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On Neutrosophic Z-algebras

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Abstract

This study presents the notion of neutrosophic Z-algebra and neutrosophic pseudo Z-algebra explores some of its properties. Also studied are the neutrosophic Z-ideal, neutrosophic Z-sub algebra, and neutrosophic Z-filter. Several properties are discovered, and some findings from the study of homomorphism are discussed.

Keywords: Neutrosophic Z-algebra; neutrosophic pseudo Z-algebra; neutrosophic Z-sub algebra; neutrosophic Z-ideal; neutrosophic Z-filter.

1 Introduction

Smarandache established the area of philosophy known as neutrosophy, which has a many implementations in the real world and in mathematics, particularly in algebra [1].also gave more information about neutrosophy see [2,3]. making use of neutrosophic theory Kandasamy and Smarandache [4] in 2004 suggested a set-based algebraic structure of neutrosophic numbers of the type $\mathcal{N} = \mathcal{Z} + \dagger\mathcal{I}$ that they dubbed $\mathcal{I}$-Neutrosophic Algebraic Structure. ,where $\mathcal{Z}, \dagger \in \mathbb{R}$ or $\mathbb{C}$, and $\mathcal{I}$ which means indetermined or uncertain thus that $\mathcal{I}^2 = \mathcal{I}$,is referred to as literal indeterminacy, here $\mathcal{Z}$ is referred to as the $\mathcal{N}'$s determinate portion, and $\dagger\mathcal{I}$ is referred to as its indeterminate portion on $\mathcal{N}$,with $g\mathcal{I} + h\mathcal{I} = (g + h)\mathcal{I}$, $0 . \mathcal{I} = 0$. Where $\mathcal{I}$ is different from the

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imaginary $i^2 = -1$, in general, $\mathcal{I}^{j} = \mathcal{I}$ if $j > 0$, and is unknown for $j \leq 0$. In 2006, the idea of neutrosophic algebraic structures was also proposed [5].

In [6,7,8,9], the idea of neutrosophic BCI/BCK –algebras, neutrosophic KU-algebras and neutrosophic B-algebras was presented.

Z-algebra is an unique algebraic structure based on logic that was first proposed in 2017 by Chandramouleeswaran et al. [10].

[11] and [12] They provided characteristics and further explanation of Z-algebra.

In this article, we explain the idea of neutrosophic Z-algebra, look at various relevant characteristics, examine a neutrosophic Z-homomorphism, and present some findings.

2 Preliminaries

Definition 2.1: [1] A neutronsophic set $\mathcal{X}(\mathcal{I}) = \langle \mathcal{X}, \mathcal{I} \rangle = \{ƻ + ϯ\mathcal{I} : ƻ, ϯ \in \mathcal{X}\}$, where $\mathcal{X} \neq \phi$ and $\mathcal{I}$ an indeterminate .

Definition 2.2: [10] let $\mathcal{Z} \neq \phi$ and $*$ is a binary operation with constant 0 then the algebra $(\mathcal{Z}, *, 0)$ named Z-Algebra if satisfying the following axiom:

$\mathcal{Z}_1$: $ƻ * 0 = 0$
$\mathcal{Z}_2$: $0 * ƻ = ƻ$
$\mathcal{Z}_3$: $ƻ * ƻ = ƻ$
$\mathcal{Z}_4$: $ƻ * ϯ = ϯ * ƻ$ When $ƻ \neq 0$ and $ϯ \neq 0, \forall ƻ, ϯ \in \mathcal{Z}$.

Definition 2.3: [10] Let $\delta \neq \phi$ and $\delta \subseteq \mathcal{Z}$ where $(\mathcal{Z}, *, 0)$is a Z-Algebra, δ is named Z-subalgebra if $ƻ * ϯ \in \delta$, $\forall ƻ, ϯ \in \delta$.

Definition 2.4: [10] Let $\mathcal{I} \neq \phi$ and $\mathcal{I} \subseteq \mathcal{Z}$, where $(\mathcal{Z}, *, 0)$is a Z-Algebra, $\mathcal{I}$ is named

Z-ideal of $\mathcal{Z}$ if satisfy (1) $0 \in \mathcal{I}$ (2) $ƻ * ϯ \in \mathcal{I}$, and $ϯ \in \mathcal{I} \Rightarrow ƻ \in \mathcal{I}$.

Definition 2.5: [11] Let $\mathcal{I} \neq \phi$ and $\mathcal{I} \subseteq \mathcal{Z}$, where $(\mathcal{Z}, *, 0)$ is a Z-Algebra, $\mathcal{I}$ is named $Z_1 -$ ideal of $\mathcal{Z}$ if satisfy

(1) $0 \in \mathcal{I}$ (2) $((ƻ * ঌ) * ƻ) * ϯ \in \mathcal{I}$, and $ϯ \in \mathcal{I} \Rightarrow ƻ \in \mathcal{I}, \forall ƻ, ϯ, ঌ \in \mathcal{Z}$.

Definition 2.6: [11] Let $\mathcal{I} \neq \phi$ and $\mathcal{I} \subseteq \mathcal{Z}$, where $(\mathcal{Z}, *, 0)$is a Z-Algebra, $\mathcal{I}$ is named Z_2 −ideal of $\mathcal{Z}$ if satisfy

(1) $0 \in \mathcal{I}$ (2) $(ƻ * ঌ) * (ƻ * ϯ) \in \mathcal{I}$, and $ϯ \in \mathcal{I} \Rightarrow ƻ \in \mathcal{I}, \forall ƻ, ϯ, ঌ \in \mathcal{Z}$

Definition 2.7: [12] Let $\mathcal{I} \neq \phi$ and $\mathcal{I} \subseteq \mathcal{Z}$, where $(\mathcal{Z}, *, 0)$is a Z-Algebra, $\mathcal{I}$ is named Z_P −ideal of $\mathcal{Z}$ if satisfy

(1) $0 \in \mathcal{I}$ (2) $(ƻ * ঌ) * (ϯ * ঌ) \in \mathcal{I}$, and $ϯ \in \mathcal{I} \Rightarrow ƻ \in \mathcal{I}, \forall ƻ, ϯ, ঌ \in \mathcal{Z}$.

Definition 2.8: [10] let $\mathcal{F} \neq \phi$ and $\mathcal{F} \subseteq \mathcal{Z}$, where $(\mathcal{Z}, *, 0)$is a Z-Algebra, $\mathcal{F}$is named $\mathcal{Z}$-filter of $\mathcal{Z}$ if $ƻ Ϫ ϯ = ƻ * (ƻ * ϯ) \in \mathcal{F}, \forall ƻ, ϯ \in \mathcal{F}, (ƻ \neq ϯ)$.

Example 2.9: let $\mathcal{Z} = \{0, ƻ, ϯ, ঌ\}$ be set and $*$ is a binary operation defined on $\mathcal{Z}$ by the table:

$*$	**0**	ƻ	ϯ	ঌ
0	0	ƻ	ϯ	ঌ
ƻ	0	ƻ	ϯ	ϯ
ϯ	0	ϯ	ϯ	ϯ
ঌ	0	ϯ	ϯ	ঌ

Then $(\mathcal{Z},*,0)$ is Z-Algebra. $\delta = \{ꙅ, †, ϡ\}$ is Z-subalgebra and $\mathcal{I} = \{0, ꙅ, †\}$ is a Z_1 –ideal, $\mathcal{I}^{\$} = \{0, ꙅ, ϡ\}$ is a (Z_2 -ideal , Z_p –ideal) Z-ideal .and $\mathcal{F} = \{ꙅ, †\}$ is $\mathcal{Z}$-filter .

Note : every (Z_1– ideal , Z_2 –ideal) is an ideal of $\mathcal{Z}$.

