submitted the Indian Institute of Technology, Dhanbad, India

Membership in scientific organizations:

- co-chair of the symposium "Hypercompositional Algebra – new Developments and Applications (1st HAnDA) within 15th International Conference on Numerical Analysis and Applied Mathematics (ICNAAM 2017)", Thessaloniki, Greece, 25-30.09.2017
- member of the organizing committee of the conferences/workshops:

1. 11th International Congress on Algebraic Hyperstructures and Applications (AHA 2011), Chieti, Italy, 17-21.10. 2011

2. A new approach in theoretical and applied methods in algebra and analysis, Constanta, Romania, 4–6.04.2013

- member of the technical committee of the conferences:

1. Conference on Computer Science & Computational Mathematics (CCSCM 2012), Melaka, Malaysia, 9-10.02.2012

2. International Conference on Computer Science & Computational Mathematics (ICCSCM 2013), Kuala Lampur, Malaysia, 9-10.02.2013

3. International Conference on Computer Science & Computational Mathematics (ICCSCM 2014), Langkawi, Malaysia, 8-9.05.2014

4. 12th International Congress on Algebraic Hyperstructures and Applications (AHA 2014), Xanthi, Greece, 2-7.09.2014

5. International Conference on Computer Science & Computational Mathematics (ICCSCM 2015), Langkawi, Malaysia, 7-8.05.2015

6. International Conference on Computer Science & Computational Mathematics (ICCSCM 2016), Langkawi, Malaysia, 5-6.05.2016

7. International Conference on Computer Science & Computational Mathematics (ICCSCM 2017), Langkawi, Malaysia, 4-5.05.2017

8. 13th International Congress on Algebraic Hyperstructures and Applications (AHA 2017), Istanbul, Turkey, 24-27.07.2017

Cooperation with international institutions and groups:

Italy (University of Udine), Romania (University "Ovidius" of Constanta, University of Bucharest), Iran (University of Tehran, University of Yazd, University of Kerman, University of Rafsanjan, Babol University of Technology, University of Bojnord, Shahid Bahonar University), Czech Republic (University of Defence of Brno, Brno University of Technology), China (Hubei Institute of Nationalities), Montenegro (University of Montenegro), Saudi Arabia (Majmaah University)

Research interest: theory of algebraic hyperstructures and their connections with fuzzy sets

Papers: 39 articles published in WoS and 45 records published in Scopus, h-index=12

Scientific monography:

B. Davvaz, I. Cristea, Fuzzy algebraic hyperstructures: an introduction, (Studies in fuzziness and soft computing, vol. 321), Springer, 2015.