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SATURDAY / 13³⁰-15³⁰**

HALL-1, SESSION-2	Head of Session: Prof. Dr. Osman ERKMEN
Erdoğan Sayan	WHAT IS WRONG WITH CANTOR'S DIAGONAL ARGUMENT?
Erdoğan Sayan	THE PROBLEM OF THE DOMAIN OF NEWTON'S SECOND LAW
SERİR UZUN NUR ÇAPA	HASTANE BAĞÇELERİNİN PEYZAJ TASARIMLARININ DÜZCE İLİ ÖRNEĞİNDE İRDELENMESİ
Beste DESTİCİOĞLU Dr. Bahar ÖZYÖRÜK	ÇOK DEPOLU EŞ ZAMANLI TOPLA DAĞIT ARAÇ ROTALAMA PROBLEMİ İÇİN MODEL ÖNERİSİ
Dr. Bahar ÖZYÖRÜK	TEDARİKÇİ SEÇİM PROBLEMİ İÇİN ENTEGRE EDİLMİŞ MATEMATİKSEL MODEL VE BİR UYGULAMA
Tülay Turgut GENÇ Melih GÜNAY	RIBOSOMAL DNA SEQUENCE-BASED IDENTIFICATION OF NON-SACCHAROMYCES YEASTS ISOLATED FROM DIFFERENT CHEESES
Tülay Turgut GENÇ Melih GÜNAY	MOLECULAR IDENTIFICATION OF YEAST BIOTA ASSOCIATED WITH YOGURTS COLLECTED FROM CENTRAL ANATOLIA, TURKEY
Neslihan DEMİR Mustafa YILDIZ	SYNTHESIS, SPECTROSCOPIC ANALYSES, BIOLOGICAL ACTIVITY AND CHEMO SENSOR STUDIES OF 4-METHYLBENZO[D]THIAZOL-2-AMINE BASED IMINE DERIVATIVE
Neslihan DEMİR Mustafa YILDIZ	SYNTHESIS, CHARACTERIZATION OF A SCHIFF BASE DERIVED FROM THIAZOLE, AND ITS APPLICATIONS IN MOLECULAR BIOLOGY
ASSOC. PROF. MEHMET ŞAHİN ABDULLAH KARGIN	NEUTROSOPHIC TRIPLET b – NORMED SPACES
ASSOC. PROF. MEHMET ŞAHİN ABDULLAH KARGIN	NEUTROSOPHIC TRIPLET PARTIAL b – NORMED SPACES

EFFECTS OF GLASS FIBER ON MECHANICAL PROPERTIES OF LAMINATED
WOOD COMPOSITE MATERIALS

Res. Assist. Emin ERSOY, Prof. Dr. M. Baki KARAMIŞ

Page 161-168

NEUTROSOPHIC TRIPLET b – NORMED SPACES

Assoc. Prof. Mehmet Şahin, Abdullah Kargın

Page 169-173

NEUTROSOPHIC TRIPLET PARTIAL b – NORMED SPACES

Assoc. Prof. Mehmet Şahin, Abdullah Kargın

Page 174-179

EFFECT OF *ALLIUM SCHOENOPRASUM* L. ADMINISTRATION ON TOTAL
ANTIOXIDANT AND TOTAL OXIDANT LEVELS IN LIVER AND KIDNEY TISSUE IN
CARBON TETRACHLORIDE INDUCED TISSUE DAMAGE