Definition 2.10: [11] Let $\mathcal{Z} \neq \phi$ with two binary operations $*$,⊛ and constant 0 then the algebra $(\mathcal{Z},*,⊛,0)$ named pseudo Z-Algebra (briefly,P$\mathcal{Z}$) if satisfying the following axiom:

$P\mathcal{Z}_1$: $ꙅ * 0 = ꙅ ⊛ 0 = 0$
$P\mathcal{Z}_2$: $0 * ꙅ = 0 ⊛ ꙅ = ꙅ$
$P\mathcal{Z}_3$: $ꙅ * ꙅ = ꙅ ⊛ ꙅ = ꙅ$
$P\mathcal{Z}_4$: $ꙅ * † = † ⊛ ꙅ$ When $ꙅ \neq 0$ and $† \neq 0, \forall\ ꙅ, † \in \mathcal{Z}$.

Definition 2.11: [11] Let $\delta \neq \phi$ and $\delta \subseteq \mathcal{Z}$, where $(\mathcal{Z},*,⊛,0)$is P$\mathcal{Z}$ then δ is named a pseudo Z-subalgebra if $ꙅ * †,\ ꙅ ⊛ † \in \delta, \forall ꙅ, † \in \delta$.

Example 2.12: Let $\mathcal{Z} = \{0, ꙅ, †, ϡ\}$ be set and $*$,⊛ are a binary operations defined on $\mathcal{Z}$ by the table as follows:

*	0	ꙅ	†	ϡ	⊛	0	ꙅ	†	ϡ
0	0	ꙅ	†	ϡ	0	0	ꙅ	†	ϡ
ꙅ	0	ꙅ	ꙅ	†	ꙅ	0	ꙅ	†	ꙅ
†	0	†	†	ꙅ	†	0	ꙅ	†	ꙅ
ϡ	0	ꙅ	ꙅ	ϡ	ϡ	0	†	ꙅ	ϡ

Then $(\mathcal{Z},*,⊛,0)$ is pseudo Z-algebra , $\delta = \{ꙅ, †, ϡ\}$ is a pseudo Z-sub algebra.

3 Neutrosophic Z-algebra

Definition 3.1: A neutrosophic Z-algebra is the triple $(\mathcal{Z}(\mathcal{I}), *, (0,0\mathcal{I}))$ (briefly,$\mathcal{NZ}$) (where $(\mathcal{Z},*,0)$be a Z-algebra , $\mathcal{Z}(\mathcal{I}) = \langle \mathcal{Z}, \mathcal{I} \rangle$ a neutrosophic set)

if $(ꙅ, ƀ\mathcal{I}), (†, ч\mathcal{I})$ are any two elements of $\mathcal{Z}(\mathcal{I})$ with $ꙅ, ƀ, †, ч \in \mathcal{Z}$ satisfies

$$(ꙅ, ƀ\mathcal{I}) * (†, ч\mathcal{I}) = (ꙅ * †, (ꙅ * ч \wedge ƀ * † \wedge ƀ * ч)\mathcal{I})$$

An element $ꙅ \in \mathcal{Z}$ is represented by $(ꙅ, 0\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$,

$(ꙅ, 0\mathcal{I}) * (ƀ, 0\mathcal{I}) = (ꙅ * ƀ, 0\mathcal{I}) = (ꙅ \wedge \backsim ƀ, 0)$. where $\backsim ƀ$ is the negation of $ƀ$ in $\mathcal{Z}$

And $(ꙅ, ƀ\mathcal{I}) = (†, ч\mathcal{I}) \Leftrightarrow (ꙅ = †$ and $ƀ = ч)$

Definition 3.2: A neutrosophic pseudo Z-algebra is $(\mathcal{Z}(\mathcal{I}), *, ⊛, (0,0\mathcal{I}))$ (briefly,$\mathcal{N}$P$\mathcal{Z}$) (where $(\mathcal{Z},*,⊛,0)$be a pseudo Z-algebra

If $(ꙅ, ƀ\mathcal{I}), (†, ч\mathcal{I})$ are any two elements of $\mathcal{Z}(\mathcal{I})$ with $x, ƀ, †, ч \in \mathcal{Z}$ satisfies

$$(ꙅ, ƀ\mathcal{I}) * (†, ч\mathcal{I}) = (ꙅ * †, (ꙅ * ч \wedge ƀ * † \wedge ƀ * ч)\mathcal{I})$$

$$(†, ч\mathcal{I}) ⊛ (ꙅ, ƀ\mathcal{I}) = († ⊛ ꙅ, (ꙅ ⊛ ч \wedge ƀ ⊛ † \wedge ƀ ⊛ ч)\mathcal{I})$$

Where $(ꙅ, ƀ\mathcal{I}) * (†, ч\mathcal{I}) = (ꙅ, ƀ\mathcal{I}) ⊛ (†, ч\mathcal{I})$
When$(ꙅ, ƀ\mathcal{I}) \neq (0,0\mathcal{I})$ and $(†, ч\mathcal{I}) \neq (0,0\mathcal{I}), \forall (ꙅ, ƀ\mathcal{I}), (†, ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

Theorem 3.3: Every $\mathcal{NZ}$ $(\mathcal{Z}(\mathcal{I}), *, (0,0\mathcal{I}))$ with condition $(0,0\mathcal{I}) * (ꙅ, ƀ\mathcal{I}) = (ꙅ, ƀ\mathcal{I})$ is a $\mathcal{Z}$ –algebra and conversely, not.

Proof: let $\left(\mathcal{X}(\mathcal{I}),*,(0,0\mathcal{I})\right)$ is $\mathcal{NZ}$

Let $\mathscr{r} = (Ƨ\,,ƀ\mathcal{I})\ and\ 0 = (0,0\mathcal{I})$

$\mathcal{Z}_1: \mathscr{r} * 0 = (Ƨ\,,ƀ\mathcal{I}) * (0,0\mathcal{I}) = (Ƨ * 0, (Ƨ * 0 \wedge ƀ * 0)\mathcal{I}) = (0,(0 \wedge 0)\mathcal{I}) = (0,0\mathcal{I})$
$\mathcal{Z}_2:\ 0 * \mathscr{r} = (0,0\mathcal{I}) * (Ƨ\,,ƀ\mathcal{I}) = (0 * Ƨ, (0 * ƀ \wedge 0 * Ƨ)\mathcal{I}) = (Ƨ, (ƀ \wedge Ƨ)\mathcal{I}) = (Ƨ, ƀ\,\mathcal{I})$
$\mathcal{Z}_3:\ \mathscr{r} * \mathscr{r} = (Ƨ\,,ƀ\mathcal{I}) * (Ƨ\,,ƀ\mathcal{I}) = (Ƨ * Ƨ, (Ƨ * ƀ \wedge ƀ * Ƨ \wedge ƀ * ƀ)\mathcal{I})$
$= (Ƨ, (Ƨ \wedge\backsim ƀ \wedge ƀ \wedge\backsim Ƨ \wedge ƀ)\mathcal{I})$
$= (Ƨ\,,ƀ\mathcal{I})$
$\mathcal{Z}_4: if\ \ \mathscr{r} * \mathscr{s} = \mathscr{s} * \mathscr{r}$, when $\mathscr{r} \neq 0\ \ \&\ \ \mathscr{s} \neq 0, \forall\ \mathscr{r}, \mathscr{s} \in \mathcal{Z}(\mathcal{I})$

$let\ \ \mathscr{r} = (Ƨ\,,ƀ\mathcal{I}), \mathscr{s} = (ϯ\,,Ч\mathcal{I})$,

$(Ƨ\,,ƀ\mathcal{I}) * (ϯ\,,Ч\mathcal{I}) = (ϯ\,,Ч\mathcal{I}) * (Ƨ\,,ƀ\mathcal{I})$

$(Ƨ * ϯ, (Ƨ * Ч \wedge ƀ * ϯ \wedge ƀ * Ч)\mathcal{I}) = (ϯ * Ƨ, (ϯ * ƀ \wedge Ч * Ƨ \wedge Ч * ƀ)\mathcal{I})$

Suppose $(Ƨ, ƀ\,\mathcal{I}) \neq (0,0\mathcal{I})\ \&\ (ϯ, Ч\mathcal{I}) \neq (0,0\mathcal{I})$ we get

$0 * ϯ = ϯ * 0 \quad \Rightarrow ϯ = 0$

and $\ 0 * Ч \wedge 0 * 0 = 0 * 0 \wedge Ч * 0 \ \Rightarrow\ Ч = 0$

We get a contradiction.

