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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 $j \le 0$. 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 $\mathcal{X}(\mathcal{I}) = \langle \mathcal{X}, \mathcal{I} \rangle = \{Ƨ + ϯ\mathcal{I} : Ƨ, ϯ \in \mathcal{X}\}$, 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:

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

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 $Ƨ * ϯ \in \delta$, $\forall Ƨ, ϯ \in \delta$.

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) $Ƨ * ϯ \in \mathcal{I}$, and $ϯ \in \mathcal{I} \Rightarrow Ƨ \in \mathcal{I}$.

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) $((Ƨ * ঽ) * Ƨ) * ϯ \in \mathcal{I}$, and $ϯ \in \mathcal{I} \Rightarrow Ƨ \in \mathcal{I}, \forall Ƨ, ϯ, ঽ \in \mathcal{Z}$.

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) $(Ƨ * ঽ) * (Ƨ * ϯ) \in \mathcal{I}$, and $ϯ \in \mathcal{I} \Rightarrow Ƨ \in \mathcal{I}, \forall Ƨ, ϯ, ঽ \in \mathcal{Z}$

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) $(Ƨ * ঽ) * (ϯ * ঽ) \in \mathcal{I}$, and $ϯ \in \mathcal{I} \Rightarrow Ƨ \in \mathcal{I}, \forall Ƨ, ϯ, ঽ \in \mathcal{Z}$.

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 $Ƨ \barwedge ϯ = Ƨ * (Ƨ * ϯ) \in \mathcal{F}, \forall Ƨ, ϯ \in \mathcal{F}, (Ƨ \neq ϯ)$.

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

$*$	**0**	$Ƨ$	$ϯ$	$ঽ$
0	0	$Ƨ$	$ϯ$	$ঽ$
$Ƨ$	0	$Ƨ$	$ϯ$	$ϯ$
$ϯ$	0	$ϯ$	$ϯ$	$ϯ$
$ঽ$	0	$ϯ$	$ϯ$	$ঽ$

Then $(\mathcal{Z},*,0)$ is Z-Algebra. $\delta = \{ϩ, ϯ, ϡ\}$ is Z-subalgebra and $\mathcal{I} = \{0, ϩ, ϯ\}$ is a Z_1 –ideal, $\mathcal{I}^{\$} = \{0, ϩ, ϡ\}$ is a (Z_2 -ideal , Z_p –ideal) Z-ideal .and $\mathcal{F} = \{ϩ, ϯ\}$ 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 $*, \circledast$ and constant 0 then the algebra $(\mathcal{Z},*,\circledast,0)$ named pseudo Z-Algebra (briefly,P$\mathcal{Z}$) if satisfying the following axiom:

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

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

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

$*$	0	ϩ	ϯ	ϡ	$\circledast$	0	ϩ	ϯ	ϡ
0	0	ϩ	ϯ	ϡ	0	0	ϩ	ϯ	ϡ
ϩ	0	ϩ	ϩ	ϯ	ϩ	0	ϩ	ϯ	ϩ
ϯ	0	ϯ	ϯ	ϩ	ϯ	0	ϩ	ϯ	ϩ
ϡ	0	ϩ	ϩ	ϡ	ϡ	0	ϯ	ϩ	ϡ

Then $(\mathcal{Z},*,\circledast,0)$ is pseudo Z-algebra , $\delta = \{ϩ, ϯ, ϡ\}$ is a pseudo Z-sub algebra.