Yılmaz KOCAK¹, Gokhan OTO², Ufuk Mercan YUCEL³, Semih YASAR⁴, Okan ARIHAN⁵

Page 180

GRAMMATICAL ISSUES IN
SAUDI EFL WRITINGS: A MINIMALIST APPROACH

Mohammad ALKHATİB

Page 181

ARTISTIC MODELS OF EMPIRE IN THE NOVELS BY OTAR CHILADZE

Ada NEMSADZE

Page 182

ÖĞRETMEN HAZIRLIĞINDA PEDAGOJİK TECRÜBENİN YERİ:
ORGANİZASYON VE İLETİŞİMDE VAHİDLİK İLKELERİ GÖZLEMİ

Nazile ABDULLAZADE

Page 183-185

NEUTROSOPHIC TRIPLET PARTIAL b – NORMED SPACES

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ÖZET

Bu çalışmada, biz nütrosifik üçlü kısmi b – normlu uzayları tanımladık. Bu yapı için örnekler ve özellikler verdik. Ayrıca nütrosifik üçlü normlu uzayları [6] ve nütrosifik üçlü kısmi b – metrik uzayları [10] nütrosifik üçlü kısmi b – normlu uzaylarla karşılaştırdık. Bunun yanı sıra bu nütrosifik üçlü yapıların nütrosifik üçlü kısmi b – normlu uzaylardan farklı olduğunu gösterdik. Ek olarak nütrosifik üçlü kısmi b – normlu uzayların hangi durumlarda diğer nütrosifik üçlü yapıların özelliklerini sağladığını tartıştık. Bundan dolayı yeni bir teori olan nütrosifik üçlü yapılara nütrosifik üçlü kısmi b – normlu uzayları eklemiş olduk.

Anahtar Kelimeler: b - metrik uzaylar, nütrosifik üçlü kümeler, nütrosifik üçlü kısmi b - metrik uzaylar, nütrosifik üçlü kısmi b – normlu uzaylar

ABSTRACT

In this study, we defined neutrosophic triplet partial b - normed spaces. We gave examples and properties for this structure. Also, neutrosophic triplet normed spaces [6], and neutrosophic triplet partial b - metric spaces [9] are compared with neutrosophic triplet partial b - normed spaces. Furthermore, we show that neutrosophic triplet partial b - normed spaces are different from these neutrosophic triplet structures. In addition, we discussed in which special cases the neutrosophic partial b - normed spaces provide the properties of other neutrosophic triplet structures. Thus, we added neutrosophic triplet partial b - normed spaces to the neutrosophic triplet structures which are a new theory.

Key words: b - metric spaces, neutrosophic triplet sets, neutrosophic triplet partial b - metric spaces, neutrosophic triplet partial b – normed spaces

1. PRELIMINARIES

Smarandache introduced neutrosophy in 1980, which studies a lot of scientific fields. In neutrosophy, there are neutrosophic logic, set and probability in [1]. Neutrosophic logic is a generalization of a lot of logics such as fuzzy logic in [2] and intuitionistic fuzzy logic in [3]. Neutrosophic set is showed by (t, i, f) such that “ t ” is degree of membership, “ i ” is degree of indeterminacy and “ f ” is degree of non-membership. Also, a lot of researchers have studied neutrosophic sets. Furthermore, Smarandache and Ali obtained neutrosophic triplet in [4] and they introduced neutrosophic triplet groups in [4]. For every element “ x ” in neutrosophic triplet set A , there exist a neutral of “ a ” and an opposite of “ a ”. Also, neutral of “ x ” must different from the classical unitary element. Therefore, the neutrosophic triplet set is different from the classical set. Furthermore, a neutrosophic triplet “ x ” is showed by $\langle x, neut(x), anti(x) \rangle$. Also, many researchers have introduced NT structures. Recently, Şahin and Kargın introduced neutrosophic triplet metric space and neutrosophic triplet normed space in [6]; Smarandache, Şahin and Kargın studied neutrosophic triplet G – modules in [7], Şahin and Kargın obtained neutrosophic triplet partial metric space in [8]; Şahin and Kargın obtained neutrosophic triplet b - metric space in [9]; Şahin and Kargın obtained neutrosophic triplet partial b - metric space in [10].

In this study, we obtained neutrosophic triplet partial b - normed space. In section 2; we gave

definitions of neutrosophic triplet set in [4], neutrosophic triplet b - metric space in [9], neutrosophic triplet field in [5], neutrosophic triplet vector space and neutrosophic triplet normed space in [6]. In section 3, we defined neutrosophic triplet partial b – normed space and we gave properties for this structure. Also, we showed relationship between neutrosophic triplet partial b – metric space and neutrosophic triplet partial b- normed space. Furthermore, we defined neutrosophic triplet partial b – Banach space. In section 5, we gave conclusions.