Then $\left(\mathcal{Z}(\mathcal{I}),*,(0,0\mathcal{I})\right)$ is a Z-algebra.

Theorem 3.4: Every $\mathcal{N}\mathrm{P}\mathcal{Z}$, $(\mathcal{Z}(\mathcal{I}),*,\circledast,(0,0\mathcal{I}))$ with condition$(0,0\mathcal{I}) * (Ƨ\,,ƀ\mathcal{I}) = (Ƨ\,,ƀ\mathcal{I}), (0,0\mathcal{I}) \circledast (Ƨ\,,ƀ\mathcal{I}) = (Ƨ\,,ƀ\mathcal{I})$ is a pseudo $\mathcal{Z}$ -algebra and conversely, not.

Proof: it is easy as above.

Definition 3.5: Let $\mathfrak{S}(\mathcal{I}) \neq \phi$ and $\mathfrak{S}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $\left(\mathcal{Z}(\mathcal{I}),*,(0,0\mathcal{I})\right)$ is $\mathcal{NZ}$,$\mathfrak{S}(\mathcal{I})$ is named a neutrosophic Z-subalgebra (briefly, $\mathcal{NZ}^{\mathscr{s}}$) of $\mathcal{Z}(\mathcal{I})$ if

1) $(0,0\mathcal{I}) \in \mathfrak{S}(\mathcal{I})$
2) $(Ƨ\,,ƀ\mathcal{I}) * (ϯ\,,Ч\mathcal{I}) \in \mathfrak{S}(\mathcal{I}), \forall (Ƨ\,,ƀ\mathcal{I}), (ϯ\,,Ч\mathcal{I}) \in \mathfrak{S}(\mathcal{I})$
3) $\mathfrak{S}(\mathcal{I})$Contains a proper sub set which a Z-algebra.

Definition 3.6: Let $\mathfrak{S}(\mathcal{I}) \neq \phi$ and $\mathfrak{S}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $(\mathcal{Z}(\mathcal{I}),*,\circledast,(0,0\mathcal{I})$is $\mathcal{N}\mathrm{P}\mathcal{Z}$, $\mathfrak{S}(\mathcal{I})$ is called a neutrosophic pseudo Z-subalgebra (briefly, $\mathcal{N}\mathrm{P}\mathcal{Z}^{\mathscr{s}}$) of $\mathcal{Z}(\mathcal{I})$ if

1) $(0,0\mathcal{I}) \in \mathfrak{S}(\mathcal{I})$
2) $(Ƨ\,,ƀ\mathcal{I}) * (ϯ\,,Ч\mathcal{I}) \in \mathfrak{S}(\mathcal{I})\ \&\ (Ƨ\,,ƀ\mathcal{I}) \circledast (ϯ\,,Ч\mathcal{I}) \in \mathfrak{S}(\mathcal{I}), \forall (Ƨ\,,ƀ\mathcal{I}), (ϯ\,,Ч\mathcal{I}) \in \mathfrak{S}(\mathcal{I})$
3) $\mathfrak{S}(\mathcal{I})$Contains a proper sub set which a pseudo Z-algebra.

Theorem 3.7: If $\mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I}) \neq \phi$ and $\mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$ for $\omega \neq 0$, $\left(\mathcal{Z}(\mathcal{I}),*,(0,0\mathcal{I})\right)$ is $\mathcal{NZ}$ **,**where $\mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I}) = \{(Ƨ\,,ƀ\mathcal{I}) \in \mathcal{Z}(\mathcal{I}): (Ƨ\,,ƀ\mathcal{I}) * (\omega, \omega\mathcal{I}) = (\omega, \omega\mathcal{I})\}$

Then 1) $\mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I})$ is $\mathcal{NZ}^{\mathscr{s}}$.
2) $\mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I}) \subseteq \mathcal{A}_{(0,0I)}(\mathcal{I})$.

Proof: 1) clearly $(0,0\mathcal{I}) \in \mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I})$

$\mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I})$ contain a proper sub set which a Z-algebra.

Let $(ƻ, ƅ\mathcal{I}), (\dagger, Ч\mathcal{I}) \in \mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I}) \Rightarrow$
$(ƻ, ƅ\mathcal{I}) * (\omega, \omega\mathcal{I}) = (\omega, \omega\mathcal{I})$, $(\dagger, Ч\mathcal{I}) * (\omega, \omega\mathcal{I}) = (\omega, \omega\mathcal{I}) \Rightarrow$

$ƻ * \omega = \omega$, $ƻ * \omega \wedge ƅ * \omega = \omega$ & $\dagger * \omega = \omega$, $\dagger * \omega \wedge Ч * \omega = \omega$ since $\omega \neq 0 \Rightarrow$
$ƻ = ƅ = \dagger = Ч = \omega$

$[(ƻ, ƅ\mathcal{I}) * (\dagger, Ч\mathcal{I})] * (\omega, \omega\mathcal{I}) = [ƻ * \dagger, (ƻ * Ч \wedge ƅ * \dagger)\mathcal{I}] * (\omega, \omega\mathcal{I})$
$= [(ƻ * \dagger) * \omega, ((ƻ * \dagger) * \omega \wedge (ƻ * Ч \wedge ƅ * \dagger) * \omega)\mathcal{I}]$
$= [\omega * \omega, (\omega * \omega \wedge \omega * \omega)\mathcal{I}]$
$= (\omega, \omega\mathcal{I})$

This shows that $(ƻ, ƅ\mathcal{I}) * (\dagger, Ч\mathcal{I}) \in \mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I})$
Then $\mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I})$ is $\mathcal{NZ}^{s}$.
(2) it's easy.

Theorem 3.8: If $\mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I}) \neq \phi$ and $\mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, for $\omega \neq 0$,

$(\mathcal{Z}(\mathcal{I}), *, \circledast, (0,0\mathcal{I})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$**,** where $\mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I}) = \{(ƻ, ƅ\mathcal{I}) \in \mathcal{Z}(\mathcal{I}): (ƻ, ƅ\mathcal{I}) * (\omega, \omega\mathcal{I}) = (\omega, \omega\mathcal{I})$ & $(ƻ, ƅ\mathcal{I}) \circledast$ $\omega, \omega\mathcal{I} = \omega, \omega\mathcal{I}$

Then 1) $\mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$.
2) $\mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I}) \subseteq \mathcal{A}_{(0,0\mathcal{I})}(\mathcal{I})$.

Proof: it is easy as above.

Theorem 3.9: If $\mathcal{Z}_{\xi}(\mathcal{I}) \neq \phi$ and $\mathcal{Z}_{\xi}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $(\mathcal{Z}(\mathcal{I}), *, (0,0\mathcal{I}))$ is $\mathcal{NZ}$ **,** where
$\mathcal{Z}_{\xi}(\mathcal{I}) = \{(ƻ, ƻ\mathcal{I}): ƻ \in \mathcal{Z}\}$ Then $\mathcal{Z}_{\xi}(\mathcal{I})$is a $\mathcal{NZ}^{s}$ of $\mathcal{Z}(\mathcal{I})$.