3 Neutrosophic Z-algebra

Definition 3.1: A neutrosophic Z-algebra is the triple $\big(\mathcal{Z}(\mathcal{I}),*,(0,0\mathcal{I})\big)$ (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 $(ϩ, ƅ\mathcal{I}), (ϯ, ϥ\mathcal{I})$ are any two elements of $\mathcal{Z}(\mathcal{I})$ with $ϩ, ƅ, ϯ, ϥ \in \mathcal{Z}$ satisfies

$(ϩ, ƅ\mathcal{I}) * (ϯ, ϥ\mathcal{I}) = (ϩ * ϯ, (ϩ * ϥ \wedge ƅ * ϯ \wedge ƅ * ϥ)\mathcal{I})$

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

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

And $(ϩ, ƅ\mathcal{I}) = (ϯ, ϥ\mathcal{I}) \Leftrightarrow (ϩ = ϯ$ and $ƅ = ϥ)$

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

If $(ϩ, ƅ\mathcal{I}), (ϯ, ϥ\mathcal{I})$ are any two elements of $\mathcal{Z}(\mathcal{I})$ with $\mathfrak{x}, ƅ, ϯ, ϥ \in \mathcal{Z}$ satisfies

$(ϩ, ƅ\mathcal{I}) * (ϯ, ϥ\mathcal{I}) = (ϩ * ϯ, (ϩ * ϥ \wedge ƅ * ϯ \wedge ƅ * ϥ)\mathcal{I})$

$(ϯ, ϥ\mathcal{I}) \circledast (ϩ, ƅ\mathcal{I}) = (ϯ \circledast ϩ, (ϩ \circledast ϥ \wedge ƅ \circledast ϯ \wedge ƅ \circledast ϥ)\mathcal{I})$

Where $(ϩ, ƅ\mathcal{I}) * (ϯ, ϥ\mathcal{I}) = (ϩ, ƅ\mathcal{I}) \circledast (ϯ, ϥ\mathcal{I})$
When$(ϩ, ƅ\mathcal{I}) \neq (0,0\mathcal{I})$ and $(ϯ, ϥ\mathcal{I}) \neq (0,0\mathcal{I}), \forall\ (ϩ, ƅ\mathcal{I}), (ϯ, ϥ\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

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

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

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

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

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

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

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

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

$0 * \dagger = \dagger * 0 \quad \Rightarrow \dagger = 0$

and $\ 0 * \text{Ч} \wedge 0 * 0 = 0 * 0 \wedge \text{Ч} * 0 \ \Rightarrow\ \text{Ч} = 0$

We get a contradiction.

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

Theorem 3.4: Every $\mathcal{N}\text{P}\mathcal{Z}$, $(\mathcal{Z}(\mathcal{I}),*,\circledast,(0,0\mathcal{I}))$ with condition$(0,0\mathcal{I}) * (\text{Ƨ}, \text{ƀ}\mathcal{I}) = (\text{Ƨ}, \text{ƀ}\mathcal{I}), (0,0\mathcal{I}) \circledast (\text{Ƨ}, \text{ƀ}\mathcal{I}) = (\text{Ƨ}, \text{ƀ}\mathcal{I})$ 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 $\mathfrak{S}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $(\mathcal{Z}(\mathcal{I}),*,(0,0\mathcal{I}))$ is $\mathcal{NZ}$,$\mathfrak{S}(\mathcal{I})$ is named a neutrosophic Z-subalgebra (briefly, $\mathcal{NZ}^{s}$) of $\mathcal{Z}(\mathcal{I})$ if

1) $(0,0\mathcal{I}) \in \mathfrak{S}(\mathcal{I})$
2) $(\text{Ƨ}, \text{ƀ}\mathcal{I}) * (\dagger, \text{Ч}\mathcal{I}) \in \mathfrak{S}(\mathcal{I}), \forall (\text{Ƨ}, \text{ƀ}\mathcal{I}), (\dagger, \text{Ч}\mathcal{I}) \in \mathfrak{S}(\mathcal{I})$
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 $\mathcal{N}\text{P}\mathcal{Z}$, $\mathfrak{S}(\mathcal{I})$ is called a neutrosophic pseudo Z-subalgebra (briefly, $\mathcal{N}\text{P}\mathcal{Z}^{s}$) of $\mathcal{Z}(\mathcal{I})$ if