2. INTRODUCTION

Definition 2.1 [4]: Let # be a binary operation. A neutrosophic triplet set $(X, #)$ is a set such that for $x \in X$,

- i) There exists neutral of “x” such that $x\#neut(x) = neut(x)\#x = x$,
- ii) There exists anti of “x” such that $x\#anti(x) = anti(x)\#x = neut(x)$.

Also, a neutrosophic triplet “x” is showed with $(x, neut(x), anti(x))$.

Furthermore, $neut(x)$ must different from classical neutral element.

Definition 2.2: [10] A neutrosophic triplet partial b - metric on a neutrosophic triplet set $(N, *)$ is a function $d_{pb}: N \times N \rightarrow \mathbb{R}$ such for every $n, m, s \in N$,

- i) $n * m \in N$
- ii) $d_{pb}(n, m) \geq 0$
- iii) If $d_{pb}(n, m) = 0$, then $n = m$,
- iv) $d_{pb}(n, m) = d_{pb}(m, n)$
- v) If there exists at least an element $s \in N$ for $n, m \in N$ pair such that $d_{pb}(n, m) \leq d_{pb}(n, m * neut(s))$, then $d_{pb}(n, m * neut(s)) \leq b(d_{pb}(n, s) + d_{pb}(s, m) + d_{pb}(s, s))$
Where, $b \in \mathbb{R}^+$ and $b \geq 1$.

Definition 2.3. [5] Let $(NTF, *, #)$ be a neutrosophic triplet set together with two binary operations $*$ and $\#$. Then $(NTF, *, #)$ is called neutrosophic triplet field if the following conditions hold.

1. $(NTF, *)$ is a commutative neutrosophic triplet group with respect to $*$.
2. $(NTF, #)$ is a neutrosophic triplet group with respect to $\#$.
3. $a\#(b*c) = (a\#b)*(a\#c)$ and $(b*c)\#a = (b\#a)*(c\#a)$ for all $a, b, c \in NTF$.

Definition 2.4. [6] Let $(NTF, *_1, \#_1)$ be a neutrosophic triplet field and let $(NTV, *_2, \#_2)$ be a neutrosophic triplet set together with binary operations “ $*_2$ ” and “ $\#_2$ ”. Then $(NTV, *_2, \#_2)$ is called a neutrosophic triplet vector space if the following conditions hold. For all $u, v \in NTV$ and for all $k \in NTF$; such that $u *_2 v \in NTV$ and $u \#_2 k \in NTV$;

- 1) $(u *_2 v) *_2 t = u *_2 (v *_2 t)$; $u, v, t \in NTV$;
- 2) $u *_2 v = v *_2 u$; $u, v \in NTV$;
- 3) $(v *_2 u) \#_2 k = (v \#_2 k) *_2 (u \#_2 k)$; $k \in NTF$ and $u, v \in NTV$;
- 4) $(k *_1 t) \#_2 u = (k \#_2 v) *_1 (u \#_2 v)$; $k, t \in NTF$ and $u \in NTV$;
- 5) $(k \#_1 t) \#_2 u = k \#_1 (t \#_2 u)$; $k, t \in NTF$ and $u \in NTV$;
- 6) there exists at least an element $k \in NTF$ for every element u such that $u \#_2 neut(k) = neut(k) \#_2 u = u$; $u \in NTV$.

Definition 2.5: [6] Let $(NTV, *_2, \#_2)$ be a neutrosophic triplet vector space on $(NTF, *_1, \#_1)$ neutrosophic triplet filed. If the function $\| \cdot \| : NTV \rightarrow \mathbb{R}^+ \cup \{0\}$ is satisfied the following

properties, then the function $\|\cdot\|$ is a neutrosophic triplet norm.
Where,

$f: \text{NTF} \times \text{NTV} \rightarrow \mathbb{R}^+ \cup \{0\}$ is a function such that
 $f(\alpha, x) = f(\alpha, \text{anti}(x))$ and if $x = \text{neut}(x)$, then $f(\alpha, x) = 0$.