Proof: clearly $(0,0\mathcal{I}) \in \mathcal{Z}_{\xi}(\mathcal{I})$ and the third condition is satisfied for $\mathcal{Z}_{\xi}(\mathcal{I})$

Let $(\dagger, \dagger\mathcal{I}), (ƅ, ƅ\mathcal{I}) \in \mathcal{Z}_{\xi}(\mathcal{I})$, $\dagger, ƅ \in \mathcal{Z} \Rightarrow$

$(\dagger, \dagger\mathcal{I}) * (ƅ, ƅ\mathcal{I}) = (\dagger * ƅ, (\dagger * ƅ)\mathcal{I})$

This shows that $(\dagger, \dagger\mathcal{I}) * (ƅ, ƅ\mathcal{I}) \in \mathcal{Z}_{\xi}(\mathcal{I})$

Then $\mathcal{Z}_{\xi}(\mathcal{I})$is a $\mathcal{NZ}^{s}$ of $\mathcal{Z}(\mathcal{I})$.

Theorem 3.10: If $\mathcal{Z}_{\xi}(\mathcal{I}) \neq \phi$ and $\mathcal{Z}_{\xi}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$,$(\mathcal{Z}(\mathcal{I}), *, \circledast, (0,0\mathcal{I})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$ **,** where

$\mathcal{Z}_{\xi}(\mathcal{I}) = \{(ƻ, ƻ\mathcal{I}): ƻ \in \mathcal{Z}\}$ Then $\mathcal{Z}_{\xi}(\mathcal{I})$is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$ of $\mathcal{Z}(\mathcal{I})$.

Proof: it is easy as above.

Example 3.11: Let $*$ is a binary operation defined on $\mathcal{Z}_{\xi}(\mathcal{I}) = \{(0,0\mathcal{I}), (ƻ, ƻ\mathcal{I}), (\dagger, \dagger\mathcal{I}), (ৎ, ৎ\mathcal{I})\}$ as follows:

$*$	$(0,0\mathcal{I})$	$(ƻ, ƻ\mathcal{I})$	$(\dagger, \dagger\mathcal{I})$	$(ৎ, ৎ\mathcal{I})$
$(0,0\mathcal{I})$	$(0,0\mathcal{I})$	$(ƻ, ƻ\mathcal{I})$	$(\dagger, \dagger\mathcal{I})$	$(ৎ, ৎ\mathcal{I})$
$(ƻ, ƻ\mathcal{I})$	$(0,0\mathcal{I})$	$(ƻ, ƻ\mathcal{I})$	$(0,0\mathcal{I})$	$(ƻ, ƻ\mathcal{I})$
$(\dagger, \dagger\mathcal{I})$	$(0,0\mathcal{I})$	$(0,0\mathcal{I})$	$(\dagger, \dagger\mathcal{I})$	$(\dagger, \dagger\mathcal{I})$
$(ৎ, ৎ\mathcal{I})$	$(0,0\mathcal{I})$	$(ƻ, ƻ\mathcal{I})$	$(\dagger, \dagger\mathcal{I})$	$(ৎ, ৎ\mathcal{I})$

Then $(\mathcal{Z}_{\xi}(\mathcal{I}), *, (0,0\mathcal{I}))$ is a $\mathcal{NZ}^{s}$ of $\mathcal{Z}(\mathcal{I})$

Theorem 3.12: Let $\{\mathcal{A}(\mathcal{I})_{\gamma}: \gamma \in \mathcal{S}\}$ and $\mathcal{A}(\mathcal{I})_{\gamma} \neq \phi$ be a collection of $\mathcal{NZ}^{s}$ of $\mathcal{Z}(\mathcal{I})$ if

$$\bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \neq \{(0,0\mathcal{J})\} \quad\Rightarrow\quad \bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \; is \text{ a } \mathcal{NZ}^{s}\ of\ \mathcal{Z}(\mathcal{J}).$$

Proof: since $(0,0\mathcal{J}) \in \mathcal{A}(\mathcal{J})_\gamma, \forall\, \gamma \in \mathcal{S} \;\Rightarrow$

$$(0,0\mathcal{J}) \in \bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \Rightarrow \bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \neq \phi$$

And the third condition was achieved for $\mathcal{A}(\mathcal{J})_\gamma, \forall\, \gamma \in \mathcal{S} \Rightarrow$

The third condition was achieved for $\bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma$

$$\bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \neq \{(0,0\mathcal{J})\} \quad \Rightarrow \exists\, (\text{Ƨ}, \text{ƅ}\mathcal{J}) \in \bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \Rightarrow (\text{Ƨ}, \text{ƅ}\mathcal{J}) \neq (0,0\mathcal{J}) \Rightarrow$$

$$\{(0,0\mathcal{J})\} \subseteq \bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma, \text{which is a Z} - \text{algebra}$$

Let $(\text{Ƨ}, \text{ƅ}\mathcal{J}), (\dagger, \text{Ч}\mathcal{J}) \in \bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \Rightarrow (\text{Ƨ}, \text{ƅ}\mathcal{J}), (\dagger, \text{Ч}\mathcal{J}) \in \mathcal{A}(\mathcal{J})_\gamma, \forall\, \gamma \in \mathcal{S}$

Since $\mathcal{A}(\mathcal{J})_\gamma$ is a $\mathcal{NZ}^{s}, \forall\, \gamma \in \mathcal{S}$ of $\mathcal{Z}(\mathcal{J})$ then

$$(\text{Ƨ}, \text{ƅ}\mathcal{J}) * (\dagger, \text{Ч}\mathcal{J}) \in \mathcal{A}(\mathcal{J})_\gamma, \forall\, \gamma \in \mathcal{S}, \Rightarrow (\text{Ƨ}, \text{ƅ}\mathcal{J}) * (\dagger, \text{Ч}\mathcal{J}) \in \bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma$$

hence $\bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma$ is a $\mathcal{NZ}^{s}$ of $\mathcal{Z}(\mathcal{J})$.

Theorem 3.13: Let $\{\mathcal{A}(\mathcal{J})_\gamma : \gamma \in \mathcal{S}\}$ and $\mathcal{A}(\mathcal{J})_\gamma \neq \phi$ be a collection of $\mathcal{N}\text{P}\mathcal{Z}^{s}\ of\ (\mathcal{Z}(\mathcal{J}), *, \circledast, (0,0\mathcal{J})$ is $\mathcal{N}\text{P}\mathcal{Z}$ if

$$\bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \neq \{(0,0\mathcal{J})\} \quad\Rightarrow\quad \bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \; is \text{ a } \mathcal{N}\text{P}\mathcal{Z}^{s}\ of\ \mathcal{Z}(\mathcal{J}).$$

Proof: it is easy as above.