1) $(0,0\mathcal{I}) \in \mathfrak{S}(\mathcal{I})$
2) $(\text{Ƨ}, \text{ƀ}\mathcal{I}) * (\dagger, \text{Ч}\mathcal{I}) \in \mathfrak{S}(\mathcal{I})\ \&\ (\text{Ƨ}, \text{ƀ}\mathcal{I}) \circledast (\dagger, \text{Ч}\mathcal{I}) \in \mathfrak{S}(\mathcal{I}), \forall (\text{Ƨ}, \text{ƀ}\mathcal{I}), (\dagger, \text{Ч}\mathcal{I}) \in \mathfrak{S}(\mathcal{I})$
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 $\omega \neq 0$, $(\mathcal{Z}(\mathcal{I}),*,(0,0\mathcal{I}))$ is $\mathcal{NZ}$ **,**where $\mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I}) = \{(\text{Ƨ}, \text{ƀ}\mathcal{I}) \in \mathcal{Z}(\mathcal{I}) : (\text{Ƨ}, \text{ƀ}\mathcal{I}) * (\omega, \omega\mathcal{I}) = (\omega, \omega\mathcal{I})\}$

Then 1) $\mathcal{A}_{(\omega,\omega\mathcal{I})}(\mathcal{I})$ is $\mathcal{NZ}^{s}$.
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 $(ƨ\,, ƀ\mathcal{J}), (\dagger\,, Ч\mathcal{J}) \in \mathcal{A}_{(\omega,\omega\mathcal{J})}(\mathcal{J}) \Rightarrow$
$(ƨ\,, ƀ\mathcal{J}) * (\omega, \omega\mathcal{J}) = (\omega, \omega\mathcal{J})$, $(\dagger\,, Ч\mathcal{J}) * (\omega, \omega\mathcal{J}) = (\omega, \omega\mathcal{J}) \Rightarrow$

$ƨ * \omega = \omega\,,\ ƨ * \omega \wedge ƀ * \omega = \omega$ & $\dagger * \omega = \omega\,, \dagger * \omega \wedge Ч * \omega = \omega$ since $\omega \neq 0 \Rightarrow$
$ƨ = ƀ = \dagger = Ч = \omega$

$$\begin{aligned}[(ƨ\,, ƀ\mathcal{J}) * (\dagger\,, Ч\mathcal{J})] * (\omega, \omega\mathcal{J}) &= [ƨ * \dagger, (ƨ * Ч \wedge ƀ * \dagger)\mathcal{J}] * (\omega, \omega\mathcal{J}) \\ &= \left[(ƨ * \dagger) * \omega\,, \left((ƨ * \dagger) * \omega \wedge (ƨ * Ч \wedge ƀ * \dagger) * \omega\right)\mathcal{J}\right] \\ &= [\omega * \omega, (\omega * \omega \wedge \omega * \omega)\mathcal{J}] \\ &= (\omega, \omega\mathcal{J})\end{aligned}$$

This shows that $(ƨ\,, ƀ\mathcal{J}) * (\dagger\,, Ч\mathcal{J}) \in \mathcal{A}_{(\omega,\omega\mathcal{J})}(\mathcal{J})$
Then $\mathcal{A}_{(\omega,\omega\mathcal{J})}(\mathcal{J})$ is $\mathcal{N}\mathcal{Z}^{\delta}$.
(2) it's easy.

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

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

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

Proof: it is easy as above.

Theorem 3.9: If $\mathcal{Z}_{\xi}(\mathcal{J}) \neq \phi$ and $\mathcal{Z}_{\xi}(\mathcal{J}) \subseteq \mathcal{Z}(\mathcal{J})$, $\left(\mathcal{Z}(\mathcal{J}),*, (0,0\mathcal{J})\right)$ is $\mathcal{N}\mathcal{Z}$ **,** where
$\mathcal{Z}_{\xi}(\mathcal{J}) = \{(ƨ, ƨ\mathcal{J}) : ƨ \in \mathcal{Z}\}$ Then $\mathcal{Z}_{\xi}(\mathcal{J})$is a $\mathcal{N}\mathcal{Z}^{\delta}$ of $\mathcal{Z}(\mathcal{J})$.