- a) $\|x\| \geq 0$
- b) If $x = \text{neut}(x)$, then $\|x\| = 0$
- c) $\|\alpha \#_2 x\| = f(\alpha, x) \cdot \|x\|$
- d) $\|\text{anti}(x)\| = \|x\|$
- e) If there exists at least an element $k \in N$ for $x, y \in \text{NTV}$ pair such that
 $\|x *_2 y\| \leq \|x *_2 y *_2 \text{neut}(k)\|$, then $\|x *_2 y *_2 \text{neut}(k)\| \leq \|x\| + \|y\|$.

Also, $((\text{NTV}, *_2, \#_2), \|\cdot\|)$ is called a neutrosophic triplet normed space.

3. NEUTROSOPHIC TRIPLET PARTIAL b – NORMED SPACES

Definition 3.1: Let $(\text{NTV}, *_2, \#_2)$ be a neutrosophic triplet vector space on $(\text{NTF}, *_1, \#_1)$ neutrosophic triplet field. If the function $\|\cdot\|_{pb}: \text{NTV} \rightarrow \mathbb{R}^+ \cup \{0\}$ is satisfied the following properties, then the function $\|\cdot\|_{pb}$ is a neutrosophic triplet partial b - norm.
Where,

$f: \text{NTF} \times \text{NTV} \rightarrow \mathbb{R}^+ \cup \{0\}$ is a function such that
 $f(\alpha, x) = f(\alpha, \text{anti}(x))$ and if $x = \text{neut}(x)$, then $f(\alpha, x) = 1$.

- a) $\|x\|_{pb} \geq 0$
- b) If $\|x\|_{pb} = 0$, then $x = \text{neut}(x)$
- c) $\|\alpha \#_2 x\|_{pb} = f(\alpha, x) \cdot \|x\|_{pb}$
- d) $\|\text{anti}(x)\|_{pb} = \|x\|_{pb}$
- e) If there exists at least an element $k \in N$ for $x, y \in \text{NTV}$ pair such that
 $\|x *_2 y\|_{pb} \leq \|x *_2 y *_2 \text{neut}(k)\|_{pb}$, then $\|x *_2 y *_2 \text{neut}(k)\|_{pb} \leq b(\|x\|_{pb} + \|y\|_{pb} + \|\text{neut}(k)\|_{pb})$. Where, $b \in \mathbb{R}^+$ and $b \geq 1$.

Also, $((\text{NTV}, *_2, \#_2), \|\cdot\|_{pb})$ is called a neutrosophic triplet b - normed space.

Example 3.2: Let $X = \{a, b\}$ and $P(X) = \{\emptyset, \{a\}, \{b\}, \{a, b\}\}$ be power set of X .
 $(P(X), *, \cap)$ is a neutrosophic triplet set and neutrosophic triplet vector space. Where,
 $A, B \in P(X)$,

$$A * B = \begin{cases} B \setminus A, & \text{if } s(A) < s(B) \wedge B \supset A \wedge A' = B \\ A \setminus B, & \text{if } s(A) > s(B) \wedge A \supset B \wedge B' = A \\ (A \setminus B)', & \text{if } s(A) > s(B) \wedge A \supset B \wedge B' \neq A \\ (B \setminus A)', & \text{if } s(A) < s(B) \wedge B \supset A \wedge A' \neq B \\ X, & \text{if } s(A) = s(B) \wedge A \neq B \\ \emptyset, & A = B \end{cases}$$

Also, $f: P(X) \times P(X) \rightarrow \mathbb{R}^+ \cup \{0\}$ is a function such that

$$f(A, B) = (s(A \cap B) + k) / (s(B) + k)$$

Thus, $\|\cdot\|_{pb}: P(X) \rightarrow \mathbb{R}^+ \cup \{0\}$, $\|A\|_{pb} = s(A) + k$ is a neutrosophic triplet b – normed space with $b = 1.1$. Where, $s(A)$ is number of elements of A and $k \in \mathbb{R}^+$ and $k \geq 1$.