Theorem 3.14: Let $\{\mathcal{A}(\mathcal{J})_\gamma : \gamma \in \mathcal{S}\}$ and $\mathcal{A}(\mathcal{J})_\gamma \neq \phi$ be a collection of $\mathcal{NZ}^{s}$ of $\mathcal{Z}(\mathcal{J})$ if $\mathcal{A}(\mathcal{J})_1 \subseteq \mathcal{A}(\mathcal{J})_2 \subseteq \cdots$ then

$$\bigcup_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \text{ is a } \mathcal{NZ}^{s} \text{ of } \mathcal{Z}(\mathcal{J}).$$

Proof: obviously $(0,0\mathcal{J}) \in \bigcup_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma \neq \Phi \Rightarrow \exists\, (\text{Ƨ}, \text{ƅ}\mathcal{J}), (\dagger, \text{Ч}\mathcal{J}) \in \bigcup_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma$

$\Rightarrow$ For some $\gamma \in \mathcal{S}\ (\text{Ƨ}, \text{ƅ}\mathcal{J}), (\dagger, \text{Ч}\mathcal{J}) \in \mathcal{A}(\mathcal{J})_\gamma\ and\ (\text{Ƨ}, \text{ƅ}\mathcal{J}) * (\dagger, \text{Ч}\mathcal{J}) \in \mathcal{A}(\mathcal{J})_{\gamma\in\mathcal{S}}$

$$\Rightarrow (\text{Ƨ}, \text{ƅ}\mathcal{J}) * (\dagger, \text{Ч}\mathcal{J}) \in \bigcup_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma$$

Let $\mathfrak{S}(\mathcal{J})_\gamma$ be aproper sub set of $\mathcal{A}(\mathcal{J})_\gamma$, for some $\gamma \in \mathcal{S}$ which a Z- algebra,
then for any $\gamma \in \mathcal{S}, \mathfrak{S}(\mathcal{J})_\gamma \in \bigcup_{\gamma\in\mathcal{S}} \mathcal{A}(\mathcal{J})_\gamma$ then

$$\bigcup_{\gamma\in\mathcal{S}} \mathcal{A}(\mathcal{J})_{\gamma\in\mathcal{S}} \text{ is } \mathcal{NZ}^{s} \text{ of } \mathcal{Z}(\mathcal{J}).$$

Theorem 3.15: Let $\{\mathcal{A}(\mathcal{J})_\gamma : \gamma \in \mathcal{S}\}$ and $\mathcal{A}(\mathcal{J})_\gamma \neq \phi$ be a collection of $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$ *of* $(\mathcal{Z}(\mathcal{J}),*,\circledast,(0,0\mathcal{J})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$ if $\mathcal{A}(\mathcal{J})_1 \subseteq \mathcal{A}(\mathcal{J})_2 \subseteq \cdots$ then

$$\bigcup_{\gamma\in\mathcal{S}} \mathcal{A}(\mathcal{J})_\gamma \text{ is } \mathcal{N}\mathrm{P}\mathcal{Z}^{s} \text{ of } \mathcal{Z}(\mathcal{J}).$$

Proof: it is easy as above.

Definition 3.16: Let $\mathcal{D}(\mathcal{J}) \neq \phi$ and $\mathcal{D}(\mathcal{J}) \subseteq \mathcal{Z}(\mathcal{J})$, $(\mathcal{Z}(\mathcal{J}),*,(0,0\mathcal{J}))$ is $\mathcal{NZ}$, $\mathcal{D}(\mathcal{J})$ is named a neutrosophic Z-ideal (briefly, $\mathcal{NZ}^{i}$) of $\mathcal{Z}(\mathcal{J})$ if :

1) $(0,0\mathcal{J}) \in \mathcal{D}(\mathcal{J})$
2) If $(ϩ,ƀ\mathcal{J}) * (†,Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J})$, and $(†,Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J}) \Rightarrow (ϩ,ƀ\mathcal{J}) \in \mathcal{D}(\mathcal{J})$

Remark 3.17: Let $\mathcal{D}(\mathcal{J})$ is a $\mathcal{NZ}^{i}$ of $\mathcal{Z}(\mathcal{J})$ if

$(†,Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J})$ and $(ϩ,ƀ\mathcal{J}) * (†,Ч\mathcal{J}) = (0,0\mathcal{J})$ then $(ϩ,ƀ\mathcal{J}) \in \mathcal{D}(\mathcal{J})$.

Proof: let $(†,Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J})$ and $(ϩ,ƀ\mathcal{J}) * (†,Ч\mathcal{J}) = (0,0\mathcal{J}) \Rightarrow$

$(†,Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J})$ *and* $(0,0\mathcal{J}) \in \mathcal{D}(\mathcal{J}), (ϩ,ƀ\mathcal{J}) * (†,Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J})$

Since $\mathcal{D}(\mathcal{J})$ is a $\mathcal{NZ}^{i}$ $\Rightarrow (ϩ,ƀ\mathcal{J}) \in \mathcal{D}(\mathcal{J})$.

Definition 3.18: Let $\mathcal{D}(\mathcal{J}) \neq \phi$ and $\mathcal{D}(\mathcal{J}) \subseteq \mathcal{Z}(\mathcal{J})$,$(\mathcal{Z}(\mathcal{J}),*,\circledast,(0,0\mathcal{J})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$,$\mathcal{D}(\mathcal{J})$ is named a neutrosophic pseudo Z-ideal (briefly, $\mathcal{N}\mathrm{P}\mathcal{Z}^{i}$) of $\mathcal{Z}(\mathcal{J})$ if :

1) $(0,0\mathcal{J}) \in \mathcal{D}(\mathcal{J})$.
2) If $(ϩ,ƀ\mathcal{J}) * (†,Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J})$, and $(†,Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J}) \Rightarrow (ϩ,ƀ\mathcal{J}) \in \mathcal{D}(\mathcal{J})$

And $(ϩ,ƀ\mathcal{J}) \circledast (†,Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J})$, and $(†,Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J}) \Rightarrow (ϩ,ƀ\mathcal{J}) \in \mathcal{D}(\mathcal{J})$.

Definition 3.19: Let $\mathcal{D}(\mathcal{J}) \neq \phi$ and $\mathcal{D}(\mathcal{J}) \subseteq \mathcal{Z}(\mathcal{J})$, $(\mathcal{Z}(\mathcal{J}),*,(0,0\mathcal{J}))$ is $\mathcal{NZ}$, $\mathcal{D}(\mathcal{J})$ is named a neutrosophic Z_1-ideal (briefly, $\mathcal{NZ}^{i1}$) of $\mathcal{Z}(\mathcal{J})$ if :

1) $(0,0\mathcal{J}) \in \mathcal{D}(\mathcal{J})$
2) If $[((ϩ,ƀ\mathcal{J}) * (ϡ,ω\mathcal{J})) * (ϩ,ƀ\mathcal{J})] * (†,Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J})$, and $(†,Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J}) \Rightarrow (ϩ,ƀ\mathcal{J}) \in \mathcal{D}(\mathcal{J}), \forall (ϩ,ƀ\mathcal{J}), (ϡ,ω\mathcal{J}), (†,Ч\mathcal{J}) \in \mathcal{Z}(\mathcal{J})$

Definition 3.20: Let $\mathcal{D}(\mathcal{J}) \neq \phi$ and $\mathcal{D}(\mathcal{J}) \subseteq \mathcal{Z}(\mathcal{J})$,$(\mathcal{Z}(\mathcal{J}),*,\circledast,(0,0\mathcal{J})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$,$\mathcal{D}(\mathcal{J})$ is named a neutrosophic pseudo Z_1-ideal (briefly, $\mathcal{N}\mathrm{P}\mathcal{Z}^{i1}$) of $\mathcal{Z}(\mathcal{J})$ if :

1) $(0,0\mathcal{J}) \in \mathcal{D}(\mathcal{J})$
2) $[((ϩ,ƀ\mathcal{J}) * (ϡ,ω\mathcal{J})) * (ϩ,ƀ\mathcal{J})] * (†,Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J})$, and $(†,Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J}) \Rightarrow (ϩ,ƀ\mathcal{J}) \in \mathcal{D}(\mathcal{J}), \forall (ϩ,ƀ\mathcal{J}), (ϡ,ω\mathcal{J}), (†,Ч\mathcal{J}) \in \mathcal{Z}(\mathcal{J})$

And$\left[\left((Ƨ, ƅ\mathcal{I}) \circledast (ϡ, ɷ\mathcal{I})\right) \circledast (Ƨ, ƅ\mathcal{I})\right] \circledast (†, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I})$, and $(†, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ƅ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ƅ\mathcal{I}), (ϡ, ɷ\mathcal{I}), (†, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

Definition 3.21: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $\left(\mathcal{Z}(\mathcal{I}),*,(0,0\mathcal{I})\right)$ is $\mathcal{NZ}$, $\mathcal{D}(\mathcal{I})$ is named a neutrosophic Z_2-ideal (briefly, $\mathcal{NZ}^{i2}$) of $\mathcal{Z}(\mathcal{I})$ if :

1) $(0,0\mathcal{I}) \in \mathcal{D}(\mathcal{I})$
2) If $[(Ƨ, ƅ\mathcal{I}) * (ϡ, ɷ\mathcal{I})] * [(Ƨ, ƅ\mathcal{I}) * (†, Ч\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(†, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ƅ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ƅ\mathcal{I}), (ϡ, ɷ\mathcal{I}), (†, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$.

