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Neutrosophic $PRE-\alpha$, $SEMI-\alpha$ and $PRE-\beta$ irresolute open and closed mappings in neutrosophic topological spaces

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Abstract

Aim of this present paper is, the notions of Neutrosophic pre-α-irresolute open & closed mappings, Neutrosophic α-irresolute open & closed mappings, Neutrosophic semi-α- irresolute open & closed mappings and Neutrosophic pre-β-irresolute open & closed mappings are introduced and Besides giving characterizations of these mappings and several interesting properties of these mappings are also discussed.

Keywords

Neutrosophic α -irresolute, Neutrosophic pre α-irresolute, Neutrosophic β-irresolute, Neutrosophic α-closed sets; Neutrosophic topological spaces.

AMS Subject Classification

03E72.

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Contents

1. Introduction

C.L. Chang [7] was introduced fuzzy topological space by using . Zadeh's L.A [23] (uncertain) fuzzy sets. Further Coker [8] was developed the notion of intuitionistic fuzzy topological spaces by using Atanassov's [1] Smarandache [7] was defined the Neutrosophic set of three component (t, f, i) = (Truth, Falsehood, Indeterminacy). The Neutrosophic crisp set concept converted to Neutrosophic topological spaces by A.A. Salama [20]. I. Arokiarani [2] et al, introduced Neutrosophic α-closed sets. K. Bageerathi [11] was developed to the concept of semiopen set and V. Venkateswara Rao [22] et.al., are introduced by pre open sets in Neutrosophic topological space.

In this paper, the concepts of Neutrosophic pre- α -irresolute open and closed mappings, Neutrosophic α-irresolute open and closed mappings, Neutrosophic semi-α-irresolute open and closed mappings and Neutrosophic pre-β-irresolute open and closed mappings are introduced and studied. Besides giving characterizations of these mappings, several interesting properties of these mappings are also given.

2. Preliminaries

In this section, we introduce the basic definition for Neutrosophic sets and its operations.

Definition 2.1 ([8]). *Let $\mathscr{S}_N^1$ be a non-empty fixed set. A Neutrosophic set $A_{\mathscr{S}_N^1}$ is the form*

$$A_{\mathscr{S}_N^1} = \{<\xi^*, \mu_{A_{\mathscr{S}_N^1}}(\xi^*), \sigma_{A_{\mathscr{S}_N^1}}(\xi^*), \gamma_{A_{\mathscr{S}_N^1}}(\xi^*)>: \xi^* \in \mathscr{S}_N^1\}.$$

Where $\mu_{\mathscr{S}_N^1}(\xi^*) : \mathscr{S}_N^1 \to [0,1]$, $\sigma_{A_{\mathscr{S}_N^1}}(\xi^*) : \mathscr{S}_N^1 \to [0,1]$, $\gamma_{A_{R_N^1}}(\xi^*) : \mathscr{S}_N^1 \to [0,1]$ are represent Neutrosophic of the degree of membership function, the degree indeterminacy and *the degree of non membership function respectively of each element $\xi^* \in \mathscr{S}_N^1$ to the set $A_{\mathscr{S}_N^1}$ with*

$$0 \le \mu_{A_{\mathscr{S}_N^1}}(\xi^*) + \sigma_{A_{\mathscr{S}_N^1}}(\xi^*) + \gamma_{A_{\mathscr{S}_N^1}}(\xi^*) \le 1.$$

This is called standard form generalized fuzzy sets. But also Neutrsophic set may be

$$0 \le \mu_{A_{\mathscr{S}_N^1}}(\xi^*) + \sigma_{A_{\mathscr{S}_N^1}}(\zeta^*) + \gamma_{A_{\mathscr{S}_N^1}}(\xi^*) \le 3.$$

Definition 2.2 ([8]). *Each Intuitionistic fuzzy set $A_{\mathscr{S}_N^1}$ is a non-empty set in $\mathscr{S}_N^1$ is obviously on Neutrosophic set having the form*

$$A_{\mathscr{S}_N^1} = \{<\xi^*, \mu_{A_{\mathscr{S}_N^1}}(\xi^*), (1-(\mu_{A_{\mathscr{S}_N^1}}(\xi^*) + \gamma_{A_{\mathscr{S}_N^1}}(\xi^*))), \gamma_{A_{\mathscr{S}_N^1}}(\xi^*) >: \xi^* \in \mathscr{S}_N^1\}.$$

Definition 2.3 ([8]). *We must introduce the Neutrosophic set 0_N and 1_N in $\mathscr{S}_N^1$ as follows:*

$$0_N = \{<\xi^*,\ 0,0,1>: \xi^* \in \mathscr{S}_N^1\}$$
and
$$1_N = \{<\xi^*,\ 1,1,0>: \xi^* \in \mathscr{S}_N^1\}.$$

Definition 2.4 ([8]). *Let $\mathscr{S}_N^1$ be a non-empty set and Neutrosophic sets $A_{\mathscr{S}_N^1}$ and $B_{\mathscr{S}_N^1}$ in the form NS*

$$A_{\mathscr{S}_N^1} = \{<\xi^*,\ \mu_{A_{\mathscr{S}_N^1}}(\xi^*), \sigma_{A_{\mathscr{S}_N^1}}(\xi^*), \gamma_{A_{\mathscr{S}_N^1}}(\xi^*)) >: \xi^* \in \mathscr{S}_N^1\}$$

and

$$B_{\mathscr{S}_N^1} = \{<\xi^*,\ \mu_{B_{\mathscr{S}_N^1}}(\xi^*), \sigma_{B_{\mathscr{S}_N^1}}(\xi^*), \gamma_{B_{\mathscr{S}_N^1}}(\xi^*) >: \xi^* \in \mathscr{S}_N^1\}$$

defined as:

1. $A_{\mathscr{S}_N^1} \subseteq B_{\mathscr{S}_N^1} \Leftrightarrow \mu_{A_{\mathscr{S}_N^1}}(\xi^*) \le \mu_{B_{\mathscr{S}_N^1}}(\xi^*), \sigma_{A_{\mathscr{S}_N^1}}(\xi^*), \le \sigma_{B_{\mathscr{S}_N^1}}(\xi^*)$, *and* $\sigma_{A_{\mathscr{S}_N^1}}(\xi^*) \ge \gamma_{B_{\mathscr{S}_N^1}}(\xi^*)$
2. $A^C_{\mathscr{S}_N^1} = \{<\xi^*,\ \gamma_{A_{\mathscr{S}_N^1}}(\xi^*),\ \sigma_{A_{\mathscr{S}_N^1}}(\xi^*), \mu_{A_{\mathscr{S}_N^1}}(\xi^*) >: \xi^* \in \mathscr{S}_N^1\}$
3. $A_{\mathscr{S}_N^1} \cap B_{\mathscr{S}_N^1} = \{<\xi^*,\ \mu_{A_{\mathscr{S}_N^1}}(\xi^*)) \wedge \mu_{B_{\mathscr{S}_N^1}}(\xi^*), \sigma_{A_{\mathscr{S}_N^1}}(\xi^*)) \wedge \sigma_{B_{\mathscr{S}_N^1}}(\xi^*),\ \gamma_{A_{\mathscr{S}_N^1}}(\xi^*) \vee \gamma_{B_{\mathscr{S}_N^1}}(\xi^*) >: \xi^* \in R_N^1\}$
4. $A_{\mathscr{S}_N^1} \cup B_{\mathscr{S}_N^1} = \{<\xi^*,\ \mu_{A_{\mathscr{S}_N^1}}(\xi^*) \vee \mu_{B_{\mathscr{S}_N^1}}(\xi),\ \sigma_{A_{\mathscr{S}_N^1}}(\xi^*) \vee \sigma_{B_{\mathscr{S}_N^1}}(\xi^*),\ \gamma_{A_{\mathscr{S}_N^1}}(\xi^*) \wedge \gamma_{B_{\mathscr{S}_N^1}}(\xi^*) >: \xi^* \in \mathscr{S}_N^1\}$.

Proposition 2.5 ([8]). *For all $A_{\mathscr{S}_N^1 and} B_{\mathscr{S}_N^1}$ are two Neutrosophic sets then the following condition are true:*

1. $(A_{\mathscr{S}_N^1} \cap B_{\mathscr{S}_N^1})^{c} = (A_{\mathscr{S}_N^1})^c \cup (B_{\mathscr{S}_N^1})^c$.
2. $(A_{\mathscr{S}_N^1} \cup B_{\mathscr{S}_N^1})^{c} = (A_{\mathscr{S}_N^1})^c \cap (B_{\mathscr{S}_N^1})^c$.

Definition 2.6 ([18]). *A Neutrosophic topology is a non - empty set $\mathscr{S}_N^1$ is a family $\tau_{N_{\mathscr{S}_N^1}}$ of Neutrosophic subsets in $\mathscr{S}_N^1$ satisfying the following axioms:*

1. $0_N, 1_N \in \tau_{N_{\mathscr{S}_N^1}}$
2. $G_{\mathscr{S}_N^1} \cap H_{\mathscr{S}_N^1} \in \tau_{N_{\mathscr{S}_N^1}}$ *for any* $G_{\mathscr{S}_1^N}, H_{\mathscr{S}_1^N} \in \tau_{N_{\mathscr{S}_N^1}}$
3. $\bigcup_i Gi_{\mathscr{S}_N^1} \in \tau_{N_{\mathscr{S}_N^1}}$ *for every* $Gi_{\mathscr{S}_N^1} \in \tau_{N_{R_N^1}}, i \in J$.

The pair $(\mathscr{S}_N^1, \tau_{N_{\mathscr{S}_N^1}})$ is called a Neutrosophic topological space.

The element Neutrosophic topological spaces of $\tau_{N_{\mathscr{S}_N^1}}$ are called Neutrosophic open sets. It is denoted by $N0S\mathscr{S}_N^1$.

A Neutrosophic set $A_{\mathscr{S}_N^1}$ is closed if and only if $A^C_{\mathscr{S}_N^1}$ is Neutrosophic open. It is denoted by $NCS\mathscr{S}_N^1$.

Definition 2.7 ([20]). *Let $(\mathscr{S}_N^1,\ \tau_{N_{\mathscr{S}_N^1}})$ be Neutrosophic topological spaces.*

$$A_{\mathscr{S}_N^1} = \{<\xi^*, \mu_{A_{\mathscr{S}_N^1}}(\xi^*), \sigma_{A_{\mathscr{S}_N^1}}(\xi^*), \gamma_{A_{\mathscr{S}_N^1}}(\xi^*)) >: \xi^* \in \mathscr{S}_N^1\}$$

be a Neutrosophic set in $\mathscr{S}_N^1$

1. *Neu-C1*$(A_{\mathscr{S}_N^1}) = \cap\{K_{\mathscr{S}_N^1} : K_{\mathscr{S}_N^1}$ *is a Neutrosophic closed set in* $\mathscr{S}_N^1$ *and* $A_{\mathscr{S}_N^1} \subseteq K_{\mathscr{S}_N^1}\}$. *It is denoted by* ${}^{Cl}_{Neu}A_{\mathscr{S}_N^1}$.
2. *Neu-Int*$(A_{\mathscr{S}_N^1}) = \cup\{G_{\mathscr{S}_N^1} : G_{\mathscr{S}_N^1}$ *is a Neutrosophic open set in* $\mathscr{S}_N^1$ *and* $G_{\mathscr{S}_N^1} \subseteq A_{\mathscr{S}_N^1}\}$. *It is denoted by* ${}^{Int}_{Neu}A_{\mathscr{S}_N^1}$.
3. *Neutrosophic semi-open if* $A_{\mathscr{S}_N^1} \subseteq {}^{Cl}_{Neu}({}^{int}_{Neu}A_{\mathscr{S}_N^1})$. *It is denoted by* $N^S0S\mathscr{S}_N^1$.
4. *The complement of Neutrosophic semi-open set is called Neutrosophic semi-closed.*
5. *Neus-C1*$(A_{\mathscr{S}_N^1}) = \cap\{K_{\mathscr{S}_N^1}/K_{\mathscr{S}_N^1}$ *is a Neutrosophic semi closed set in* $\mathscr{S}_N^1$ *and* $A_{\mathscr{S}_N^1} \subseteq K_{\mathscr{S}_N^1}\}$. *It is denoted by* ${}^{SCl}_{Neu}A_{\mathscr{S}_N^1}$.
6. *Neus-Int*$(A_{\mathscr{S}_N^1}) = \cup\{G_{\mathscr{S}_N^1} : G_{\mathscr{S}_N^1}$ *is a Neutrosophic semi open set in* $\mathscr{S}_N^1$ *and* $G_{\mathscr{S}_N^1} \subseteq A_{\mathscr{S}_N^1}\}$. *It is denoted by* ${}^{Sint}_{Neu}A_{\mathscr{S}_N^1}$.
7. *Neutrosophic* α*-open set if* $A_{\mathscr{S}_N^1} \subseteq {}^{int}_{Neu}({}^{Cl}_{Neu}({}^{int}_{Neu}A_{\mathscr{S}_N^1}))$. *It is denoted by* $N^\alpha 0S\mathscr{S}_N^1$.
8. *The complement of Neutrosophic* α*-open set is called Neutrosophic* α*-closed.*
9. $Neu\alpha - C1(A_{\mathscr{S}_N^1}) = \cap\{K_{\mathscr{S}_N^1} : KA_{\mathscr{S}_N^1}$ *is a Neutrosophic* α*-closed set in* $\mathscr{S}_N^1$ *and* $A_{\mathscr{S}_N^1} \subseteq K_{\mathscr{S}_N^1}\}$. *It is denoted by* ${}^{\alpha cl}_{Neu}A_{\mathscr{S}_N^1}$.