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

Let $(\dagger, \dagger\mathcal{J}), (ƀ, ƀ\mathcal{J}) \in \mathcal{Z}_{\xi}(\mathcal{J}),\ \dagger, ƀ \in \mathcal{Z} \Rightarrow$

$(\dagger, \dagger\mathcal{J}) * (ƀ, ƀ\mathcal{J}) = (\dagger * ƀ, (\dagger * ƀ)\mathcal{J})$

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

Then $\mathcal{Z}_{\xi}(\mathcal{J})$is a $\mathcal{N}\mathcal{Z}^{\delta}$ of $\mathcal{Z}(\mathcal{J})$.

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

$\mathcal{Z}_{\xi}(\mathcal{J}) = \{(ƨ, ƨ\mathcal{J}) : ƨ \in \mathcal{Z}\}$ Then $\mathcal{Z}_{\xi}(\mathcal{J})$is a $\mathcal{N}\mathrm{P}\mathcal{Z}^{\delta}$ of $\mathcal{Z}(\mathcal{J})$.

Proof: it is easy as above.

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

$*$	$(0,0\mathcal{J})$	$(ƨ, ƨ\mathcal{J})$	$(\dagger, \dagger\mathcal{J})$	$(ℷ, ℷ\mathcal{J})$
$(0,0\mathcal{J})$	$(0,0\mathcal{J})$	$(ƨ, ƨ\mathcal{J})$	$(\dagger, \dagger\mathcal{J})$	$(ℷ, ℷ\mathcal{J})$
$(ƨ, ƨ\mathcal{J})$	$(0,0\mathcal{J})$	$(ƨ, ƨ\mathcal{J})$	$(0,0\mathcal{J})$	$(ƨ, ƨ\mathcal{J})$
$(\dagger, \dagger\mathcal{J})$	$(0,0\mathcal{J})$	$(0,0\mathcal{J})$	$(\dagger, \dagger\mathcal{J})$	$(\dagger, \dagger\mathcal{J})$
$(ℷ, ℷ\mathcal{J})$	$(0,0\mathcal{J})$	$(ƨ, ƨ\mathcal{J})$	$(\dagger, \dagger\mathcal{J})$	$(ℷ, ℷ\mathcal{J})$

Then $\left(\mathcal{Z}_{\xi}(\mathcal{J}),*, (0,0\mathcal{J})\right)$ is a $\mathcal{N}\mathcal{Z}^{\delta}$ of $\mathcal{Z}(\mathcal{J})$

Theorem 3.12: Let $\left\{\mathcal{A}(\mathcal{J})_{\gamma} : \gamma \in \mathcal{S}\right\}$ and $\mathcal{A}(\mathcal{J})_{\gamma} \neq \phi$ be a collection of $\mathcal{N}\mathcal{Z}^{\delta}$ of $\mathcal{Z}(\mathcal{J})$ if

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

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 $\bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma$

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

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

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

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

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

hence $\bigcap_{\gamma\in\mathcal{S}}\mathcal{A}(\mathcal{J})_\gamma$ is a $\mathcal{NZ}^{\mathcal{s}}$ 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 $\mathcal{N}\mathrm{P}\mathcal{Z}^{\mathcal{s}}$ *of* $(\mathcal{Z}(\mathcal{J}), *, \circledast, (0,0\mathcal{J}))$ is $\mathcal{N}\mathrm{P}\mathcal{Z}$ if

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

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 $\mathcal{NZ}^{\mathcal{s}}$ of $\mathcal{Z}(\mathcal{J})$ if $\mathcal{A}(\mathcal{J})_1 \subseteq \mathcal{A}(\mathcal{J})_2 \subseteq \cdots$ then

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

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

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

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

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

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

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

Proof: it is easy as above.