Definition 3.22: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $(\mathcal{Z}(\mathcal{I}),*,\circledast,(0,0\mathcal{I})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$, $\mathcal{D}(\mathcal{I})$ is named a neutrosophic pseudo Z_2-ideal (briefly, $\mathcal{N}\mathrm{P}\mathcal{Z}^{i2}$) of $\mathcal{Z}(\mathcal{I})$ if :

1) $(0,0\mathcal{I}) \in \mathcal{D}(\mathcal{I})$
2) If $[(Ƨ, ƅ\mathcal{I}) * (ϡ, ɷ\mathcal{I})] * [(Ƨ, ƅ\mathcal{I}) * (†, Ч\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(†, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ƅ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ƅ\mathcal{I}), (ϡ, ɷ\mathcal{I}), (†, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

And $[(Ƨ, ƅ\mathcal{I}) \circledast (ϡ, ɷ\mathcal{I})] \circledast [(Ƨ, ƅ\mathcal{I}) \circledast (†, Ч\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(†, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ƅ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ƅ\mathcal{I}), (ϡ, ɷ\mathcal{I}), (†, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$.

Definition 3.23: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $\left(\mathcal{Z}(\mathcal{I}),*,(0,0\mathcal{I})\right)$ is $\mathcal{NZ}$, $\mathcal{D}(\mathcal{I})$ is named a neutrosophic Z_q-ideal (briefly, $\mathcal{NZ}^{iq}$) of $\mathcal{Z}(\mathcal{I})$ if :

1) $(0,0\mathcal{I}) \in \mathcal{D}(\mathcal{I})$
2) If $[(Ƨ, ƅ\mathcal{I}) * (ϡ, ɷ\mathcal{I})] * [(†, Ч\mathcal{I}) * (ϡ, ɷ\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(†, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ƅ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ƅ\mathcal{I}), (ϡ, ɷ\mathcal{I}), (†, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

Definition 3.24: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $(\mathcal{Z}(\mathcal{I}),*,\circledast,(0,0\mathcal{I})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$, $\mathcal{D}(\mathcal{I})$ is named a neutrosophic pseudo Z_q ideal (briefly, $\mathcal{N}\mathrm{P}\mathcal{Z}^{iq}$) of $\mathcal{Z}(\mathcal{I})$ if :

1) $(0,0\mathcal{I}) \in \mathcal{D}(\mathcal{I})$
2) If $[(Ƨ, ƅ\mathcal{I}) * (ϡ, ɷ\mathcal{I})] * [(†, Ч\mathcal{I}) * (ϡ, ɷ\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(†, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ƅ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ƅ\mathcal{I}), (ϡ, ɷ\mathcal{I}), (†, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

And $[(Ƨ, ƅ\mathcal{I}) \circledast (ϡ, ɷ\mathcal{I})] \circledast [(†, Ч\mathcal{I}) \circledast (ϡ, ɷ\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(†, Ч\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ƅ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ƅ\mathcal{I}), (ϡ, ɷ\mathcal{I}), (†, Ч\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

Definition 3.25: Let $\mathcal{D}_\xi(\mathcal{I}) \neq \phi$ and $\mathcal{D}_\xi(\mathcal{I}) \subseteq \mathcal{Z}_\xi(\mathcal{I})$, $\mathcal{D}_\xi(\mathcal{I})$ is named a neutrosophic Z-ideal (briefly, $\mathcal{NZ}^{\xi i}$) of $\mathcal{Z}_\xi$(I) if :

1) $(0,0\mathcal{I}) \in \mathcal{D}_\xi(\mathcal{I})$
2) If $(Ƨ, Ƨ\mathcal{I}) * [(†, †\mathcal{I}) * (ϡ, ϡ\mathcal{I})] \in \mathcal{D}_\xi(\mathcal{I})$, and $(†, †\mathcal{I}) \in \mathcal{D}_\xi(\mathcal{I})$
$\Rightarrow (Ƨ, Ƨ\mathcal{I}) * (ϡ, ϡ\mathcal{I}) \in \mathcal{D}_\xi(\mathcal{I}), \ \forall\, (Ƨ, Ƨ\mathcal{I}), (†, †\mathcal{I}), (ϡ, ϡ\mathcal{I})\, \mathcal{D}_\xi(\mathcal{I})$

Theorem 3.26: Every $\mathcal{NZ}^{\xi i}$ of $\mathcal{X}_\xi(\mathcal{I})$ is a $\mathcal{NZ}^{i}$ of $\mathcal{X}_\xi(\mathcal{I})$.

Proof: suppose that $(Ƨ, Ƨ\mathcal{I}) = (0,0\mathcal{I})$ in 2 $\Rightarrow$ it's proofed. .

Definition 3.27: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $\left(\mathcal{Z}(\mathcal{I}),*,(0,0\mathcal{I})\right)$ is $\mathcal{NZ}$,$\mathcal{D}(\mathcal{I})$ is named a neutrosophic Z-filter (briefly, $\mathcal{NZ}^{f}$) of $\mathcal{Z}(\mathcal{I})$if :

1) $(0,0\mathcal{I}) \notin \mathcal{D}(\mathcal{I})$
2) $\forall (\text{Ƨ}, \text{ƀ}\mathcal{I}), (\dagger, \text{Ч}\mathcal{I}) \in \mathcal{D}(\mathcal{I})$and $(\text{Ƨ}, \text{ƀ}\mathcal{I}) \neq (\dagger, \text{Ч}\mathcal{I}) \Rightarrow$
   $(\text{Ƨ}, \text{ƀ}\mathcal{I})\bar{X}(\dagger, \text{Ч}\mathcal{I}) = (\text{Ƨ}, \text{ƀ}\mathcal{I}) * [(\text{Ƨ}, \text{ƀ}\mathcal{I}) * (\dagger, \text{Ч}\mathcal{I})] \in \mathcal{D}(\mathcal{I})$

Definition 3.28: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$,$(\mathcal{Z}(\mathcal{I}),*,\circledast,(0,0\mathcal{I})$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$,$\mathcal{D}(\mathcal{I})$ is named a neutrosophic pseudo Z-filter (briefly, $\mathcal{N}\mathrm{P}\mathcal{Z}^f$) of $\mathcal{Z}(\mathcal{I})$if :

1) $(0,0\mathcal{I}) \notin \mathcal{D}(\mathcal{I})$
2) $\forall (\text{Ƨ}, \text{ƀ}\mathcal{I}), (\dagger, \text{Ч}\mathcal{I}) \in \mathcal{D}(\mathcal{I})$and $(\text{Ƨ}, \text{ƀ}\mathcal{I}) \neq (\dagger, \text{Ч}\mathcal{I}) \Rightarrow$
   $(\text{Ƨ}, \text{ƀ}\mathcal{I})\bar{X}(\dagger, \text{Ч}\mathcal{I}) = (\text{Ƨ}, \text{ƀ}\mathcal{I}) * [(\text{Ƨ}, \text{ƀ}\mathcal{I}) * (\dagger, \text{Ч}\mathcal{I})] \in \mathcal{D}(\mathcal{I})$