10. *$Neu\alpha - Int(A_{R_N^1}) = \cup\{G_{\mathscr{S}_N^1} : G_{\mathscr{S}_N^1}$ is a Neutrosophic α -open set in $\mathscr{S}_N^1$ and $G_{\mathscr{S}_N^1} \subseteq A_{\mathscr{S}_N^1}\}$. It is denoted by $\alpha_{Neq}^{int} A_{\mathscr{S}_N^1}$.*

11. *Neutrosophicpre open set if $A_{\mathscr{S}_N^1} \subseteq {}^{int}_{Neu}({}^{Cl}_{Neu} A_{\mathscr{S}_N^1})$. It is denoted by $N^P 0S\mathscr{S}_N^1$.*

12. *The complement of Neutrosophic pre-open set is called Neutrosophic pre-closed.*

13. *Neup-C1($A_{\mathscr{S}_N^1}$) $= \cap\{K_{A_{\mathscr{S}_N^1}} : K_{A_{\mathscr{S}_N^1}}$ is a Neutrosophic p-closed set in $\mathscr{S}_N^1$ and $A_{\mathscr{S}_N^1} \subseteq K_{\mathscr{S}_N^1}\}$. It is deoted by ${}^{pcl}_{Neu} A_{\mathscr{S}_N^1}$.*

14. *Neup-Int ($A_{R_N^1}$) $= \cup\{G_{A_{\mathscr{S}_N^1}} : G_{A_{\mathscr{S}_N^1}}$ is a Neutrosophic p -open set in $\mathscr{S}_N^1$ and $G_{\mathscr{S}_N^1} \subseteq A_{\mathscr{S}_N^1}\}$. It is denoted by ${}^{pint}_{Neu} A_{\mathscr{S}_N^1}$.*

Definition 2.8 ([9]). *Take $\Sigma_1', \Sigma_2', \Sigma_3'$ are belongs to real numbers 0 to 1 such that $0 \le \Sigma_1' + \Sigma_2' + \Sigma_3' \le 1$. An Neutrosophic point $f(\Sigma_1', \Sigma_2', \Sigma_3')$ is Neutrosophic set defined by*

$$f(\Sigma_1', \Sigma_2', \Sigma_3') = \begin{cases} (\Sigma_1', \Sigma_2', \Sigma_3'), & \text{if } \Sigma = f \\ (0,0,1), & \text{if } \Sigma \neq f. \end{cases}$$

Take $(\Sigma_1, \Sigma_2, \Sigma_3) = < f_{\Sigma_1}, f_{\Sigma_2}, f_{\Sigma_3} >$, where $f_{\Sigma_1}, f_{\Sigma_2}, f_{\Sigma_3}$ are represent Neutrosophic the degree of membership function, the degree indeterminacy and the degree of non-membership function respectively of each element $\Sigma^* \in \mathscr{S}_N^1$ to the set $A_{\mathscr{S}_N^1}$.

Definition 2.9 ([9]). *Let $\mathscr{S}_N^1$ and $\mathscr{S}_N^2$ be two finite sets. Define $\psi_1 : \mathscr{S}_N^1 \to \mathscr{S}_N^2$. If*

$$A_{\mathscr{S}_N^2} = \{< \theta,\ \mu_{A_{\mathscr{S}_N^2}}(\theta), \sigma_{A_{\mathscr{S}_N^2}}(\theta), \gamma_{A_{\mathscr{S}_N^2}}(\theta)) >: \theta \in \mathscr{S}_N^2\}$$

is an NS in $\mathscr{S}_N^2$, then the inverse image(pre image) $A_{\mathscr{S}_N^2}$ under ψ_1 is an NS defined by

$$\psi_1^{-1}(A_{\mathscr{S}_N^2}) = \\ < \xi^*, \psi_1^{-1}\mu_{A_{\mathscr{S}_N^2}}(\xi^*), \psi_1^{-1}\sigma_{A_{\mathscr{S}_N^2}}(\xi^*), \psi_1^{-1}\gamma_{A_{\mathscr{S}_N^2}}(\xi^*) : \xi^* \in \mathscr{S}_N^1 > .$$

Also define image NS

$$U =< \xi^*, \mu_U(\xi^*), \sigma_U(\xi^*), \gamma_U(\xi^*) : \xi^* \in \mathscr{S}_N^1 :>$$

under ψ_1 is an NS defined by

$$\psi_1(U) = \\ < \theta, \psi_1(\mu_{A_{\mathscr{S}_N^2}}(\theta)), \psi_1(\sigma_{A_{\mathscr{S}_N^2}}(\theta)), \psi_1(\gamma_{A_{\mathscr{S}_N^2}}(\theta) : \theta \in \mathscr{S}_N^2 >$$

where

$$\psi_1(\mu_{A_{\mathscr{S}_N^2}}(\theta)) = \begin{cases} \sup \mu_{A_{\mathscr{S}_N^2}}(\xi^*), & \text{if } \psi_1^{-1}(\theta) \neq \phi, \\ & \xi^* \in \psi_1^{-1}(\theta) \\ 0, & \text{elsewhere} \end{cases}$$

$$\psi_1(\sigma_{A_{\mathscr{S}_N^2}}(\theta)) = \begin{cases} \sup \sigma_{A_{\mathscr{S}_N^2}}(\xi^*), & \text{if } \psi_1^{-1}(\theta) \neq \phi, \\ & \xi^* \in \psi_1^{-1}(\theta) \\ 0, & \text{elsewhere} \end{cases}$$

$$\psi_1(\gamma_{A_{\mathscr{S}_N^2}}(\theta)) = \begin{cases} \inf(\gamma_{A_{\mathscr{S}_N^2}}(\xi^*), & \text{if} \psi_1^{-1}(\theta) \neq \phi, \\ & \xi^* \in \psi_1^{-1}(\theta) \\ 0, & \text{elsewhere} \end{cases}$$

Definition 2.10 ([2]). *A mapping $\psi_1 : (\mathscr{S}_N^1, \tau_{N_{\mathscr{S}_N^1}}) \to (\mathscr{S}_N^2, \tau_{N_{\mathscr{S}_N^2}})$ is called a*

1. *Neutrosophic continuous (Neu-continuous) if $\psi_1^{-1}(A_{\mathscr{S}_N^2}) \in NCS\mathscr{S}_N^1$ whenever $A_{\mathscr{S}_N^2} \in NCS\mathscr{S}_N^2$.*
2. *Neutrosophic α-continuous (Neu $\alpha-$continuous) if $\psi_1^{-1}(A_{\mathscr{S}_N^2}) \in N^\alpha CS\mathscr{S}_N^1$ whenever $A_{\mathscr{S}_N^2} \in NCS\mathscr{S}_N^2$.*
3. *Neutrosophic semi-continuous (Neu semi-continuous) if $\psi_1^{-1}(A_{\mathscr{S}_N^2}) \in N^s CS\mathscr{S}_N^1$ whenever $A_{\mathscr{S}_N^2} \in NCS\mathscr{S}_N^2$.*

Definition 2.11 ([2]). *A mapping $\psi_1 : (\mathscr{S}_N^1, \tau_{N_{\mathscr{S}_N^1}}) \to (\mathscr{S}_N^2, \tau_{N_{\mathscr{S}_N^2}})$ is called a*

1. *Neutrosophic open map if $\psi_1(A_{\mathscr{S}_N^1}) \in NOS\mathscr{S}_N^2$ whenever $A_{\mathscr{S}_N^1} \in NOS\mathscr{S}_N^1$.*
2. *Neutrosophic α-open map if $\psi_1(A_{\mathscr{S}_N^1}) \in N^\alpha OS\mathscr{S}_N^2$ whenever $A_{\mathscr{S}_N^1} \in NOS\mathscr{S}_N^1$.*
3. *Neutrosophic pre -open map if $\psi_1(A_{\mathscr{S}_N^1}) \in N^P 0S\mathscr{S}_N^2$ whenever $A_{\mathscr{S}_N^1} \in NOS\mathscr{S}_N^1$.*
4. *Neutrosophic β-open map if $\psi_1(A_{\mathscr{S}_N^1}) \in N^\beta OS\mathscr{S}_N^2$ whenever $A \in NOS\mathscr{S}_N^1$.*

3. Neutrosophic PRE-α,SEMI-α and PRE-β Irresolute Open Mappings

In this section, we introduce the Neutrosophic PRE-α, SEMI-α and PRE-β Irresolute Open Mappings and its properties.

Definition 3.1. *A mapping $\lambda_\dashv^N : (\mathfrak{R}_N^1, \mathfrak{I}_N^1) \to (\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ and $\lambda_\dashv^N$ is said to be*

1. *Neutrosophic Pre-α irresolute open (Neutrosophic pre-α -irresolute closed.) mapping if $\lambda_\dashv^N(V_1)$ is an $N^\alpha OS(N^\alpha CS)$ in $(\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ for every $N^P OS(N^P CS)V_1$ in $(\mathfrak{R}_N^1, \mathfrak{I}_N^1)$.*

2. *Neutrosophic α-irresolute open mapping (Neutrosophic α-irresolute closed) mapping if $\lambda_{\dashv}^{N}(V_1)$ is an $N^{\alpha}OS(N^{\alpha}CS)$ in $(\mathfrak{R}_N^2,\ \mathfrak{I}_N^2)$ for every $N^{\alpha}OS(CS)V_1$ in $(\mathfrak{R}_N^1,\ \mathfrak{I}_N^1)$.*
3. *Neutrosophic semi- α-irresolute open (Neutrosophic semi-α -irresolute closed.) mapping. if $\lambda_{\dashv}^{N}(V_1)$ is an $N^{\alpha}OS(N^{\alpha}CS)$ in $(\mathfrak{R}_N^2,\ \mathfrak{I}_N^2)$ for every $N^{\mathscr{S}}OS(N^{\mathscr{S}}CS)V_1$ in $(\mathfrak{R}_N^1,\ \mathfrak{I}_N^1)$.*
4. *Neutrosophic pre-β-irresolute open (Neutrosophic pre-β -irresolute closed.) mapping if $\lambda_{\dashv}^{N}(V_1)$ is an $N^{\beta}OS(N^{\beta}CS)$ in $(\mathfrak{R}_N^2,\mathfrak{I}_N^2)$ for every $N^{P}OS(N^{P}CS)V_1$ in $(\mathfrak{R}_N^1,\mathfrak{I}_N^1)$.*

Proposition 3.2. *Every Neutrosophic Pre-α (Neutrosophic α and Neutrosophic semi-α) irresolute open mapping is Neutrosophic α-open mapping.*

Proof. Let $\lambda_{\dashv}^{N}:(\mathfrak{R}_N^1,\mathfrak{I}_N^1)\to(\mathfrak{R}_N^2,\mathfrak{I}_N^2)$. Assume that $\lambda_{\dashv}^{N}$ is Neutrosophic pre-α (Neutrosophic α and Neutrosophic semi-α) -irresolute open mapping. Let V_1 be $NOS\mathfrak{R}_N^1$. Since every $NOS\mathfrak{R}^1$ is an $N^{P}OS\mathfrak{R}_N^1(N^{\alpha}OS\mathfrak{R}_N^1$ and $N^{\mathscr{S}}OS\mathfrak{R}_N^1)$. Take V_1 is an $N^{P}OS\mathfrak{R}_N^1(N^{\mathscr{S}}OS\mathfrak{R}_N^1$ and $N^{\mathscr{S}}OS\mathfrak{R}_N^1)$. As $\lambda_{\dashv}^{N}$ is an Neutrosophic pre-α (Neutrosophic- α and Neutrosophic semi-α, resp.) irresolute open mapping. $\lambda_{\dashv}^{N}(V_1)$ is an $N^{\alpha}OS\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^{N}$ is Neutrosophic $\alpha-open$ (Neutrosophic α and Neutrosophic semi-α) mapping. □

Remark 3.3. *The above converse of the Proposition necessity not be true as shown by the following below examples.*

Example 3.4. *Let $\mathfrak{R}_N^1=\{a_nb_nc_n\}=\mathfrak{R}_N^2$ then $\mathfrak{I}_N^1=\{0_N,A_{\mathfrak{R}_N^1},\ 1_N\}$, $\mathfrak{I}_N^2=\{0_N,\ B_{\mathfrak{R}_N^2},\ C_{\mathfrak{R}_N^2},\ B_{\mathfrak{R}_N^2 U}C_{\mathfrak{R}_N^2},\ B_{\mathfrak{R}_N^2}\cap C_{\mathfrak{R}_N^2},\ 1_N\}$ are Neutrosophic Ts on $\mathfrak{R}_N^1$ and $\mathfrak{R}_N^2$ where*

$$A_{\mathfrak{R}_N^1}=\{<x,\ (a_n,0.5,0.5,0.5),\ (b_n,0.4,0.5,0.6),(c_n,0.6,0.5,0.4)>;x\in\mathfrak{R}_N^1\}$$
$$B_{\mathfrak{R}_N^2}=\{<y,\ (a_n,0.5,0.5,0.5),\ (b_n,0.3,0.5,0.7),\ (c_n,0.6,0.5,0.4)>;y\in\mathfrak{R}_N^1\}$$
$$C_{\mathfrak{R}_N^2}=\{<y,\ (a_n,0.2,0.5,0.7),\ (b_n,0.4,0.5,0.6),\ (c_n,0.3,0.5,0.7)>;y\in\mathfrak{R}_N^1\}$$
$$D_{\mathfrak{R}_N^1}=\{<x,\ (a_n,0.5,0.5,0.4),\ (b_n,0.4,0.5,0.5),\ (c_n,0.6,0.5,0.4)>;x\in\mathfrak{R}_N^1\}.$$