Definition 3.16: Let $\mathcal{D}(\mathcal{J}) \neq \phi$ and $\mathcal{D}(\mathcal{J}) \subseteq \mathcal{Z}(\mathcal{J})$, $\left(\mathcal{Z}(\mathcal{J}),*,(0,0\mathcal{J})\right)$ 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 $(ƨ, ƀ\mathcal{J}) * (ϯ, Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J})$, and $(ϯ, Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J}) \Rightarrow (ƨ, ƀ\mathcal{J}) \in \mathcal{D}(\mathcal{J})$

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

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

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

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

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

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 $(ƨ, ƀ\mathcal{J}) * (ϯ, Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J})$, and $(ϯ, Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J}) \Rightarrow (ƨ, ƀ\mathcal{J}) \in \mathcal{D}(\mathcal{J})$

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

Definition 3.19: Let $\mathcal{D}(\mathcal{J}) \neq \phi$ and $\mathcal{D}(\mathcal{J}) \subseteq \mathcal{Z}(\mathcal{J})$, $\left(\mathcal{Z}(\mathcal{J}),*,(0,0\mathcal{J})\right)$ 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
$[((ƨ, ƀ\mathcal{J}) * (ϡ, ω\mathcal{J})) * (ƨ, ƀ\mathcal{J})] * (ϯ, Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J})$, and $(ϯ, Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J}) \Rightarrow (ƨ, ƀ\mathcal{J}) \in \mathcal{D}(\mathcal{J}), \forall\, (ƨ, ƀ\mathcal{J}), (ϡ, ω\mathcal{J}), (ϯ, Ч\mathcal{J}) \in \mathcal{Z}(\mathcal{J})$

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) $[((ƨ, ƀ\mathcal{J}) * (ϡ, ω\mathcal{J})) * (ƨ, ƀ\mathcal{J})] * (ϯ, Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J})$, and $(ϯ, Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J}) \Rightarrow (ƨ, ƀ\mathcal{J}) \in \mathcal{D}(\mathcal{J}), \forall\, (ƨ, ƀ\mathcal{J}), (ϡ, ω\mathcal{J}), (ϯ, Ч\mathcal{J}) \in \mathcal{Z}(\mathcal{J})$

And $\big[\big((Ƨ, ƅ\mathcal{I}) \circledast (ϡ, ω\mathcal{I})\big) \circledast (Ƨ, ƅ\mathcal{I})\big] \circledast (ϯ, Ϥ\mathcal{I}) \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ϥ\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ƅ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ƅ\mathcal{I}), (ϡ, ω\mathcal{I}), (ϯ, Ϥ\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

Definition 3.21: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $\big(\mathcal{Z}(\mathcal{I}), *, (0,0\mathcal{I})\big)$ 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 $[(Ƨ, ƅ\mathcal{I}) * (ϡ, ω\mathcal{I})] * [(Ƨ, ƅ\mathcal{I}) * (ϯ, Ϥ\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ϥ\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ƅ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ƅ\mathcal{I}), (ϡ, ω\mathcal{I}), (ϯ, Ϥ\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$.

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 $[(Ƨ, ƅ\mathcal{I}) * (ϡ, ω\mathcal{I})] * [(Ƨ, ƅ\mathcal{I}) * (ϯ, Ϥ\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ϥ\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ƅ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ƅ\mathcal{I}), (ϡ, ω\mathcal{I}), (ϯ, Ϥ\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

And $[(Ƨ, ƅ\mathcal{I}) \circledast (ϡ, ω\mathcal{I})] \circledast [(Ƨ, ƅ\mathcal{I}) \circledast (ϯ, Ϥ\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ϥ\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ƅ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ƅ\mathcal{I}), (ϡ, ω\mathcal{I}), (ϯ, Ϥ\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$.