And $\forall (\text{Ƨ}, \text{ƀ}\mathcal{I}), (\dagger, \text{Ч}\mathcal{I}) \in \mathcal{D}(\mathcal{I})$and $(\text{Ƨ}, \text{ƀ}\mathcal{I}) \neq (\dagger, \text{Ч}\mathcal{I}) \Rightarrow$
$(\text{Ƨ}, \text{ƀ}\mathcal{I})\bar{X}(\dagger, \text{Ч}\mathcal{I}) = (\text{Ƨ}, \text{ƀ}\mathcal{I}) \circledast [(\text{Ƨ}, \text{ƀ}\mathcal{I}) \circledast (\dagger, \text{Ч}\mathcal{I})] \in \mathcal{D}(\mathcal{I})$

Definition 3.29: If $(\mathcal{Z}(\mathcal{I}),*,(0,0\mathcal{I}))$ & $\left(\acute{\mathcal{Z}}(\mathcal{I}),\acute{*},(\acute{0},\acute{0}\mathcal{I})\right)$ be two $\mathcal{N}\mathcal{Z}$, a mapping $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$is named a neutrosophic Z- homomorphism (briefly, $\mathcal{N}\mathcal{Z}^{\hbar}$) if satisfied

1) $f[(\text{Ƨ}, \text{ƀ}\mathcal{I}) * (\dagger, \text{Ч}\mathcal{I})] = f(\text{Ƨ}, \text{ƀ}\mathcal{I}) \acute{*} f(\dagger, \text{Ч}\mathcal{I}), \forall(\text{Ƨ}, \text{ƀ}\mathcal{I}), (\dagger, \text{Ч}\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$
2) $f(0,0\mathcal{I}) = (\acute{0}, \acute{0}\mathcal{I})$
3) If f is 1-1 $\Rightarrow f$ is named a neutrosophic Z- monomorphism.
4) If f is onto $\Rightarrow f$ is named a neutrosophic Z- epimorphism.
5) If f is 1-1 and onto $\Rightarrow f$ is named a neutrosophic Z-isomorphism.

Definition 3.30: If $(\mathcal{Z}(\mathcal{I}),*,\circledast,(0,0\mathcal{I}))$ & $\left(\acute{\mathcal{Z}}(\mathcal{I}),\acute{*},\acute{\circledast},(\acute{0},\acute{0}\mathcal{I})\right)$ be two $\mathcal{N}\mathrm{P}\mathcal{Z}$, a mapping $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$is named a neutrosophic pseudo Z- homomorphism (briefly, $\mathcal{N}\mathrm{P}\mathcal{Z}^{\hbar}$) if satisfied

1) $f[(\text{Ƨ}, \text{ƀ}\mathcal{I}) * (\dagger, \text{Ч}\mathcal{I})] = f(\text{Ƨ}, \text{ƀ}\mathcal{I}) \acute{*} f(\dagger, \text{Ч}\mathcal{I}), \forall(\text{Ƨ}, \text{ƀ}\mathcal{I}), (\dagger, \text{Ч}\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$
2) $f[(\text{Ƨ}, \text{ƀ}\mathcal{I}) \circledast (\dagger, \text{Ч}\mathcal{I})] = f(\text{Ƨ}, \text{ƀ}\mathcal{I}) \acute{\circledast} f(\dagger, \text{Ч}\mathcal{I}), \forall(\text{Ƨ}, \text{ƀ}\mathcal{I}), (\dagger, \text{Ч}\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$
3) $f(0,0\mathcal{I}) = (\acute{0}, \acute{0}\mathcal{I})$
4) If f is 1-1 $\Rightarrow f$ is named "a neutrosophic pseudo Z- monomorphism".
5) If f is onto $\Rightarrow f$ is named "a neutrosophic pseudo Z- epimorphism".
6) If f is 1-1 and onto $\Rightarrow f$ is named a neutrosophic pseudo Z-isomorphism.

Theorem 3.31: Let $\mathcal{Z}(\mathcal{I})$ & $\acute{\mathcal{Z}}(\mathcal{I})$ be two $\mathcal{N}\mathcal{Z}$, $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$ be a neutrosophic Z- epimorphism .If $\mathcal{D}(\mathcal{I})$is a $\mathcal{N}\mathcal{Z}^f$ of $\mathcal{Z}(\mathcal{I}) \Rightarrow f(\mathcal{D}(\mathcal{I}))$ is a $\mathcal{N}\mathcal{Z}^f$ of $\acute{\mathcal{Z}}(\mathcal{I})$.

Proof: let $(\text{Ƨ}, \text{ƀ}\mathcal{I}), (\dagger, \text{Ч}\mathcal{I}) \in f(\mathcal{D}(\mathcal{I})) \Rightarrow$

$(\text{Ƨ}, \text{ƀ}\mathcal{I}) = f(\text{ঽ}, \omega\mathcal{I})$, $(\dagger, \text{Ч}\mathcal{I}) = f(\text{Ϙ}, \text{Є}\mathcal{I})$ where $(\text{ঽ}, \omega\mathcal{I}), (\text{Ϙ}, \text{Є}\mathcal{I}) \in \mathcal{D}(\mathcal{I})$

Since $\mathcal{D}(\mathcal{I})$is a $\mathcal{N}\mathcal{Z}^f$ of $\mathcal{Z}(\mathcal{I}), \Rightarrow$

$(\text{ঽ}, \omega\mathcal{I})\bar{X}(\text{Ϙ}, \text{Є}\mathcal{I}) = (\text{ঽ}, \omega\mathcal{I}) * [(\text{ঽ}, \omega\mathcal{I}) * (\text{Ϙ}, \text{Є}\mathcal{I})] \in \mathcal{D}(\mathcal{I})$

Also $f\left((\text{ঽ}, \omega\mathcal{I})\bar{X}(\text{ʒ}, \text{ŋ}\mathcal{I})\right) \in f(\mathcal{D}(\mathcal{I}))$

$$
\begin{aligned}
(\text{Ƨ}, \text{ƀ}\mathcal{I})\bar{X}(\dagger, \text{Ч}\mathcal{I}) &= (\text{Ƨ}, \text{ƀ}\mathcal{I}) * \left((\text{Ƨ}, \text{ƀ}\mathcal{I}) * (\dagger, \text{Ч}\mathcal{I})\right) \\
&= f(\text{ঽ}, \omega\mathcal{I}) \acute{*} \left(f(\text{ঽ}, \omega\mathcal{I}) \acute{*} f(\text{Ϙ}, \text{Є}\mathcal{I})\right) \\
&= f\left[(\text{ঽ}, \omega\mathcal{I}) * \left((\text{ঽ}, \omega\mathcal{I}) * (\text{Ϙ}, \text{Є}\mathcal{I})\right)\right] \\
&= f\left[(\text{ঽ}, \omega\mathcal{I})\Delta(\text{Ϙ}, \text{Є}\mathcal{I})\right]
\end{aligned}
$$

$(\text{Ƨ}, \text{ƀ}\mathcal{I})\bar{X}(\dagger, \text{Ч}\mathcal{I}) \in f(\mathcal{D}(\mathcal{I})) \Rightarrow$
$f(\mathcal{D}(\mathcal{I}))$ is a $\mathcal{N}\mathcal{Z}^f$ of $\acute{\mathcal{Z}}(\mathcal{I})$.