Define an Neutrosophic mapping $\lambda_{\dashv}^{N}:(\mathfrak{R}_N^1,\ \mathfrak{I}_N^1)\to(\mathfrak{R}_N^2,\ \mathfrak{I}_N^2)$ by $\lambda_{\dashv}^{N}(a_n)=a_n$, $\lambda_{\dashv}^{N}(b_n)=b_n$, $\lambda_{\dashv}^{N}(c_n)=c_n$. Then $\lambda_{\dashv}^{N}(D_{\mathfrak{R}_N^1})$ is an $N^{\alpha}OS\mathfrak{R}_N^2$ and $\lambda_{\dashv}^{N}(D_{\mathfrak{R}_N^1})$ is an $N^{\beta}OS\mathfrak{R}_N^2$. Therefore $\lambda_{\dashv}^{N}$ is Neutrosophi $\alpha-$ open mapping and Neutrosophic-open mapping. $D_{\mathfrak{R}_N^1}$ is an Neutrosophic in $\mathfrak{R}_N^1$. Also $D_{\mathfrak{R}_N^1}$ is $N^{\alpha}OS\mathfrak{R}_N^1$. Thus $D_{\mathfrak{R}_N^1}$ is $N^{\beta}OS\mathfrak{R}_N^1$ and $N^{\mathscr{S}}OS\mathfrak{R}_N^1$. $\lambda_{\dashv}^{N}(D_{\mathfrak{R}_N^1})$ is not $N^{\alpha}0S\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^{N}$ is not Neutrosophic α-irresolute open mapping, not Neutrosophic pre- α -irresolute open mapping and not Neutrosophic Semi- $\alpha-$ irresolute open mapping.

Proposition 3.5. *Every Neutrosophic Pre-α Neutrosophic and Neutrosophic semi-α, resp.)-irresolute open mapping is Neutrosophic-open mapping.*

Proof. Let $\lambda_{\dashv}^{N}:(\mathfrak{R}_N^1,\ \mathfrak{I}_N^1)\to(\mathfrak{R}_N^2,\ \mathfrak{I}_N^2)$. Assume that $\lambda_{\dashv}^{N}$ is Neutrosophic pre- α (Neutrosophic α and Neutrosophic semi-α.)-irresolute open mapping. Let V_1 be $NOS\mathfrak{R}_N^1$. Since every $NOS\mathfrak{R}_N^1$ is an $N^{P}OS\mathfrak{R}_N^1(N^{\alpha}OS\mathfrak{R}_N^1$ and $N^{\mathscr{S}}OS\mathfrak{R}_N^1$, resp) V_1 is an $N^{P}OS\mathfrak{R}_N^1(N^{\alpha}OS\mathfrak{R}_N^1$ and $N^{\mathscr{S}}OS\mathfrak{R}_N^1)$. As $\lambda_{\dashv}^{N}$ is an Neutrosophic pre-α (Neutrosophic $\alpha-$ and Neutrosophic semi-α-, resp.) irresolute open mapping. $\lambda_{\dashv}^{N}(V_1)$ is an $N^{\alpha}OS$ in $\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^{N}(V_1)$ is an $N^{\beta}OS$ in $\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^{N}$ is Neutrosophic β-open(Neutrosophic α and Neutrosophic semi-α) mapping. □

Remark 3.6. *The above converse of the Proposition necessity not be true as shown by the following below examples.*

Example 3.7. *Let $\mathfrak{R}_N^1=\{a_n,b_n,c_n\}=\mathfrak{R}_N^2$ and let $\mathfrak{I}_N^1=\{0_N,A_{\mathfrak{R}_N^1},\ 1_N\}$, $\mathfrak{I}_N^2=\{0_N,\ B_{\mathfrak{R}_N^2},1_N\}$ be a two Neutrosophic Topological spaces on $\mathfrak{R}_N^1$ and $\mathfrak{R}_N^2$. Where*

$$A_{\mathfrak{R}_N^1}=\{<x,\ (a_n,0.5,0.5,0.3),(b_n,0.3,0.5,0.5),(c_n,0.4,0.5,0.6)>;x\in\mathfrak{R}_N^1\},$$
$$B_{\mathfrak{R}_N^2}=\{<y,\ (a_n,0.4,0.5,0.6),(b_n,0.4,0.5,0.3),(c_n,0.2,0.5,0.6)>;y\in\mathfrak{R}_N^1\},$$

Define an Neutrosophic mapping $\lambda_{\dashv}^{N}:(\mathfrak{R}_N^1,\mathfrak{I}_N^1)\to(\mathfrak{R}_N^2,\mathfrak{I}_N^2)$ by $\lambda_{\dashv}^{N}(a_n)=a_n$, $\lambda_{\dashv}^{N}(b_n)=b_n$, $\lambda_{\dashv}^{N}(c_n)=c_n$. Take $A_{\mathfrak{R}_N^1}$ is Neutrosophic Open set in $\mathfrak{R}_N^1$. Then $\lambda_{\dashv}^{N}(A_N)$ is an $N^{\beta}OS\mathfrak{R}_N^2$. Thus $\lambda_{\dashv}^{N}$ is Neutrosophic-open mapping. But not Neutrosophic Pre-α (Neutrosophic and Neutrosophic semi-α)-irresolute open mapping.

Proposition 3.8. *Every Neutrosophic pre-α (Neutrosophic semi-α) irresolute open mapping is Neutrosophic- irresolute open mapping.*

Proof. Consider, $\lambda_{\dashv}^{N}:(\mathfrak{R}_N^1,\mathfrak{I}_N^1)\to(\mathfrak{R}_N^2,\mathfrak{I}_N^2)$ is Neutrosophic pre-α (Neutrosophic semi-α.) - irresolute open mapping. Let V_1 be $N^{\alpha}OS\mathfrak{R}_N^1$. Since every $N^{\alpha}OS\mathfrak{R}_N^1$ is an $N^{P}OS\mathfrak{R}_N^1(N^{S}OS\mathfrak{R}_N^1)$. Then V_1 is an $N^{P}OS\mathfrak{R}_N^1(N^{\mathscr{S}}OS\mathfrak{R}_N^1)$. As $\lambda_{\dashv}^{N}$ is an Neutrosophic pre-α (Neutrosophic semi-α resp.) -irresolute open mapping, $\lambda_{\dashv}^{N}(V_1)$ is an $N^{\alpha}OS\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^{N}$ is Neutrosophic-irresolute open mapping. □

Remark 3.9. *The above converse of the Proposition necessity not be true as shown by the following below examples.*

Example 3.10. *Let $\mathfrak{R}_N^1=\{a_n,b_n,c_n\}=\mathfrak{R}_N^2$ and take,$\mathfrak{I}_N^1=\{0_N,A_{\mathfrak{R}_N^1},\ 1_N\},\mathfrak{I}_N^2=\{0_N,\ B_{\mathfrak{R}_N^2},\ 1_N\}$ are a two Neutrosophic*

Topological spaces on $\mathfrak{R}_N^1$ and $\mathfrak{R}_N^2$ where

$$A_{\mathfrak{R}_N^1} = \{< x, (a_n, 0.5, 0.5, 0.3), (b_n, 0.3, 0.5, 0.5), (c_n, 0.4, 0.5, 0.6) >; x \in \mathfrak{R}_N^1\},$$
$$B_{\mathfrak{R}_N^2} = \{< y, (a_n, 0.4, 0.5, 0.6), (b_n, 0.4, 0.5, 0.3), (c_n, 0.2, 0.5, 0.6) >; y \in \mathfrak{R}_N^1\},$$
$$C_{\mathfrak{R}_N^1} = \{< x, (a_b, 0.4, 0.5, 0.5), (b_n, 0.6, 0.5, 0.3), (c_n, 0.7, 0.5, 0.3) >; x \in \mathfrak{R}_N^1\}$$

Define an Neutrosophic mapping $\lambda_\dashv^N : (\mathfrak{R}_N^1, \mathfrak{I}_N^1) \to (\mathfrak{R}_N^2, \mathfrak{I}_N^2)$, $\lambda_\dashv^N(a_n) = a_n$, $\lambda_\dashv^N(b_n) = b_n$, $\lambda_\dashv^N(c_n) = c_n.A_{\mathfrak{R}_N^1 is}$ an Neutrosophic Open set and $N^\alpha OS\mathfrak{R}_N^1$. Hence $\lambda_\dashv^N(A_{\mathfrak{R}_N^1})$, is an $N^\alpha OS\mathfrak{R}_N^2$. Thus $\lambda_\dashv^N$ is Neutrosophic-irresolute open mapping. Then $C_{\mathfrak{R}_N^1}$ is $N^P OS\mathfrak{R}_N^1$ and $\lambda_\dashv^N(C_{\mathfrak{R}_N^1})$ is an $N^\beta OS\mathfrak{R}_N^2$. Thus $\lambda_\dashv^N$ is Neutrosophic pre-β-irresolute open mapping. But $\lambda_\dashv^N(C_{\mathfrak{R}_N^1})$ is not $N^\alpha OS\mathfrak{R}_N^2$. Hence $\lambda_\dashv^N$ is not Neutrosophic pre-α-irresolute open mapping.

Example 3.11. *Let $\mathfrak{R}_N^1 = \{a_n, b_n\}$, $\mathfrak{R}_N^2 = \{c_n, d_n\}$ and take,*

$$\mathfrak{I}_N^1 = \{0_{N\prime} A_{\mathfrak{R}_{N'}^1} 1_N\}, \qquad \mathfrak{I}_N^2 = \{0_N, B_{\mathfrak{R}_N^2}, 1_N\}$$

are two Neutrosophic Topological spaces on $\mathfrak{R}_N^1$ and $\mathfrak{R}_N^2$ where

$$A_{\mathfrak{R}_N^1} = \{< x, (a_n, 0.4, 0.5, 0.5), (b_n, 0.3, 0.5, 0.6) >; x \in \mathfrak{R}_N^1\},$$
$$B_{\mathfrak{R}_N^2} = \{< y, (c_n, 0.3, 0.5, 0.6), (d_n, 0.4, 0.5, 0.5) >; y \in \mathfrak{R}_N^1\},$$
$$C_{\mathfrak{R}_N^1} = \{< x, (a_n, 0.4, 0.5, 0.5), (b_n, 0.6, 0.5, 0.3) >; x \in \mathfrak{R}^{1_N}\}$$

is in Neutrosophic $\mathfrak{R}^{1_N}$. Define an Neutrosophic mapping $\lambda_\dashv^N : (\mathfrak{R}^{1_N}, \mathfrak{I}^{1_N}) \to (\mathfrak{R}_N^2, \mathfrak{I}_N^2)\lambda_\dashv^N(a_n) = c_n, \lambda_\dashv^N(b_n) = d_n$. Then $A_{\mathfrak{R}_N^1}$ is an $NOS\mathfrak{R}_N^1$ and $N^\alpha OS\mathfrak{R}_N^1$. Therefore $\lambda_\dashv^N$ is Neutrosophic α-irresolute open mapping. and also $C_{\mathfrak{R}_N^1}$ is an $N^{\mathscr{S}} OS\mathfrak{R}_N^1$. Hence $\lambda_\dashv^N(C_{\mathfrak{R}_N^1})$ is not in $N^\alpha OS\mathfrak{R}_N^2$ and $\lambda_\dashv^N$ is not Neutrosophic semi-α-irresolute open mapping.