Corollary 3.3: From Definition 2.5 and Definition 3.1, neutrosophic triplet partial b –normed space is generally different from neutrosophic triplet normed space since for triangle inequality.

Property 3.4: Let $((NTV, *_2, \#_2), \|\cdot\|_{pb})$ be a neutrosophic triplet partial b - normed space on $(NTF, *_1, \#_1)$ neutrosophic triplet field. Then, the function $d_{pb}: NTV \times NTV \rightarrow \mathbb{R}$ defined by $d_{pb}(x, y) = \|x *_2 \text{anti}(y)\|_{pb}$ provides neutrosophic triplet partial b - metric space conditions.

Corollary 3.5: From Property 3.4, every neutrosophic triplet partial b - normed space is a neutrosophic triplet partial b – metric space.

Definition 3.6: Let $((NTV, *_2, \#_2), \|\cdot\|_{pb})$ be a neutrosophic triplet partial b - normed space on $(NTF, *_1, \#_1)$ neutrosophic triplet field. $d_{pb}: NTV \times NTV \rightarrow \mathbb{R}$ neutrosophic triplet partial b - metric define by $d_b(x, y) = \|x *_2 \text{anti}(y)\|_b$ is called the neutrosophic triplet partial b - metric space reduced by neutrosophic triplet partial b – normed space $((NTV, *_2, \#_2), \|\cdot\|_{pb})$.

Definition 3.7: Let $((NTV, *_2, \#_2), \|\cdot\|_{pb})$ be a neutrosophic triplet partial b - normed space on $(NTF, *_1, \#_1)$ neutrosophic triplet field, $\{x_n\}$ be a sequence in this space and d_{pb} a neutrosophic triplet partial b - metric reduced by $((NTV, *_2, \#_2), \|\cdot\|_{pb})$. $\{x_n\}$ sequence converges to x, if for every $\varepsilon > 0$ there exists $M \in \mathbb{N}$ such that for all $n \geq M$ we have $d_{pb}(x, \{x_n\}) = \|x *_2 \text{anti}(x_n)\|_{pb} < \varepsilon$.
It is showed that $\lim_{n \rightarrow \infty} x_n = x$ or $x_n \rightarrow x$

Definition 3.8: Let $((NTV, *_2, \#_2), \|\cdot\|_{pb})$ be a neutrosophic triplet partial b - normed space on $(NTF, *_1, \#_1)$ neutrosophic triplet field, $\{x_n\}$ be a sequence in this space and d_{pb} be a neutrosophic triplet partial b - metric reduced by $((NTV, *_2, \#_2), \|\cdot\|_{pb})$. $\{x_n\}$ is a Cauchy sequence, if for every $\varepsilon > 0$ there exists $M \in \mathbb{N}$ such that for all $n, m \geq M$ we have $d_{pb}(x, \{x_n\}) = \|x *_2 \text{anti}(x_n)\|_{pb} < \varepsilon$.

Definition 3.9: Let $((NTV, *_2, \#_2), \|\cdot\|_{pb})$ be a neutrosophic triplet partial b - normed space on $(NTF, *_1, \#_1)$ neutrosophic triplet field, $\{x_n\}$ be a sequence in this space and d_{pb} be a neutrosophic triplet partial b - metric reduced by $((NTV, *_2, \#_2), \|\cdot\|_{pb})$. If each $\{x_n\}$ Cauchy sequence in this space is convergent, then $((NTV, *_2, \#_2), \|\cdot\|_{pb})$ is called neutrosophic triplet partial b - Banach space.

4. CONCLUSION

In this chapter, we obtained neutrosophic triplet partial b – normed space. We also show that neutrosophic triplet partial b – normed space is different from the neutrosophic triplet normed space. Thus, we have added a new structure to neutrosophic structures and we gave rise to a new field or research called neutrosophic triplet partial b – normed space. Also, thanks to neutrosophic triplet partial b – normed space researcher can obtain new structure and properties. For example, neutrosophic triplet partial b – inner product space and neutrosophic triplet partial b – Hilbert space

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