Definition 3.23: Let $\mathcal{D}(\mathcal{I}) \neq \phi$ and $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $\big(\mathcal{Z}(\mathcal{I}), *, (0,0\mathcal{I})\big)$ 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 $[(Ƨ, ƅ\mathcal{I}) * (ϡ, ω\mathcal{I})] * [(ϯ, Ϥ\mathcal{I}) * (ϡ, ω\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ϥ\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ƅ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ƅ\mathcal{I}), (ϡ, ω\mathcal{I}), (ϯ, Ϥ\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

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 $[(Ƨ, ƅ\mathcal{I}) * (ϡ, ω\mathcal{I})] * [(ϯ, Ϥ\mathcal{I}) * (ϡ, ω\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ϥ\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ƅ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ƅ\mathcal{I}), (ϡ, ω\mathcal{I}), (ϯ, Ϥ\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

And $[(Ƨ, ƅ\mathcal{I}) \circledast (ϡ, ω\mathcal{I})] \circledast [(ϯ, Ϥ\mathcal{I}) \circledast (ϡ, ω\mathcal{I})] \in \mathcal{D}(\mathcal{I})$, and $(ϯ, Ϥ\mathcal{I}) \in \mathcal{D}(\mathcal{I}) \Rightarrow (Ƨ, ƅ\mathcal{I}) \in \mathcal{D}(\mathcal{I}), \forall\, (Ƨ, ƅ\mathcal{I}), (ϡ, ω\mathcal{I}), (ϯ, Ϥ\mathcal{I}) \in \mathcal{Z}(\mathcal{I})$

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 $(Ƨ, Ƨ\mathcal{I}) * [(ϯ, ϯ\mathcal{I}) * (ϡ, ϡ\mathcal{I})] \in \mathcal{D}_\xi(\mathcal{I})$, and $(ϯ, ϯ\mathcal{I}) \in \mathcal{D}_\xi(\mathcal{I})$
$\Rightarrow (Ƨ, Ƨ\mathcal{I}) * (ϡ, ϡ\mathcal{I}) \in \mathcal{D}_\xi(\mathcal{I}),\ \forall\, (Ƨ, Ƨ\mathcal{I}), (ϯ, ϯ\mathcal{I}), (ϡ, ϡ\mathcal{I})\, \mathcal{D}_\xi(\mathcal{I})$

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 $\mathcal{D}(\mathcal{I}) \subseteq \mathcal{Z}(\mathcal{I})$, $\big(\mathcal{Z}(\mathcal{I}), *, (0,0\mathcal{I})\big)$ is $\mathcal{NZ}$,$\mathcal{D}(\mathcal{I})$ is named a neutrosophic Z-filter (briefly, $\mathcal{NZ}^{f}$) of $\mathcal{Z}(\mathcal{I})$if :

1) $(0,0\mathcal{J}) \notin \mathcal{D}(\mathcal{J})$
2) $\forall\, (Ƨ, ƀ\mathcal{J}), († , Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J})$and $(Ƨ, ƀ\mathcal{J}) \neq († , Ч\mathcal{J}) \Rightarrow$
   $(Ƨ, ƀ\mathcal{J})Ẍ(† , Ч\mathcal{J}) = (Ƨ, ƀ\mathcal{J}) * [(Ƨ, ƀ\mathcal{J}) * († , Ч\mathcal{J})] \in \mathcal{D}(\mathcal{J})$

Definition 3.28: 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-filter (briefly, $\mathcal{N}\mathrm{P}\mathcal{Z}^f$) of $\mathcal{Z}(\mathcal{J})$if :

1) $(0,0\mathcal{J}) \notin \mathcal{D}(\mathcal{J})$
2) $\forall\, (Ƨ, ƀ\mathcal{J}), († , Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J})$and $(Ƨ, ƀ\mathcal{J}) \neq († , Ч\mathcal{J}) \Rightarrow$
   $(Ƨ, ƀ\mathcal{J})Ẍ(† , Ч\mathcal{J}) = (Ƨ, ƀ\mathcal{J}) * [(Ƨ, ƀ\mathcal{J}) * († , Ч\mathcal{J})] \in \mathcal{D}(\mathcal{J})$

And $\forall\, (Ƨ, ƀ\mathcal{J}), († , Ч\mathcal{J}) \in \mathcal{D}(\mathcal{J})$and $(Ƨ, ƀ\mathcal{J}) \neq († , Ч\mathcal{J}) \Rightarrow$
$(Ƨ, ƀ\mathcal{J})Ẍ(† , Ч\mathcal{J}) = (Ƨ, ƀ\mathcal{J}) \circledast [(Ƨ, ƀ\mathcal{J}) \circledast († , Ч\mathcal{J})] \in \mathcal{D}(\mathcal{J})$