Proposition 3.12. *Every Neutrosophic pre-α irresolute open mapping is Neutrosophic pre-β-irresolute open mapping.*

Proof. Consider, $\lambda_\dashv^N : (\mathfrak{R}_N^1, \mathfrak{I}_N^1) \to (\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ is Neutrosophic pre-α irresolute open mapping. Let V_1 be $N^P OS\mathfrak{R}_N^1$. As $\lambda_\dashv^N$ is an Neutrosophic pre-α irresolute open mapping, $\lambda_\dashv^N(V_1)$ is an $N^\alpha OS\mathfrak{R}_N^2$. Hence $\lambda_\dashv^N(V_1)$ is an $N^\beta OS\mathfrak{R}_N^2$. Hence $\lambda_\dashv^N$ is Neutrosophic pre β-irresolute open mapping. □

Remark 3.13. *The above converse of the Proposition necessity not be true as shown by the following below examples.*

Example 3.14. *Let $\mathfrak{R}_N^1 = \{a_n, b_n, c_n\} = \mathfrak{R}_N^2$ and take $\mathfrak{I}_N^1 = \{0_N, A_{\mathfrak{R}_N^1}, 1_N\}$, $\mathfrak{I}_N^2 = \{0_N, B_{\mathfrak{R}_N^2}, 1_N\}$ are a two Neutrosophic Topological spaces on $\mathfrak{R}_N^1$ and $\mathfrak{R}_N^2$ where*

$$A_{\mathfrak{R}_N^1} = \{< x, (a_n, 0.5, 0.5, 0.3), (b_n, 0.3, 0.5, 0.5), (c_n, 0.4, 0.5, 0.6) >; x \in \mathfrak{R}_N^1\},$$
$$B_{\mathfrak{R}_N^2} = \{< y, (a_n, 0.4, 0.5, 0.6), (b_n, 0.4, 0.5, 0.3), (c_n, 0.2, 0.5, 0.6) >; y \in \mathfrak{R}_N^1\},$$
$$C_{\mathfrak{R}_N^1} = \{< x, (a_n, 0.4, 0.5, 0.5), (b_n, 0.6, 0.5, 0.3), (c_n, 0.7, 0.5, 0.3) >; x \in \mathfrak{R}_N^1\}.$$

is in neutrosophic $\mathfrak{R}_N^1$. Define an Neutrosophic mapping $\lambda_\dashv^N : (\mathfrak{R}_N^1, \mathfrak{I}_N^1) \to (\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ by $\lambda_\dashv^N(a_n) = b_n$, $\lambda_\dashv^N(b_n) = c_n, \lambda_\dashv^N(c_n) = a_n$. Here $A_{\mathfrak{R}_N^1}$ is an NeutrosophicOpen set and, $N^\alpha OS\mathfrak{R}_N^1$. We get, $\lambda_\dashv^N(A_{\mathfrak{R}_N^1})$, is an $N^\alpha OS\mathfrak{R}_N^2$ in $\mathfrak{R}_N^2$. Thus $\lambda_\dashv^{Nis}$ Neutrosophic- irresolute open mapping. Finally $C_{\mathfrak{R}_N^1}$ is $N^P OS\mathfrak{R}_N^1$. We get $\lambda_\dashv^N(C_{\mathfrak{R}_N^1})$ is an $N^\beta OS\mathfrak{R}_N^2$. Thus $\lambda_\dashv^N$ is Neutrosophic pre-β-irresolute open mapping. And also $\lambda_\dashv^N(C_{\mathfrak{R}_N^1})$ is not $N^\alpha OS\mathfrak{R}_N^2$. Hence $\lambda_\dashv^N$ is not Neutrosophic Pre-α-irresolute open mapping.

Proposition 3.15. *Every Neutrosophic semi-α-irresolute open mapping is Neutrosophic irresolute open mapping.*

Proof. Take $\lambda_\dashv^N : (\mathfrak{R}_N^1, \mathfrak{I}_N^1) \to (\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ from an Neutrosophic topological space. $(\mathfrak{R}_N^1, \mathfrak{I}_N^1)$ to another Neutrosophic topological space $(\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ is Neutrosophic semi- α -irresolute open mapping. Let $C_{\mathfrak{R}_N^1}$ bein $N^{\mathscr{S}} OS\mathfrak{R}_N^1$. As $\lambda_\dashv^N$ is an Neutrosophic semi-$\alpha-$ irresolute open $\lambda_\dashv^N(C_{\mathfrak{R}_N^1})$ is an $N^\alpha OS\mathfrak{R}_N^2$. Every $N^\alpha OS\mathfrak{R}_N^2$ is also in $N^S OS\mathfrak{R}_N^2$. So $\lambda_\dashv^N(C_{\mathfrak{R}_N^1})$ is $N^{\mathscr{S}} OS\mathfrak{R}_N^2$. Hence $\lambda_\dashv^N$ is Neutrosophic irresolute open mapping. □

Remark 3.16. *The above converse of the Proposition necessity not be true as shown by the following below examples.*

Example 3.17. *Let $\mathfrak{R}_N^1 = \{a_n, b_n, c_n\} = \mathfrak{R}_N^2$, then $\mathfrak{I}_N^1 = \{0_N, A_{\mathfrak{R}_N^1}, 1_N\}$, $\mathfrak{I}_N^2 = \{0_N, B_{\mathfrak{R}_N^2}, C_{\mathfrak{R}_N^2}, B_{\mathfrak{R}_N^2} \cup C_{\mathfrak{R}_N^2}, B_{\mathfrak{R}_N^2} \cap C_{\mathfrak{R}_N^2}, 1_N\}$ are Neutrosophic Ts on $\mathfrak{R}_N^1$ and $\mathfrak{R}_N^2$, where*

$$A_{\mathfrak{R}_N^1} = \{< x, (a_n, 0.5, 0.5, 0.5), (b_n, 0.4, 0.5, 0.6), (c_n, 0.6, 0.5, 0.4) >; x \in \mathfrak{R}_N^1\}$$
$$B_{\mathfrak{R}_N^2} = \{< y, (a_n, 0.5, 0.5, 0.5), (b_n, 0.3, 0.5, 0.7), (c_n, 0.6, 0.5, 0.4) >; y \in \mathfrak{R}_N^1\}$$
$$C_{\mathfrak{R}_N^2} = \{< y, (a_n, 0.2, 0.5, 0.7), (b_n, 0.4, 0.5, 0.6), (c_n, 0.3, 0.5, 0.7) >; y \in \mathfrak{R}_N^1\}$$
$$D_{\mathfrak{R}_N^1} = \{< x, (a_n, 0.5, 0.5, 0.4), (b_n, 0.4, 0.5, 0.5), (c_n, 0.6, 0.5, 0.4) >; x \in \mathfrak{R}_N^1\}.$$

Define an Neutrosophic mapping $\lambda_{\dashv}^{N}:(\mathfrak{R}_N^1,\ \mathfrak{I}_N^1)\to(\mathfrak{R}_N^2,\ \mathfrak{I}_N^2)$ by $\lambda_{\dashv}^{N}(a_n)=a_n$, $\lambda_{\dashv}^{N}(b_n)=b_n$, $\lambda_{\dashv}^{N}(c_n)=c_n$.

Then $A_{\mathfrak{R}_N^1}$ and $D_{\mathfrak{R}_N^1}$ arein $N^S OS\mathfrak{R}_N^1$ and $\lambda_{\dashv}^{N}(A_{\mathfrak{R}_N^1})$ and $\lambda_{\dashv}^{N}(D_{\mathfrak{R}_N^1})$ are $N^S OS$ in $\mathfrak{R}_N^2$. So $\lambda_{\dashv}^{N}$ is Neutrosophic irresolute open mapping. But $\lambda_{\dashv}^{N}(D_{\mathfrak{R}_N^1})$ is not $N^{\alpha}OS$ in $\mathfrak{R}_N^2$. Therefore $\lambda_{\dashv}^{N}$ is not Neutrosophic semi-α-irresolute open mapping.

Proposition 3.18. *Every Neutrosophic pre-β-irresolute open mapping is Neutrosophic β -open mapping.*

Proof. Let $\lambda_{\dashv}^{N}$ be a map from an Neutrosophic topological space $(\mathfrak{R}_N^1,\ \mathfrak{I}_N^1)$ to another Neutrosophic topological space $(\mathfrak{R}_N^2,\ \mathfrak{I}_N^2)$ and Neutrosophic pre-β -irresolute open mapping. Let $C_{\mathfrak{R}_N^1}$ be $NOS\mathfrak{R}_N^1$. Since every $NOS\mathfrak{R}_N^1$ is an $N^P OS\mathfrak{R}_N^1$, hence $C_{\mathfrak{R}_N^1}$ is an $N^P OS\mathfrak{R}_N^1$. As $\lambda_{\dashv}^{N}$ is an Neutrosophic pre-β -irresolute open. we get $\lambda_{\dashv}^{N}(C_{\mathfrak{R}_N^1})$ is an $N^{\beta}OS\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^{N}$ is Neutrosophic β -open mapping. □

Remark 3.19. *The above converse of the Proposition necessity not be true as shown by the following below examples.*

Example 3.20. *Let $\mathfrak{R}_N^1=\{a_n,b_n,c_n\}=\mathfrak{R}_N^2$, then $\mathfrak{I}_N^1=\{0_N,A_{\mathfrak{R}_N^1},\ 1_N\}$, $\mathfrak{I}_N^2=\{0_N,\ B_{\mathfrak{R}_N^2},\ C_{\mathfrak{R}_N^2},\ B_{\mathfrak{R}_N^2}\cup C_{\mathfrak{R}_N^2},\ B_{\mathfrak{R}_N^2}\cap C_{\mathfrak{R}_N^2},\ 1_N\}$ are Neutrosophic Ts on $\mathfrak{R}_N^1$ and $\mathfrak{R}_N^2$, where*

$$\begin{aligned}A_{\mathfrak{R}_N^1}&=\{<x,(a_n,0.5,0.5,0.5),(b_n,0.4,0.5,0.6),\\&\quad(c_n,\ 0.6,0.5,0.4)>;x\in\mathfrak{R}_N^1\}\\B_{\mathfrak{R}_N^2}&=\{<y,(a_n,0.5,0.5,0.5),(b_n,0.3,0.5,0.7),\\&\quad(c_n,\ 0.6,0.5,0.4)>;y\in\mathfrak{R}_N^1\}.\\C_{\mathfrak{R}_N^2}&=\{<y,(a_n,0.2,0.5,0.7),(b_n,0.4,0.5,0.6),\\&\quad(c_n,\ 0.3,0.5,0.7)>;y\in\mathfrak{R}_N^1\}\\D_{\mathfrak{R}_N^1}&=\{<x,\ (a_n,\ 0.5,0.5,0.4),\ (b_n,\ 0.4,0.5,0.5),\\&\quad(c_n,0.6,0.5,0.4)>;x\in\mathfrak{R}_N^1\}\end{aligned}$$

Define an Neutrosophic mapping $\lambda_{\dashv}^{N}:(\mathfrak{R}_N^1,\ \mathfrak{I}_N^1)\to(\mathfrak{R}_N^2,\ \mathfrak{I}_N^2)$ by $\lambda_{\dashv}^{N}(a_n)=a_n$, $\lambda_{\dashv}^{N}(b_n)=b_n$, $\lambda_{\dashv}^{N}(c_n)=c_n$. Here $A_{\mathfrak{R}_N^1 is}$ an $NOS\mathfrak{R}_N^1$. We get $\lambda_{\dashv}^{N}$ is an $N^{\beta}OS\mathfrak{R}_N^2$ which implies $\lambda_{\dashv}^{N}$ is β-open mapping. But $D_{\mathfrak{R}_N^1}$ is $N^P OS$ in $\mathfrak{R}_N^1$ and $\lambda_{\dashv}^{N}(D_{\mathfrak{R}_N^1})$ is not $N^{\beta}OS\mathfrak{R}_N^2$. So, $\lambda_{\dashv}^{Nis}$ not Neutrosophic pre-β irresolute open mapping.

Proposition 3.21. *Every Neutrosophic pre-α-irresolute open mapping is Neutrosophic pre irresolute open mapping.*

Proof. Let $\lambda_{\dashv}^{N}:(\mathfrak{R}_N^1,\ \mathfrak{I}_N^1)\to(\mathfrak{R}_N^2,\ \mathfrak{I}_N^2)$ from an Neutrosophic topological space to another Neutrosophic topological space and Neutrosophic pre-α-irresolute open mapping. Let $A_{\mathfrak{R}_N^1}$ be in $N^P OS\mathfrak{R}_N^1$. As $\lambda_{\dashv}^{N}$ is Neutrosophic pre- α-irresolute open. We get $\lambda_{\dashv}^{N}(A_{\mathfrak{R}_N^1})$ is an $N^{\alpha}OS\mathfrak{R}_N^2$. As every $N^{\alpha}OS\mathfrak{R}_N^2$ is $N^P OS\mathfrak{R}_N^2$, finally $\lambda_{\dashv}^{N}(A_{\mathfrak{R}_N^1})$ is an $N^P OS\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^{N}$ is Neutrosophic pre irrresolute open mapping. □

Remark 3.22. *The above converse of the Proposition necessity not be true as shown by the following below examples.*

Remark 3.23. *Let $\mathfrak{R}_N^1=\{a_n,b_n,c_n\}=\mathfrak{R}_N^2$ and take, $\mathfrak{I}_N^1=\{0_N,A_{\mathfrak{R}_N^1},\ 1_N\}$, $\mathfrak{I}_N^2=\{0_N,\ B_{\mathfrak{R}_N^2},\ 1_N\}$ are a two Neutrosophic Topological spaces on $\mathfrak{R}_N^1$ and $\mathfrak{R}_N^2$, where*

$$\begin{aligned}A_{\mathfrak{R}_N^1}&=\{<x,\ (a_n,\ 0.5,0.5,0.3),\ (b_n,\ 0.3,0.5,0.5),\\&\quad(c_n,0.4,0.5,0.6)>;x\in\mathfrak{R}_N^1\},\\B_{\mathfrak{R}_N^2}&=\{<y,\ (a_n,\ 0.4,0.5,0.6),\ (b_n,\ 0.4,0.5,0.3),\\&\quad(c_n,\ 0.2,0.5,0.6)>;y\in\mathfrak{R}_N^1\},\\C_{\mathfrak{R}_N^1}&=\{<x,(a_n,0.4,0.5,0.5),(b_n,0.6,0.5,0.3),\\&\quad(c_n,0.7,0.5,0.3)>;x\in\mathfrak{R}_N^1\}\end{aligned}$$

Define an Neutrosophic mapping $\lambda_{\dashv}^{N}:(\mathfrak{R}_N^1,\ \mathfrak{I}_N^1)\to(\mathfrak{R}_N^2,\ \mathfrak{I}_N^2)$ $\lambda_{\dashv}^{N}(a_n)=b_n$, $\lambda_{\dashv}^{N}(c_n)=b_n$, $\lambda_{\dashv}^{N}(c_n)=a_n$. Then $A_{\mathfrak{R}_N^1}$ and $C_{\mathfrak{R}_N^1}$ are $N^P OS\mathfrak{R}_N^1$ and $\lambda_{\dashv}^{N}(A_{\mathfrak{R}_N^1})$ and $\lambda_{\dashv}^{N}(C_{\mathfrak{R}_N^1})$ are in $N^P OS\mathfrak{R}_N^2$. Therefore $\lambda_{\dashv}^{N}$ is Neutrosophic pre irresolute open mapping. But $\lambda_{\dashv}^{N}(C_{\mathfrak{R}_N^1})$ is not $N^{\alpha}OS\mathfrak{R}_N^2$. Thus $\lambda_{\dashv}^{N}$ is not Neutrosophic pre-α-irresolute open mapping. Hence the converse of the above Proposition need not be true.