Theorem 3.32: Let $\mathcal{Z}(\mathcal{I})$ & $\acute{\mathcal{Z}}(\mathcal{I})$ be two $\mathcal{N}\mathrm{P}\mathcal{Z}$, $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$ be a neutrosophic pseudo Z- epimorphism .If $\mathcal{D}(\mathcal{I})$is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{f}$ of $\mathcal{Z}(\mathcal{I}) \Rightarrow f(\mathcal{D}(\mathcal{I}))$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{f}$ of $\acute{\mathcal{Z}}(\mathcal{I})$.

Proof: it is easy as above.

Definition 3.33: Let $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$ be a $\mathcal{N}\mathcal{Z}^{\hbar}$ then $\ker(f) = \{(Ƨ, ƅ\mathcal{I}) \in \mathcal{Z}(\mathcal{I}): f(Ƨ, ƅ\mathcal{I}) = (\acute{0}, \acute{0}\mathcal{I})\}$ is named the kernel of f.

Definition 3.34: Let $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$ be a $\mathcal{N}\mathrm{P}\mathcal{Z}^{\hbar}$ then

$\ker(f) = \{(Ƨ, ƅ\mathcal{I}) \in \mathcal{Z}(\mathcal{I}): f(Ƨ, ƅ\mathcal{I}) = (\acute{0}, \acute{0}\mathcal{I})\}$ is named the kernel of f .

Remark 3.35: (1) Let $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$ is a $\mathcal{N}\mathcal{Z}^{\hbar}$, then $\ker(f)$ is not a $\mathcal{N}\mathcal{Z}^{f}$ of $\mathcal{Z}(\mathcal{I})$.
(2) $\mathcal{N}\mathcal{Z}^{f}$ is not $\mathcal{N}\mathcal{Z}^{i}$ and conversely .
(3) $\mathcal{N}\mathcal{Z}^{f}$ is not $\mathcal{N}\mathcal{Z}^{s}$ and conversely .

Remark 3.36: (1) Let $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{\hbar}$, then $\ker(f)$ is not a $\mathcal{N}\mathrm{P}\mathcal{Z}^{f}$ of $\mathcal{Z}(\mathcal{I})$.
(2) $\mathcal{N}\mathrm{P}\mathcal{Z}^{f}$ is not $\mathcal{N}\mathrm{P}\mathcal{Z}^{i}$ and conversely .
(3) $\mathcal{N}\mathrm{P}\mathcal{Z}^{f}$ is not $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$ and conversely .

Theorem 3.37: Let $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$ be a $\mathcal{N}\mathcal{Z}^{\hbar}$ then

1) If the identity of $\mathcal{Z}(\mathcal{I})$ is $(0,0\mathcal{I}) \Rightarrow$ the identity of $\acute{\mathcal{Z}}(\mathcal{I})$ is $f(0,0\mathcal{I})$.
2) If $\mathcal{U}$ is a $\mathcal{N}\mathcal{Z}^{s}$ of $\mathcal{Z}(\mathcal{I})$, then $f(\mathcal{U})$ is a $\mathcal{N}\mathcal{Z}^{s}$of $\acute{\mathcal{Z}}(\mathcal{I})$.
3) If $\mathcal{U}$ is a $\mathcal{N}\mathcal{Z}^{s}$ of $\acute{\mathcal{Z}}(\mathcal{I})$, then $f^{-1}(\mathcal{U})$ is a $\mathcal{N}\mathcal{Z}^{s}$of $\mathcal{Z}(\mathcal{I})$.

Proof: it's clear.

Theorem 3.38: Let $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$ be a $\mathcal{N}\mathrm{P}\mathcal{Z}^{\hbar}$ then

1) If the identity of $\mathcal{Z}(\mathcal{I})$ is $(0,0\mathcal{I}) \Rightarrow$ the identity of $\acute{\mathcal{Z}}(\mathcal{I})$ is $f(0,0\mathcal{I})$.
2) If $\mathcal{U}$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$ of $\mathcal{Z}(\mathcal{I})$, then $f(\mathcal{U})$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$of $\acute{\mathcal{Z}}(\mathcal{I})$.
3) If $\mathcal{U}$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$ of $\acute{\mathcal{Z}}(\mathcal{I})$, then $f^{-1}(\mathcal{U})$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{s}$of $\mathcal{Z}(\mathcal{I})$.

Proof: it's clear.

Theorem 3.39: Let $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$ is a $\mathcal{N}\mathcal{Z}^{\hbar}$ then f is a neutrosophic Z- monomorphism $\Leftrightarrow \ker(f) = \{(0,0I)\}$

Proof: it's clear.

Theorem 3.40: Let $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{\hbar}$ then f is a neutrosophic Z- monomorphism $\Leftrightarrow \ker(f) = \{(0,0I)\}$

Proof: it's clear.

Theorem 3.41: Let $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$ is a $\mathcal{N}\mathcal{Z}^{\hbar}$ then $\ker(f)$ is a $\mathcal{N}\mathcal{Z}^{i}$ of $\mathcal{Z}(\mathcal{I})$.

Proof: $f(0,0\mathcal{I}) = (\acute{0}, \acute{0}\mathcal{I}) \Rightarrow (0,0\mathcal{I}) \in \ker(f)$

Let $(Ƨ, ƅ\mathcal{I}) * [(†, Ч\mathcal{I}) * (ϡ, ω\mathcal{I})] \in \ker(f)$ and $(†, Ч\mathcal{I}) \in \ker(f) \Rightarrow$

$$
\begin{aligned}
&f\big((Ƨ, ƅ\mathcal{I}) * [(†, Ч\mathcal{I}) * (ϡ, ω\mathcal{I})]\big) = (\acute{0}, \acute{0}\mathcal{I}) \text{ and } f(†, Ч\mathcal{I}) = (\acute{0}, \acute{0}\mathcal{I}) \\
&(\acute{0}, \acute{0}\mathcal{I}) = f\big((Ƨ, ƅ\mathcal{I}) * [(†, Ч\mathcal{I}) * (ϡ, ω\mathcal{I})]\big) \\
&\qquad = f(Ƨ, ƅ\mathcal{I}) \acute{*} [f(†, Ч\mathcal{I}) \acute{*} f(ϡ, ω\mathcal{I})] \\
&\qquad = f(Ƨ, ƅ\mathcal{I}) \acute{*} [(\acute{0}, \acute{0}\mathcal{I}) \acute{*} f(ϡ, ω\mathcal{I})]
\end{aligned}
$$

$$= f(\text{Ƨ}, \text{ƀ}\mathcal{I}) \acute{*} f(\text{ϡ}, \omega\mathcal{I})$$
$$= f\big((\text{Ƨ}, \text{ƀ}\mathcal{I}) * (\text{ϡ}, \omega\mathcal{I})\big)$$

We get $\big((\text{Ƨ}, \text{ƀ}\mathcal{I}) * (\text{ϡ}, \omega\mathcal{I})\big) \in \ker(f)$.then $\ker(f)$ is a a $\mathcal{NZ}^{i}$ of $\mathcal{Z}(\mathcal{I})$.

Theorem 3.42: Let $f: \mathcal{Z}(\mathcal{I}) \to \acute{\mathcal{Z}}(\mathcal{I})$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{\hbar}$ then $\ker(f)$ is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{i}$ of $\mathcal{Z}(\mathcal{I})$.

Proof: it is easy as above.

4 Conclusion

We discussed the idea of a neutrosophic Z-algebra and neutrosophic $\mathrm{pseudoZ} - \mathrm{algebra}$ looked into some of its properties, and the concept of neutrosophic Z-ideal, neutrosophic Z-sub algebra, neutrosophic Z-filter and neutrosophic Z- homomorphism are studied and a few properties are obtained.

Competing Interests

Authors have declared that no competing interests exist.

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