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

1) $f[(Ƨ, ƀ\mathcal{J}) * († , Ч\mathcal{J})] = f(Ƨ, ƀ\mathcal{J}) \acute{*} f(† , Ч\mathcal{J}), \forall (Ƨ, ƀ\mathcal{J}), († , Ч\mathcal{J}) \in \mathcal{Z}(\mathcal{J})$
2) $f(0,0\mathcal{J}) = \left(\acute{0},\acute{0}\mathcal{J}\right)$
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 $(\mathcal{Z}(\mathcal{J}),*,\circledast,(0,0\mathcal{J}))$ & $\left(\acute{\mathcal{Z}}(\mathcal{J}),\acute{*},\acute{\circledast},\left(\acute{0},\acute{0}\mathcal{J}\right)\right)$ be two $\mathcal{N}\mathrm{P}\mathcal{Z}$, a mapping $f\colon \mathcal{Z}(\mathcal{J}) \to \acute{\mathcal{Z}}(\mathcal{J})$is named a neutrosophic pseudo Z- homomorphism (briefly, $\mathcal{N}\mathrm{P}\mathcal{Z}^{\hbar}$) if satisfied

1) $f[(Ƨ, ƀ\mathcal{J}) * († , Ч\mathcal{J})] = f(Ƨ, ƀ\mathcal{J}) \acute{*} f(† , Ч\mathcal{J}), \forall (Ƨ, ƀ\mathcal{J}), († , Ч\mathcal{J}) \in \mathcal{Z}(\mathcal{J})$
2) $f[(Ƨ, ƀ\mathcal{J}) \circledast († , Ч\mathcal{J})] = f(Ƨ, ƀ\mathcal{J})\ \acute{\circledast}\ f(† , Ч\mathcal{J}), \forall (Ƨ, ƀ\mathcal{J}), († , Ч\mathcal{J}) \in \mathcal{Z}(\mathcal{J})$
3) $f(0,0\mathcal{J}) = \left(\acute{0},\acute{0}\mathcal{J}\right)$
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 $\mathcal{Z}(\mathcal{J})$ & $\acute{\mathcal{Z}}(\mathcal{J})$ be two $\mathcal{N}\mathcal{Z}$, $f\colon \mathcal{Z}(\mathcal{J}) \to \acute{\mathcal{Z}}(\mathcal{J})$ be a neutrosophic Z- epimorphism .If $\mathcal{D}(\mathcal{J})$is a $\mathcal{N}\mathcal{Z}^f$ of $\mathcal{Z}(\mathcal{J}) \Rightarrow f(\mathcal{D}(\mathcal{J}))$ is a $\mathcal{N}\mathcal{Z}^f$ of $\acute{\mathcal{Z}}(\mathcal{J})$.

Proof: let $(Ƨ, ƀ\mathcal{J}), († , Ч\mathcal{J}) \in f(\mathcal{D}(\mathcal{J})) \Rightarrow$

$(Ƨ, ƀ\mathcal{J}) = f\ (ɿ, ω\mathcal{J})$, $(† , Ч\mathcal{J}) = f(Ϙ, Є\,\mathcal{J})$ where $(ɿ, ω\mathcal{J}), (Ϙ, Є\,\mathcal{J}) \in \mathcal{D}(\mathcal{J})$

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

$(ɿ, ω\mathcal{J})Ẍ(Ϙ, Є\,\mathcal{J}) = (ɿ, ω\mathcal{J}) * [(ɿ, ω\mathcal{J}) * (Ϙ, Є\,\mathcal{J})] \in \mathcal{D}(\mathcal{J})$