Proposition 3.24. *Every Neutrosophic pre irresolute open mapping is Neutrosophic pre-β-irresolute open mapping.*

Proof. Take, $\lambda_{\dashv}^{N}:(\mathfrak{R}_N^1,\ \mathfrak{I}_N^1)\to(\mathfrak{R}_N^2,\ \mathfrak{I}_N^2)$ from an Neutrosophic topological space $(\mathfrak{R}_N^1,\ \mathfrak{I}_N^1)$ to another Neutrosophic topological space $(\mathfrak{R}_N^2,\ \mathfrak{I}_N^2)$ is Neutrosophic pre irresolute open mapping. Let $A_{\mathfrak{R}_N^1}$ be in $N^P OS\mathfrak{R}_N^1$. As $\lambda_{\dashv}^{N}$ is Neutrosophic pre irresolute open $\lambda_{\dashv}^{N}(A_{\mathfrak{R}_N^1})$ is an $N^P OS\mathfrak{R}_N^2$. As every $N^P OS\mathfrak{R}_N^2$ is $N^{\beta}OS\mathfrak{R}_N^2$. Fianally we get $\lambda_{\dashv}^{N}(A_{\mathfrak{R}_N^1})$ is an $N^{\beta}OS\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^{N}$ is Neutrosophic pre-β -irrresolute open mapping. □

Remark 3.25. *Let $\mathfrak{R}_N^1=\{a_n,b_n,c_n\}=\mathfrak{R}_N^2$ then $\mathfrak{I}_N^1=\{0_N,A_{\mathfrak{R}_N^1},\ 1_N\}$, $\mathfrak{I}_N^2=\{0_N,\ B_{\mathfrak{R}_N^2},\ C_{\mathfrak{R}_N^2},\ B_{\mathfrak{R}_N^2}\cup C_{\mathfrak{R}_N^2},\ B_{\mathfrak{R}_N^2}\cap C_{\mathfrak{R}_N^2},\ 1_N\}$ are Neutrosophic Ts on $\mathfrak{R}_N^1$ and $\mathfrak{R}_N^2$, where*

$$\begin{aligned}A_{\mathfrak{R}_N^1}&=\{<x,\ (a_n,\ 0.5,0.5,0.5),(b_n,\ 0.4,0.5,0.6),\\&\quad(c_n,\ 0.6,0.5,0.4)>;x\in\mathfrak{R}_N^1\}\\B_{\mathfrak{R}_N^2}&=\{<y,(a_n,0.5,0.5,0.5),(b_n,0.3,0.5,0.7),\\&\quad(c_n,0.6,0.5,0.4)>;y\in\mathfrak{R}_N^1\}.\\C_{\mathfrak{R}_N^2}&=\{<y,(a_n,0.2,0.5,0.7),(b_n,0.4,0.5,0.6),\\&\quad(c_n,0.3,0.5,0.7)>;y\in\mathfrak{R}_N^1\}\\D_{\mathfrak{R}_N^1}&=\{<x,\ (a_n,0.5,0.5,0.4),(b_n,0.4,0.5,0.5),\\&\quad(c_n,\ 0.6,0.5,0.4)>;x\in\mathfrak{R}_N^1\}.\end{aligned}$$

Define an Neutrosophic mapping $\lambda_{\dashv}^{N}:(\mathfrak{R}_N^1,\ \mathfrak{I}_N^1)\to(\mathfrak{R}_N^2,\ \mathfrak{I}_N^2)$ by $\lambda_{\dashv}^{N}(a_n)=a_n$, $\lambda_{\dashv}^{N}(b_n)=b_n$,

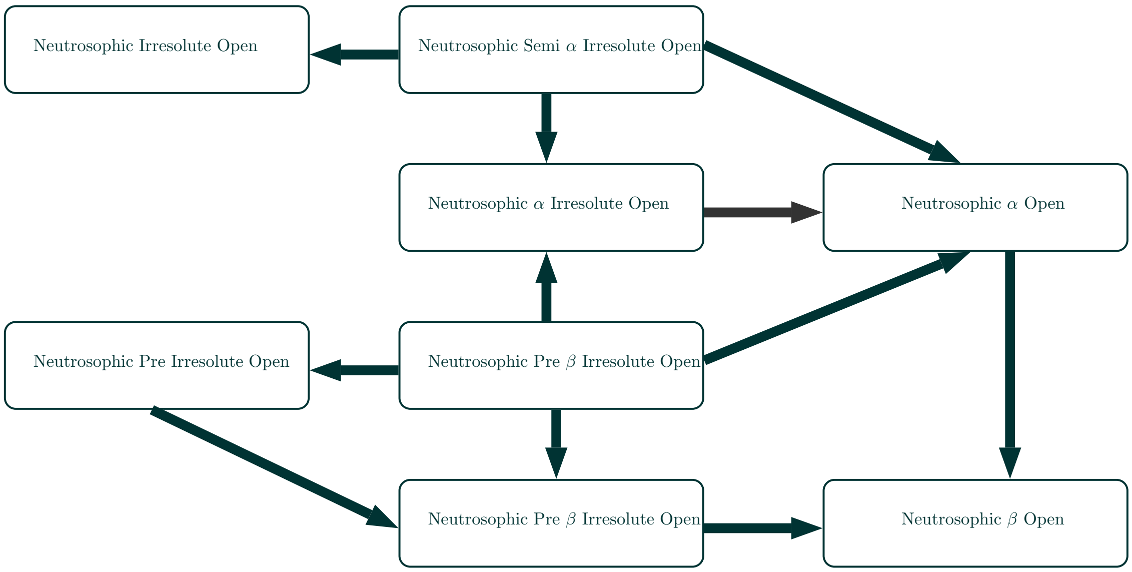

Figure 1

$\lambda_{\dashv}^{N}(c_n) = c_n$. Here $A_{\mathfrak{R}_N^1}$. And $D_{\mathfrak{R}_N^1}$ are in $N^P OS\mathfrak{R}_N^1$ and $\lambda_{\dashv}^{N}(A_{\mathfrak{R}_N^1})$ and $\lambda_{\dashv}^{N}(D_{\mathfrak{R}_N^1})$ are in $N^\beta OS\mathfrak{R}_N^2$. But $\lambda_{\dashv}^{N}(D_{\mathfrak{R}_N^1})$ is not in $N^P OS\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^{N}$ is Neutrosophic pre-β-irresolute open mapping and not Neutrosophic pre irresolute open mapping. Thus the converse of the above Proposition need not be true.

Diagram I

Interrelationships between Neutrosphicpre-α (Neutrosphic $alpha$, Neutrosphic semi-α and Neutrosphic pre-β, resp.) -irresolute open mappings with existing mappings in Neutrosphic topological spaces.

4. Properties and Characterizations

Theorem 4.1. *Let $(\mathfrak{R}_N^1, \mathfrak{I}_N^1)$, $(\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ and $(\mathfrak{R}_N^3, \mathfrak{I}_N^3)$ be Neutrosophic TSs. Let $\lambda_{\dashv}^{N} : (\mathfrak{R}_N^1, \mathfrak{I}_N^1) \to (\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ and $\mu_{\dashv}^{N} : (\mathfrak{R}_N^2, \mathfrak{I}_N^2) \to (\mathfrak{R}_N^3, \mathfrak{I}_N^3)$ be any two maps. If $\mu_{\dashv}^{N} \circ \lambda_{\dashv}^{N} : (\mathfrak{R}_N^1, \mathfrak{I}_N^1) \to (\mathfrak{R}_N^3, \mathfrak{I}_N^3)$ is Neutrosophic pre-α-irresolute (Neutrosophic semi-α-irresolute) open and $\lambda_{\dashv}^{N}$ is Onto, Neutrosophic pre-α-irresolute (Neutrosophic semi-$\alpha-$irresolute, resp.) function then $\mu_{\dashv}^{N}$ is Neutrosophic α-irresolute open mapping.*

Proof. Let C_N be any in $N^\alpha OS\mathfrak{R}_N^2$. Since $\lambda_{\dashv}^{N}$ is an Neutrosophic pre-α-irresolute (Neutrosophic semi-α-irresolute.) function, $\lambda_{\dashv}^{N^{-1}}(C_N)$is $N^P OS\mathfrak{R}_N^1 (N^{\mathscr{S}} OS\mathfrak{R}_N^1)$. Also $\mu_{\dashv}^{N} \circ \lambda_{\dashv}^{N}$ is Neutrosophic pre-α -irresolute (Neutrosophic semi- α -irresolute.) open. Therefore $(\mu_{\dashv}^{N} \circ \lambda_{\dashv}^{N})\lambda_{\dashv}^{N^{-1}}(C_N) = \mu_{\dashv}^{N}(C_N)$ is an $N^\alpha OS\mathfrak{R}_N^3$ in $(\mathfrak{R}_N^3, \mathfrak{I}_N^3)$. Hence $\mu_{\dashv}^{N}$ is an Neutrosophic-α-irresolute open mapping. □

Theorem 4.2. *Let $(\mathfrak{R}_N^1, \mathfrak{I}_N^1)$, $(\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ and $(\mathfrak{R}_N^3, \mathfrak{I}_N^3)$ be Neutrosophic TSs. Let $\lambda_{\dashv}^{N} : (\mathfrak{R}_N^1, \mathfrak{I}_N^1) \to (\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ and $\mu_{\dashv}^{N} : (\mathfrak{R}_N^2, \mathfrak{I}_N^2) \to (\mathfrak{R}_N^3, \mathfrak{I}_N^3)$ be any two maps. If $\mu_{\dashv}^{N} \circ \lambda_{\dashv}^{N} : (\mathfrak{R}_N^1, \mathfrak{I}_N^1) \to (\mathfrak{R}_N^3, \mathfrak{I}_N^3)$ is an Neutrosophic α-irresolute open and $\lambda_{\dashv}^{Nis}$ surjective, Neutrosophic α-continuous function then $\mu_{\dashv}^{N}$ is Neutrosophic α-open mapping.*

Proof. Let B_N be any in $NOS\mathfrak{R}_N^2$. Since $\lambda_{\dashv}^{N}$ is an Neutrosophic α-continuous function, $\lambda_{\dashv}^{N^{-1}}(B_N)$ is $N^\alpha OS\mathfrak{R}_N^1$. As $\mu_{\dashv}^{N} \circ \lambda_{\dashv}^{N}$ is Neutrosophic α-irresolute open, then $((\mu_{\dashv}^{\Box} \circ \lambda_{\dashv}^{N})(\lambda_{\dashv}^{N^{-1}}(B_N)) = \mu_{\dashv}^{N}(B_N)$ is an $N^\alpha OS\mathfrak{R}_N^3$ in $(\mathfrak{R}_N^3, \mathfrak{I}_N^3)$. Hence $\mu_{\dashv}^{N}(B_N)$ is an Neutrosophic-α open mapping. □

Theorem 4.3. *Let $(\mathfrak{R}_N^1, \mathfrak{I}_N^1), (\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ and $(\mathfrak{R}_N^3, \mathfrak{I}_N^3)$ be Neutrosophic TSs. Let $\lambda_{\dashv}^{N} : (\mathfrak{R}_N^1, \mathfrak{I}_N^1) \to (\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ and $\mu_{\dashv}^{N} : (\mathfrak{R}_N^2, \mathfrak{I}_N^2) \to (\mathfrak{R}_N^3, \mathfrak{I}_N^3)$ be any two maps. If $\mu_{\dashv}^{N} \circ \lambda_{\dashv}^{N} : (\mathfrak{R}_N^1, \mathfrak{I}_N^1) \to (\mathfrak{R}_N^3, \mathfrak{I}_N^3)$ is Neutrosophic pre-β-irresolute open and $\lambda_{\dashv}^{N}$ is surjective, Neutrosophic pre irresolute function then $\mu_{\dashv}^{N}$ is Neutrosophic pre-β -irresolute open mapping.*

Proof. Let B_N be any in $NOS\mathfrak{R}_N^2$. Since $\lambda_{\dashv}^{N}(B_N)$ is Neutrosophic pre-irresolute function, $\lambda_{\dashv}^{N^{-1}}(B_N)$ is $N^P OS\mathfrak{R}_N^1$. As $\mu_{\dashv}^{N} \circ \lambda_{\dashv}^{N}$ is Neutrosophic pre-β-irresolute open, $(\mu_{\dashv}^{N} \circ \lambda_{\dashv}^{N})(\lambda_{\dashv}^{N^{-1}}(B_N)) = \mu_{\dashv}^{N}(B_N)$ is an $N^\beta OS\mathfrak{R}_N^3$ in $(\mathfrak{R}_N^3, \mathfrak{I}_N^3$. Hence $\mu_{\dashv}^{N}$ is an Neutrosophic pre-β -irresolute open mapping. □

Theorem 4.4. *Let $(\mathfrak{R}_N^1, \mathfrak{I}_N^1), (\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ and $(\mathfrak{R}_N^3, \mathfrak{I}_N^3)$ be Neutrosophic TSs. Let $\lambda_{\dashv}^{N} : (\mathfrak{R}_N^1, \mathfrak{I}_N^1) \to (\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ and $\mu_{\dashv}^{N} : (\mathfrak{R}_N^2, \mathfrak{I}_N^2) \to (\mathfrak{R}_N^3, \mathfrak{I}_N^3)$be any two maps. If $\mu_{\dashv}^{N} \circ \lambda_{\dashv}^{N} : (\mathfrak{R}_N^1, \mathfrak{I}_N^1) \to (\mathfrak{R}_N^3, \mathfrak{I}_N^3)$. Then the following statements hold:*

1. *If $\lambda_{\dashv}^{N}$ is Neutrosophic pre-α-irresolute (Neutrosophic α-irresolute and Neutrosophic semi -$\alpha-$ irresolute) open and $\mu_{\dashv}^{N}$ is Neutrosophic α-irresolute open*

mappings, then $\mu^N_\dashv \circ \lambda^N_\dashv : (\mathfrak{R}^1_N, \mathfrak{I}^1_N) \to (\mathfrak{R}^3_N, \mathfrak{I}^3_N)$ is Neutrosophic pre-α-irresolute (Neutrosophic α-irresolute and Neutrosophic semi-α-irresolute, resp.) open mapping.

2. *If $\lambda^N_\dashv$ is Neutrosophic pre open (Neutrosophic α-open and Neutrosophic semi open, resp.) mapping and $\mu^N_\dashv$ is an Neutrosophic pre-α-irresolute (Neutrosophic α -irresolute and Neutrosophic semi-α-irresolute, resp.) open mapping then $\mu^N_\dashv \circ \lambda^N_\dashv : (\mathfrak{R}^1_N, \mathfrak{I}^1_N) \to (\mathfrak{R}^3_N, \mathfrak{I}^3_N)$ is an Neutrosophic-open mapping.*

3. *If $\lambda^N_\dashv$ is Neutrosophic pre irresolute open and $\mu^N_\dashv$ is Neutrosophic pre-β-irresolute open then $\mu^N_\dashv \circ \lambda^N_\dashv : (\mathfrak{R}^1_N, \mathfrak{I}^1_N) \to (\mathfrak{R}^3_N, \mathfrak{I}^3_N)$ is Neutrosophic pre-β -irresolute open mapping.*

4. *If $\lambda^N_\dashv$ is Neutrosophic pre open mapping and $\mu^N_\dashv$ is Neutrosophic pre-β-irresolute open mapping then $\mu^N_\dashv \circ \lambda^N_\dashv : (\mathfrak{R}^1_N, \mathfrak{I}^1_N) \to (\mathfrak{R}^3_N, \mathfrak{I}^3_N)$ is an Neutrosophic-β-open mapping.*

Proof. 1. Let B_N be an $N^P OS\mathfrak{R}^1_N (N^\alpha OS\mathfrak{R}^1_N$ and $N^{\mathscr{S}} OS\mathfrak{R}^1_N$, resp.) in $\mathfrak{R}^1_N$. Since $\lambda^N_\dashv$ is Neutrosophic pre-α-irresolute (Neutrosophic α-irresolute and Neutrosophic semi-α-irresolute,resp.) open, $\lambda^N_\dashv(B_N)$ is an $N^\alpha OS$ in $\mathfrak{R}^2_N$. Now $(\mu^N_\dashv \circ \lambda^N_\dashv)(B_N) = \mu^N_\dashv(\lambda^N_\dashv(B_N))$. Also $\mu^N_\dashv$ is Neutrosophic-α-irresolute open, $\mu^N_\dashv(\lambda^N_\dashv(B_N))$ is $N^\alpha OS\mathfrak{R}^3_N$ in $\mathfrak{R}^3_N$. Hence $\mu^N_\dashv \circ \lambda^N_\dashv$ is Neutrosophic pre-$\alpha-$irresolute (Neutrosophic-irresolute and Neutrosophic semi-$\alpha-$ irresolute, resp.) open mapping.

2. Let B_N be an in$NOS\mathfrak{R}^1_N$. Since $\lambda^N_\dashv$ is Neutrosophic pre open (Neutrosophic $\alpha-$open and Neutrosophic semi open, resp.), $\lambda^N_\dashv(B_N)$ is $N^P OS\mathfrak{R}^2_N (N^\alpha OS\mathfrak{R}^2_N$ and $N^{SOS}\mathfrak{R}^2_N$, resp.) in $\mathfrak{R}^2_N$. Now $(\mu^N_\dashv \circ \lambda^N_\dashv(B_N) = \mu^N_\dashv(\lambda^N_\dashv(B_N))$. As $\mu^N_\dashv$ is Neutrosophic pre-α (Neutrosophic α and Neutrosophic semi-α resp.)-irresolute open, $\mu^N_\dashv(\lambda^N_\dashv(B_N))$ is $N^\alpha OS\mathfrak{R}^2_N$ in $\mathfrak{R}^3_N$. Hence $\mu^N_\dashv \circ \lambda^N_\dashv$ is Neutrosophic α-open mapping.

3. Let A_N be an $N^P OS\mathfrak{R}^1_N$ in $\mathfrak{R}^1_N$. Since $\lambda^N_\dashv$ is Neutrosophic pre irresolute open $\lambda^N_\dashv(A_N)$ is an $N^P OS\mathfrak{R}^2_N$ in $\mathfrak{R}^2_N$. Now $(\mu^N_\dashv \circ \lambda^N_\dashv)(A_N) = \mu^N_\dashv(\lambda^N_\dashv(A_N))$. But $\mu^N_\dashv$ is Neutrosophic pre-β -irresolute open, $\mu^N_\dashv(\lambda^N_\dashv A_N)$ is $N^\beta OS\mathfrak{R}^2_N$ in $\mathfrak{R}^3_N$. Hence $\mu^N_\dashv \circ \lambda^N_\dashv$ is Neutrosophic pre-β -irresolute open mapping.

4. Let B_N be an in $NOS\mathfrak{R}^1_N$. Since $\lambda^N_\dashv$ is Neutrosophic preopen, $\lambda^N_\dashv(B_N)$ is an $N^P OS\mathfrak{R}^2_N$. Now $(\mu^N_\dashv \circ \lambda^N_\dashv)(B_N) = \mu^N_\dashv(\lambda^N_\dashv(B_N))$. But $\mu^N_\dashv$ is Neutrosophic pre-β -irresolute open, $\mu^N_\dashv(\lambda^N_\dashv(B_N))$ is $N^\beta OS\mathfrak{R}^3_N$ in $\mathfrak{R}^3_N$. Hence $\mu^N_\dashv \circ \lambda^N_\dashv$ is Neutrosophic β open mapping.

□

Theorem 4.5. *Let $(\mathfrak{R}^1_N, \mathfrak{I}^1_N)$ and $(\mathfrak{R}^2_N, \mathfrak{I}^2_N)$) be two Neutrosophic Topological spaces and let $\lambda^N_\dashv : (\mathfrak{R}^1_N, \mathfrak{I}^1_N) \to (\mathfrak{R}^2_N, \mathfrak{I}^2_N)$ be a mapping. Then the following conditions are equivalent:*

1. *$\lambda^N_\dashv$ is Neutrosophic pre-α-irresolute open mapping.*
2. *$\mu^N_\dashv(^{Pre}_{Neu}int\, A_N) \subseteq {}^{\alpha}_{Neu}int\, \mu^N_\dashv(A_N)$ for each Neutrosophic set A_N in $\mathfrak{R}^1_N$.*
3. *${}^{Pre}_{Neu}int\,(\lambda^{N^{-1}}_\dashv(B_N)) \subseteq \lambda_\dashv N^{-1}({}^{\alpha}_{Neu}int\, B_N)$ for each Neutrosophic set B_N in $\mathfrak{R}^2_N$.*
4. *For any NS,A_N in $\mathfrak{R}^1_N$ and NSB_N in $\mathfrak{R}^2_N$ and let A_N be $N^P CS\mathfrak{R}^1_N$ such that $\lambda^{N^{-1}}_\dashv(B_N) \subseteq A_N$. Then there exists an $C_N \varepsilon N^\alpha CS\mathfrak{R}^2_N$ in $\mathfrak{R}^2_N$ and $B_N \subseteq C_N$ such that $\lambda^{N^{-1}}_\dashv(C_N) \subseteq A_N$.*

Proof. (i) ⇒(ii):
Here ${}^{Pre}_{Neu}int\, A_N \subseteq A_N \Rightarrow \lambda^N_\dashv({}^{Pre}_{Neu}int\, A_N) \subseteq \lambda^N_\dashv(A_N)$. But, ${}^{Pre}_{Neu}intA_N$ is an $N^P OS\mathfrak{R}^1_N$. And $\lambda^N_\dashv({}^{Pre}_{Neu}intA_N)$ is an $N^\alpha OS\mathfrak{R}^2_N$ in $\mathfrak{R}^2_N$. Hence

$$\lambda^N_\dashv({}^{Pre}_{Neu}int\, A_N) = {}^{\alpha}_{Neu}int\, \lambda^N_\dashv({}^{Pre}_{Neu}int\, A_N) \subseteq {}^{\alpha}_{Neu}int\, \lambda^N_\dashv.$$

(ii)⇒ (iii):
Let $A_N = \lambda^{N^{-1}}_\dashv(B_N)$ By (ii),

$$\lambda^N_\dashv({}^{Pre}_{Neu}int(\lambda^{N^{-1}}_\dashv(B_N)) \subseteq {}^{\alpha}_{Neu}int\lambda^N_\dashv(\lambda^{N^{-1}}_\dashv(B_N)) \subseteq {}^{\alpha}_{Neu}int(B_N)$$

which gives

$$\begin{aligned}{}^{Pre}_{Neu}int(\lambda^{N^{-1}}_\dashv(B_N)) &\subseteq \lambda^{N^{-1}}_\dashv(\lambda^N_\dashv({}^{Pre}_{Neu}int(\lambda^{N^{-1}}_\dashv(B_N)))) \\ &\subseteq \lambda^{N^{-1}}_\dashv({}^{\alpha}_{Neu}int(B_N)).\end{aligned}$$

Thus ${}^{Pre}_{Neu}int(\lambda^{N^{-1}}_\dashv(B_N)) \subseteq \lambda^{N^{-1}}_\dashv({}^{\alpha}_{Neu}int(B_N))$.
(iii) ⇒ (iv) :
Let A_N be $N^P CS$ in $\mathfrak{R}^1_N$ and B_N be an Neutrosophic set in $\mathfrak{R}^2_N$. Such that $\lambda^{N^{-1}}_\dashv(B_N) \subseteq A_N$. Then

$$\overline{\lambda^{N^{-1}}_\dashv(B_N)} \supseteq \overline{A_N} \Rightarrow \overline{A_N} \subseteq \overline{\lambda^{N^{-1}}_\dashv(B_N)} = \lambda^{N^{-1}}_\dashv(B_N).$$

But $\overline{A_N}$ is an $N^P OS\mathfrak{R}^1_N$. Thus

$$\overline{A_N} = {}^{Pre}_{Neu}int(A_N) \subseteq {}^{Pre}_{Neu}int(\lambda^{N^{-1}}_\dashv(B_N) \subseteq (\lambda^N_\dashv)^{-1}({}^{\alpha}_{Neu}int(B_N)).$$

Hence $\overline{(\lambda^N_\dashv)^{-1}({}^{\alpha}_{Neu}int(\overline{B_N}))} = \lambda^{N^{-1}}_\dashv(\alpha cl(B_N))$. Take ${}^{\alpha}_{Neu}cl(B_N) = C_N$. Therefore $\lambda^{N^{-1}}_\dashv(C_N) \subseteq A_N$.
(iv) ⇒ (i) :
Let D be an $N^P OS\mathfrak{R}^1_N$. And $B_N = \overline{\lambda^N_\dashv(D)}$ and $A_N = \overline{D}$. Then A is an $N^P CS\mathfrak{R}^1_N$. Hence

$$\lambda^{N^{-1}}_\dashv(B_N) = \lambda^{N^{-1}}_\dashv\overline{(\lambda^N_\dashv(D))} = \overline{\lambda^{N^{-1}}_\dashv \lambda^N_\dashv(D))} \subseteq \overline{D} = A_N.$$

Then there exists an $N^\alpha CSC_N$ and $B_N \subseteq C_N$ such that $\lambda^{N^{-1}}_\dashv(C_N) \subseteq A_N = \overline{D}$. Thus $D \subseteq \overline{\lambda^{N^{-1}}_\dashv(C_N)}$, which implies $\lambda^N_\dashv(D) \subseteq \lambda^N_\dashv(\lambda^{N^{-1}}_\dashv(\overline{C_N})) \subseteq \overline{C_N}$. On the other hand, by $B_N \subseteq C_N, \lambda^N_\dashv(D) = \overline{B_N} \supseteq \overline{C_N}$. Hence $\lambda^N_\dashv(D_N) = \overline{C_N}$. Since $\overline{C_N}$ is an $N^\alpha OS$, then $\lambda^N_\dashv(D_N)$ is an $N^\alpha OS\mathfrak{R}^2_N$. Therefore $\lambda^N_\dashv$ is Neutrosophic pre-α-irresloute open mapping. □