Also $f\left((ɿ, ω\mathcal{J})Ẍ(ʒ, ŋ\mathcal{J})\right) \in f(\mathcal{D}(\mathcal{J}))$

$$
\begin{aligned}
(Ƨ, ƀ\mathcal{J})Ẍ(† , Ч\mathcal{J}) &= (Ƨ, ƀ\mathcal{J}) * \left((Ƨ, ƀ\mathcal{J}) * († , Ч\mathcal{J})\right) \\
&= f\ (ɿ, ω\mathcal{J})\ \acute{*} \left(f\ (ɿ, ω\mathcal{J})\ \acute{*}\ f\ (Ϙ, Є\,\mathcal{J})\right) \\
&= f\left[(ɿ, ω\mathcal{J}) * \left((ɿ, ω\mathcal{J}) * (Ϙ, Є\,\mathcal{J})\right)\right] \\
&= f\ [(ɿ, ω\mathcal{J})\Delta\, (Ϙ, Є\,\mathcal{J})]
\end{aligned}
$$

$(Ƨ, ƀ\mathcal{J})Ẍ(† , Ч\mathcal{J}) \in f(\mathcal{D}(\mathcal{J})) \Rightarrow$
$f(\mathcal{D}(\mathcal{J}))$ is a $\mathcal{N}\mathcal{Z}^f$ of $\acute{\mathcal{Z}}(\mathcal{J})$.

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 $\ker(f) = \{(\text{Ƨ}, \text{ƀ}\mathcal{I}) \in \mathcal{Z}(\mathcal{I}): f(\text{Ƨ}, \text{ƀ}\mathcal{I}) = (\acute{0}, \acute{0}\mathcal{I})\}$ 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

$\ker(f) = \{(\text{Ƨ}, \text{ƀ}\mathcal{I}) \in \mathcal{Z}(\mathcal{I}): f(\text{Ƨ}, \text{ƀ}\mathcal{I}) = (\acute{0}, \acute{0}\mathcal{I})\}$ 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 $(\text{Ƨ}, \text{ƀ}\mathcal{I}) * [(\dagger, \text{Ч}\mathcal{I}) * (\text{ϡ}, \text{ɷ}\mathcal{I})] \in \ker(f)$ and $(\dagger, \text{Ч}\mathcal{I}) \in \ker(f) \Rightarrow$

$$f\big((\text{Ƨ}, \text{ƀ}\mathcal{I}) * [(\dagger, \text{Ч}\mathcal{I}) * (\text{ϡ}, \text{ɷ}\mathcal{I})]\big) = (\acute{0}, \acute{0}\mathcal{I}) \text{ and } f(\dagger, \text{Ч}\mathcal{I}) = (\acute{0}, \acute{0}\mathcal{I})$$
$$\begin{aligned} (\acute{0}, \acute{0}\mathcal{I}) &= f\big((\text{Ƨ}, \text{ƀ}\mathcal{I}) * [(\dagger, \text{Ч}\mathcal{I}) * (\text{ϡ}, \text{ɷ}\mathcal{I})]\big) \\ &= f(\text{Ƨ}, \text{ƀ}\mathcal{I}) \mathbin{\acute{*}} [f(\dagger, \text{Ч}\mathcal{I}) \mathbin{\acute{*}} f(\text{ϡ}, \text{ɷ}\mathcal{I})] \\ &= f(\text{Ƨ}, \text{ƀ}\mathcal{I}) \mathbin{\acute{*}} \big[(\acute{0}, \acute{0}\mathcal{I}) \mathbin{\acute{*}} f(\text{ϡ}, \text{ɷ}\mathcal{I})\big] \end{aligned}$$

$$= f(\mathcal{Z}, \mathfrak{b}\mathcal{I}) \acute{*} f(\lambda, \omega\mathcal{I})$$
$$= f\big((\mathcal{Z}, \mathfrak{b}\mathcal{I}) * (\lambda, \omega\mathcal{I})\big)$$

We get $\big((\mathcal{Z}, \mathfrak{b}\mathcal{I}) * (\lambda, \omega\mathcal{I})\big) \in \ker(f)$.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 $\mathrm{pseudoZ-algebra}$ 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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