Theorem 4.6. *Let* $(\mathfrak{R}_N^1,\ \mathfrak{I}_N^1)$ *and* $(\mathfrak{R}_N^2,\ \mathfrak{I}_N^2)$ *be two NTSs and let* $\lambda_{\dashv}^N : \mathfrak{R}_N^1 \to \mathfrak{R}_N^2$ *be a mapping. Then the following conditions are equivalent:*

1. $\lambda_{\dashv}^N$ *is Neutrosophic* α *-irresolute open mapping.*
2. $\lambda_{\dashv}^N({}^{\alpha}_{Neu}intA_N) \subseteq {}^{\alpha}_{Neu}int\lambda_{\dashv}^N(A_N)$ *for each Neutrosophic setin* $\mathfrak{R}_N^1$.
3. ${}^{\alpha}_{Neu}int((\lambda_{\dashv}^N)^{-1}) \subseteq {}^{\alpha}_{Neu}int(\lambda_{\dashv}^N)^{-1}(B_N)$ *for each Neutrosophic set B in* $\mathfrak{R}_N^2$.
4. *For any Neutrosophic set* A_N *in* $\mathfrak{R}_N^1$. *Neutrosophic set* B_N *in* $\mathfrak{R}_N^2$ *and let* A_N *be* $N^{\alpha}CS\mathfrak{R}_N^1$ *such that* $\lambda_{\dashv}^{N^{-1}}(B_N) \subseteq A_N$. *Then there exists an* $N^{\alpha}CS\mathfrak{R}_N^2$, C_N *in* $\mathfrak{R}_N^2$ *and* $B_N \subseteq C_N$ *such that* $\lambda_{\dashv}^N(C_N) \subseteq A_N$.

Proof. (i) $\Rightarrow$ (ii):
${}^{\alpha}_{Neu}int\,A_N \subseteq A_N \Rightarrow \lambda_{\dashv}^N({}^{\alpha}_{Neu}intA_N) \subseteq \lambda_{\dashv}^N(A_N)$. But ${}^{\alpha}_{Neu}intA_N$ is an $N^{\alpha}OS\mathfrak{R}_N^1\lambda_{\dashv}^N({}^{\alpha}_{Neu}intA_N)$ is an $N^{\alpha}OS$ in $\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^N({}^{\alpha}_{Neu}intA_N) = {}^{\alpha}_{Neu}int\lambda_{\dashv}({}^{\alpha}_{Neu}intA_N) \subseteq {}^{\alpha}_{Neu}int\lambda_{\dashv}^N(A_N)$.
(ii) $\Rightarrow$ (iii):
Let $A_N = \lambda_{\dashv}^{N^{-1}}$. By (ii), $\lambda_{\dashv}^N({}^{\alpha}_{Neu}int(\lambda_{\dashv}^{N^{-1}}(B_N))) \subseteq {}^{\alpha}_{Neu}int(B_N)$ which implies ${}^{\alpha}_{Neu}int((\lambda_{\dashv}^{N^{-1}}(B_N))) \subseteq \lambda_{\dashv}^{N^{-1}}(\lambda_{\dashv}^N({}^{\alpha}_{Neu}int(\lambda_{\dashv}^{N^{-1}}(B_N))) \subseteq \lambda_{\dashv}({}^{\alpha}_{Neu}int\,B_N)$. Thus, ${}^{\alpha}_{Neu}int(\lambda_{\dashv}^{N^{-1}}(B_N)) \subseteq \lambda_{\dashv}^{N^{-1}}({}^{\alpha}_{Neu}int(B_N))$.
(iii) $\Rightarrow$ (iv):
Let A_N be $N^{\alpha}CS\mathfrak{R}_N^1$ and B_N be an Neutrosophic set in $\mathfrak{R}_N^2$. Such that $\lambda_{\dashv}^{N^{-1}}(B_N)) \subseteq A_N$. Hence $\overline{\lambda_{\dashv}^{N^{-1}}(B_N)} \supseteq \overline{A_N} \Rightarrow \overline{A_N} \subseteq \overline{\lambda_{\dashv}^{N^{-1}}(B_N)} = \lambda_{\dashv}^{N^{-1}}(\overline{B_N})$. But $\overline{A_N}$ is an $N^{\alpha}OS\mathfrak{R}_N^1$. Thus $\overline{A_N} = {}^{\alpha}_{Neu}int(\overline{A_N}) \subseteq {}^{\alpha}_{Neu}int(\lambda_{\dashv}^{N^{-1}}(B_N)) \subseteq \lambda_{\dashv}^{N^{-1}}({}^{\alpha}_{Neu}int(\overline{B_N}))$. As $A_N \supseteq \overline{\lambda_{\dashv}^{N^{-1}}({}^{\alpha}_{Neu}int(\overline{B_N}))} = \lambda_{\dashv}^{N^{-1}}(\alpha cl(B_N))$. Put $\alpha cl(B_N) = C_N$. Hence $\lambda_{\dashv}^{N^{-1}}(C_N) \subseteq A_N$.
(iv) $\Rightarrow$(i) :
Let D be an $N^{\alpha}OS\mathfrak{R}_N^1$, $B_N = \lambda_{\dashv}^N(D)$ and $A_N = \overline{D}$. Then A_N is an $N^{\alpha}CS\mathfrak{R}_N^1$. Hence $\lambda_{\dashv}^{N^{-1}}(B_N) = \lambda_{\dashv}^{N^{-1}}\ \overline{(\lambda_{\dashv}^N(D))} = \overline{\lambda_{\dashv}^{N^{-1}}(\lambda_{\dashv}^N(D))} = A_N$. Then, there exists an $N^{\alpha}CS\mathfrak{R}_N^1C_N$ and $B_N \subseteq C_N$. Such that $\lambda_{\dashv}^{N^{-1}}(C_N) \subseteq A_N = \overline{D}$. Thus, $D \subseteq (\lambda_{\dashv}^{N^{-1}}C_N) \Rightarrow \lambda_{\dashv}^N(D) \subseteq \lambda_{\dashv}^N(\lambda_{\dashv}^{N^{-1}}(C_N)) \subseteq \overline{C_N}$. On the other hand by $B_N \subseteq C_N, \lambda_{\dashv}^N(D) = \overline{B_N} \supseteq \overline{C_N}$. Therefore $\lambda_{\dashv}^N(D) = \overline{C_N}$. As $\overline{C_N}$ is an $N^{\alpha}OS\mathfrak{R}_N^1, \lambda_{\dashv}^N(D)$ is an $N^{\alpha}OS\mathfrak{R}_N^2$ in $\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^N$ is Neutrosophic α-irresloute open mapping. □

Theorem 4.7. *Let* $(\mathfrak{R}_N^1,\ \mathfrak{I}_N^1)$ *and* $(\mathfrak{R}_N^2,\ \mathfrak{I}_N^2)$ *be two NTSs and let* $\lambda_{\dashv}^N : \mathfrak{R}_N^1 \to \mathfrak{R}_N^2$ *be a mapping. Then the following conditions are equivalent:*

1. $\lambda_{\dashv}^N$ *is Neutrosophic semi-*α*-irresolute open mapping.*
2. $\lambda_{\dashv}^N({}^{S}_{Neu}int(A_N) \subseteq {}^{\alpha}_{Neu}int\lambda_{\dashv}^N(A_N)$ *for each Neutrosophic set* A_N *in* $\mathfrak{R}_N^1$.
3. ${}^{S}_{Neu}int(\lambda_{\dashv}^{N^{-1}}(B_N) \subseteq \lambda_{\dashv}^{N^{-1}}({}^{\alpha}_{Neu}intB_N)$ *for each Neutrosophic set* B_N *in* $\mathfrak{R}_N^2$.
4. *For any Neutrosophic set in* $\mathfrak{R}_N^1$, *Neutrosophic set in* $\mathfrak{R}_N^2$ *and let* A_N *be* $N^{\mathscr{S}}CS\mathfrak{R}_N^1$ *such that* $\lambda_{\dashv}^{N^{-1}}(B_N) \subseteq A_N$. *Then there exists an* $N^{\alpha}CS\mathfrak{R}_N^2, C_N$ *in*$\mathfrak{R}_N^2$ *and* $B_N \subseteq C_N$ *such that* $\lambda_{\dashv}^{N^{-1}}(C_N) \subseteq A_N$.

Proof. (i) $\Rightarrow$(ii):
${}^{S}_{Neu}intA_N \subseteq A_N \Rightarrow \lambda_{\dashv}^N({}^{S}_{Neu}intA_N) \subseteq \lambda_{\dashv}^N(A_N)$. But ${}^{S}_{Neu}int\,A_N$ is an $N^{\mathscr{S}}OS\mathfrak{R}_N^1, \lambda_{\dashv}^N({}^{S}_{Neu}int\,A_N)$ is an $N^{\alpha}OS\mathfrak{R}_N^2$ in $\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^N({}^{S}_{Neu}int\,A_N) = {}^{\alpha}_{Neu}int\lambda_{\dashv}^N({}^{S}_{Neu}intA_N) \subseteq {}^{\alpha}_{Neu}int\lambda_{\dashv}^N(A_N)$.
(ii) $\Rightarrow$ (iii):
Let $A_N = \lambda_{\dashv}^{N^{-1}}(B_N)$. By (ii), $\lambda_{\dashv}^N({}^{S}_{Neu}int(\lambda_{\dashv}^{N^{-1}}(B_N))) \subseteq {}^{\alpha}_{Neu}int\lambda_{\dashv}^N(\lambda_{\dashv}^{N^{-1}}(B_N)) \subseteq {}^{\alpha}_{Neu}int(B_N)$ which implies ${}^{S}_{Neu}int(\lambda_{\dashv}^{N^{-1}}(B_N) \subseteq \lambda_{\dashv}^{N^{-1}}(\lambda_{\dashv}^N({}^{S}_{Neu}int(\lambda_{\dashv}^{N^{-1}}(B_N))) \subseteq \lambda_{\dashv}^{N^{-1}}$ $({}^{\alpha}_{Neu}int(B_N))$. Thus, ${}^{S}_{Neu}int(\lambda_{\dashv}^{N^{-1}}(B_N) \subseteq (\lambda_{\dashv}^N)^{-1}\ ({}^{\alpha}_{Neu}intB_N)$.
(iii) $\Rightarrow$ (iv):
Let A_N be $N^{\mathscr{S}}CS\mathfrak{R}_N^1$ and B_N be an Neutrosophic set in $\mathfrak{R}_N^2$ such that $\lambda_{\dashv}^{N^{-1}}(B_N) \subseteq A_N$. Hence $\overline{\lambda_{\dashv}^{N^{-1}}(B_N)} \supseteq \overline{A_N} \Rightarrow \overline{A_N} \subseteq \overline{\lambda_{\dashv}^{N^{-1}}(B_N)} = \lambda_{\dashv}^{N^{-1}}(\overline{B_N})$. But $\overline{A_N}$ is an $N^{\mathscr{S}}OS\mathfrak{R}_N^1$. Thus, $\overline{A_N} = {}^{S}_{Neu}int(\overline{A_N}) \subseteq {}^{S}_{Neu}int(\lambda_{\dashv}^{N^{-1}}(\overline{B_N})) \subseteq \lambda_{\dashv}^{N^{-1}}({}^{\alpha}_{Neu}int(\overline{B_N}))$. Hence $A_N \supseteq \overline{\lambda_{\dashv}^{N^{-1}}({}^{\alpha}_{Neu}int(\overline{B_N}))} = \lambda_{\dashv}^{N^{-1}}({}^{\alpha}_{Neu}cl(B_N))$. Put ${}^{\alpha}_{Neu}cl(B_N) = C_N$, obtain $\lambda_{\dashv}^{N^{-1}}(A_N) \subseteq A_N$.
(iv) $\Rightarrow$ (i):
Let D be an $N^{\mathscr{S}}OS\mathfrak{R}_N^1$, $B_N = \overline{\lambda_{\dashv}^N(D)}$ and $A_N = \overline{D}$. Then A_N is an $N^{\mathscr{S}}CS\mathfrak{R}_N^1$. Hence $\lambda_{\dashv}^{N^{-1}}(B_N) = \lambda_{\dashv}^{N^{-1}}\ \overline{(\lambda_{\dashv}^N(D))} = \overline{\lambda_{\dashv}^{N^{-1}}(\lambda_{\dashv}^N(D))}$. Then, there exists an $N^{\alpha}CS\mathfrak{R}_N^1$, C_N and $B_N \subseteq C_N$. Such that $\lambda_{\dashv}^{N^{-1}}(C_N) \subseteq A_N = \overline{D}$, thus, $D \subseteq \overline{\lambda_{\dashv}^{N^{-1}}(C_N)} \Rightarrow \lambda_{\dashv}^N(D) \subseteq \lambda_{\dashv}^N(\lambda_{\dashv}^{N^{-1}}(\overline{C_N})) \subseteq \overline{C_N}$. On the other hand by $B_N \subseteq C_N$, $\lambda_{\dashv}^N(D) = \overline{B_N} \supseteq \overline{C_N}$. Hence $\lambda_{\dashv}^N(D) = \overline{C_N}$. Since $\overline{C_N}$ is an $N^{\alpha}OS\mathfrak{R}_N^1, \lambda_{\dashv}^N(D)$ is an $N^{\alpha}OS\mathfrak{R}_N^2$. Therefore $\lambda_{\dashv}^N$ is Neutrosophic semi -$\alpha-$ irresloute open mapping. □

Theorem 4.8. *Let* $(\mathfrak{R}_N^1,\ \mathfrak{I}_N^1)$ *and* $(\mathfrak{R}_N^2,\ \mathfrak{I}_N^2)$ *be twoNTSs and let* $\lambda_{\dashv}^N : \mathfrak{R}_N^1 \to \mathfrak{R}_N^2$ *be a mapping. Then the following conditions are equivalent:*

1. $\lambda_{\dashv}^N$ *is an Neutrosophic pre-*β*-irresolute open mapping.*
2. $\lambda_{\dashv}^N({}^{Pre}_{Neu}intA_N) \subseteq {}^{\beta}_{Neu}int\lambda_{\dashv}^N(A_N)$ *for each Neutrosophic set in* $\mathfrak{R}_N^1$.
3. ${}^{Pre}_{Neu}int(\lambda_{\dashv}^{N^{-1}}(B_N)) \subseteq \lambda_{\dashv}^{N^{-1}}({}^{\beta}_{Neu}intB)$ *for each Neutrosophic set* B_N *in* $\mathfrak{R}_N^2$.
4. *For any Neutrosophic set* A_N *in* $\mathfrak{R}_N^1$, *Neutrosophic set* B_N *in* $\mathfrak{R}_N^2$ *and let* A_N *be* $N^{P}CS\mathfrak{R}_N^1$ *such that* $\lambda_{\dashv}^{N^{-1}}(B_N) \subseteq A_N$. *Then there exists an* $N^{\beta}CS\mathfrak{R}_N^2$, C_N *in* $\mathfrak{R}_N^2$ *and* $B_N \subseteq C_N$ *such that* $\lambda_{\dashv}^{N^{-1}}(C_N) \subseteq A_N$.

Proof. (i) $\Rightarrow$ (ii):
${}^{Pre}_{Neu}intA_N \subseteq A_N \Rightarrow \lambda_{\dashv}^N({}^{Pre}_{Neu}intA_N) \subseteq \lambda_{\dashv}^N(A_N)$. But ${}^{Pre}_{Neu}intA_N$ is an $N^{P}OS$ in $\mathfrak{R}_N^1$, $\lambda_{\dashv}^N({}^{Pre}_{Neu}intA_N)$ is an Neutrosophic $N^{\beta}OS$ in

$\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^N({}^{Pre}_{Neu}intA_N) = \beta int\lambda_{\dashv}^N \; ({}^{Pre}_{Neu}intA_N) \subseteq {}^{\beta}_{Neu}int\lambda_{\dashv}^N(A_N)$.

(ii) $\Rightarrow$ (iii):

Let $A_N = \lambda_{\dashv}^{N^{-1}}$. By (ii), $\lambda_{\dashv}^N({}^{Pre}_{Neu}int(\lambda_{\dashv}^{N^{-1}}(B_N))) \subseteq {}^{\beta}_{Neu}int\lambda_{\dashv}^N(\lambda_{\dashv}^{N^{-1}}(B_N) \subseteq {}^{\beta}_{Neu}int(B_N)$ which implies ${}^{Pre}_{Neu}int(\lambda_{\dashv}^{N^{-1}}(B_N) \subseteq \lambda_{\dashv}^{N^{-1}}(\lambda_{\dashv}^N({}^{Pre}_{Neu}int(\lambda_{\dashv}^{N^{-1}}(B_N)))) \subseteq \lambda_{\dashv}^{N^{-1}} ({}^{\beta}_{Neu}int(B_N))$. Thus ${}^{Pre}_{Neu}int(\lambda_{\dashv}^{N^{-1}}(B_N)) \subseteq \lambda_{\dashv}^{N^{-1}} \; ({}^{\beta}_{Neu}intB)$.

(iii) $\Rightarrow$ (iv):

Let A_N be $N^PCS\mathfrak{R}_N^1$ and B_N be an Neutrosophic set in $\mathfrak{R}_N^2$. Such that $\lambda_{\dashv}^{N^{-1}}(B_N) \subseteq A_N$. Therefore $\overline{\lambda_{\dashv}^{N^{-1}}(B_N)} \supseteq \overline{A_N}$ which implies $\overline{A_N} \subseteq \overline{\lambda_{\dashv}^{N^{-1}}(B_N)} = \lambda_{\dashv}^{N^{-1}}(\overline{B_N})$. But $\overline{A_N}$ is an $N^POS\mathfrak{R}_N^1$. Thus,$\overline{A_N} = {}^{Pre}_{Neu}int(\overline{A_N}) \subseteq {}^{Pre}_{Neu}int(\overline{\lambda_{\dashv}^{N^{-1}}(B_N)} \subseteq \lambda_{\dashv}^{N^{-1}}({}^{\beta}_{Neu}int(\overline{B_N}))$. Hence $A_N \supseteq \lambda_{\dashv}^{N^{-1}}({}^{\beta}_{Neu}int(\overline{B_N})) = \lambda_{\dashv}^{N^{-1}} ({}^{\beta}_{Neu}Cl(B_N))$. Take ${}^{\beta}_{Neu}Cl(B_N) = C_N$. Therefore $\lambda_{\dashv}^{N^{-1}} (C_N) \subseteq A_N$.

(iv) $\Rightarrow$ (i):

Let D be an N^POS in $\mathfrak{R}_N^1$, $B_N = \overline{\lambda_{\dashv}^N(D)}$ and $A_N = \overline{D}$. Then A_N is an $N^PCS\mathfrak{R}_N^1$. Hence $\lambda_{\dashv}^{N^{-1}}(B_N) = \lambda_{\dashv}^{N^{-1}} \; \overline{(\lambda_{\dashv}^N(D))} = \overline{\lambda_{\dashv}^{N^{-1}}(\lambda_{\dashv}^N(D))} \subseteq \overline{D} = A_N$. Then there exists an $N\beta CSC_N$ and $B_N \subseteq C_N$ such that $\lambda_{\dashv}^{N^{-1}}(C_N) \subseteq A_N = \overline{D}$. Thus $D \subseteq \overline{\lambda_{\dashv}^{N^{-1}}(C_N)} \Rightarrow \lambda_{\dashv}^N(D) \subseteq \lambda_{\dashv}^N(\lambda_{\dashv}^{N^{-1}}(C_N)) \subseteq C_N$. On the other hand by $B_N \subseteq C_N$, $\lambda_{\dashv}^N(D) = \overline{B_N} \supseteq \overline{C_N}$. Hence $\lambda_{\dashv}^N(D) = \overline{C}$. Since $\overline{C}$ is an $N^\beta OS$,$\lambda_{\dashv}^N(D)$ is an $N^\beta OS$ in $\mathfrak{R}_N^2$. Therefore $\lambda_{\dashv}^N$ is Neutrosophic pre-β-irresloute open mapping. □

5. Properites of Neutrosophic PRE-α, SEMI-α and PRE-β Irresolute closed Mappings

Theorem 5.1. *Let $(\mathfrak{R}_N^1, \mathfrak{I}_N^1)$ and $(\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ be two NTSs. A function 1et $\lambda_{\dashv}^N : \mathfrak{R}_N^1 \to \mathfrak{R}_N^2$ Neutrosophic pre- α-irresolute closed mapping if and only if ${}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N({}^{pre}_{Neu}clA_N)$ for each $N^{\mathscr{S}}$, A_N in $NT\mathfrak{R}_N^1$.*

Proof. Let $\lambda_{\dashv}^N$ be Neutrosophic pre-α-irresolute closed mapping, then $\lambda_{\dashv}^N({}^{pre}_{Neu}clA_N)$ is $N^\alpha CS\mathfrak{R}_N^2$. Therefore $\lambda_{\dashv}^N({}^{pre}_{Neu}clA_N) = {}^{\alpha}_{Neu}cl\lambda_{\dashv}^N({}^{pre}_{Neu}clA_N)$ and $\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N \; ({}^{\alpha}_{Neu}clA_N)$. Thus ${}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N) \subseteq {}^{\alpha}_{Neu}cl\lambda_{\dashv}^N \; ({}^{pre}_{Neu}clA_N) = \lambda_{\dashv}^N \; ({}^{pre}_{Neu}clA_N)$. Hence ${}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N) \subseteq ({}^{pre}_{Neu}clA_N)$.

Conversely, Let A_N be an $N^PCS\mathfrak{R}_N^1$. Then ${}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N({}^{pre}_{Neu}clA_N) = \lambda_{\dashv}^N(A_N)$. Thus ${}^{\alpha}_{Neu}cl \; \lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N$. But $\lambda_{\dashv}^N(A_N) \subseteq {}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N)$. So ${}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N) = \lambda_{\dashv}^N(A_N)$. Therefore $\lambda_{\dashv}^N(A_N)$ is an $N^\alpha CS\mathfrak{R}_N^2$ in $\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^N$ is Neutrosophic pre -α -irresolute closed mapping. □

Theorem 5.2. *Let $(\mathfrak{R}_N^1, \mathfrak{I}_N^1)$ and $(\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ be two NTSs. A function 1et $\lambda_{\dashv}^N : \mathfrak{R}_N^1 \to \mathfrak{R}_N^2$ is Neutrosophic α -irresolute closed mapping if and only if ${}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N({}^{\alpha}_{Neu}clA_N)$ for each Neutrosophic set A_N in $NTS\mathfrak{R}_N^1$.*

Proof. Let $\lambda_{\dashv}^N$ is Neutrosophic α-irresolute closed mapping, then $\lambda_{\dashv}^N({}^{\alpha}_{Neu}clA_N)$ is $N^\alpha CS\mathfrak{R}_N^2$ in $\mathfrak{R}_N^2$. Therefore $\lambda_{\dashv}^N \; ({}^{\alpha}_{Neu}clA_N) = {}^{\alpha}_{Neu}cl\lambda_{\dashv}^N \; ({}^{\alpha}_{Neu}clA_N)$ and $\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N \; ({}^{\alpha}_{Neu}clA_N)$. Thus ${}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N({}^{\alpha}_{Neu}clA_N)$.

Conversely, Let A_N be an $N^\alpha CS\mathfrak{R}_N^1$. Then ${}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N({}^{\alpha}_{Neu}clA_N) = \lambda_{\dashv}^N(A_N)$. Thus ${}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N(A_N)$. But $\lambda_{\dashv}^N(A_N) \subseteq {}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N)$ obtain ${}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(_N) = \lambda_{\dashv}^N(A_N)$. Therefore $\lambda_{\dashv}^N(A_N)$ is an $N^\alpha CS\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^N$ is Neutrosophic α- irresolute closed mapping. □

Theorem 5.3. *Let $(\mathfrak{R}_N^1, \mathfrak{I}_N^1)$ and $(\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ be two NTSs. A function $\lambda_{\dashv}^N : \mathfrak{R}_N^1 \to \mathfrak{R}_N^2$ is Neutrosophic semi-α-irresolute closed mapping if and only if ${}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N({}^{S}_{Neu}clA_N)$ for each Neutrosophic set A_N in $NTS\mathfrak{R}_N^1$.*

Proof. Let $\lambda_{\dashv}^N$ Neutrosophic semi-α-irresolute closed mapping, then $\lambda_{\dashv}^N({}^{S}_{Neu}clA_N)$ in $N^\alpha CS\mathfrak{R}_N^2$ in $\mathfrak{R}_N^2$. Therefore $\lambda_{\dashv}^N({}^{S}_{Neu}clA_N) = {}^{\alpha}_{Neu}cl\lambda_{\dashv}^N({}^{S}_{Neu}clA_N)$ also $\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N \; ({}^{S}_{Neu}clA_N)$. Thus ${}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N) \subseteq {}^{\alpha}_{Neu}cl\lambda_{\dashv}^N({}^{S}_{Neu}clA_N) = \lambda_{\dashv}^N \; ({}^{S}_{Neu}clA_N)$. Hence ${}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N({}^{S}_{Neu}clA_N)$.

Conversely, let A_N be an $N^{\mathscr{S}}CS\mathfrak{R}_N^1$. Then ${}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N({}^{S}_{Neu}clA_N) = \lambda_{\dashv}^N(A_N)$. Thus ${}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N$. But $\lambda_{\dashv}^N(A_N) \subseteq {}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N)$ obtain ${}^{\alpha}_{Neu}cl\lambda_{\dashv}^N(A_N) = \lambda_{\dashv}^N(A_N)$. Thus $\lambda_{\dashv}^N(A_N)$ is an $N^\alpha CS\mathfrak{R}_N^2$ in $\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^N$ is Neutrosophic semi-α-irresolute closed mapping. □

Theorem 5.4. *Let $(\mathfrak{R}_N^1, \mathfrak{I}_N^1)$ and $(\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ be two NTSs. A function 1et $\lambda_{\dashv}^N : \mathfrak{R}_N^1 \to \mathfrak{R}_N^2$ is Neutrosophic pre-β-irresolute closed mapping if and only if ${}^{\beta}_{Neu}Cl\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N({}^{pre}_{Neu}clA_N)$ for each Neutrosophic set A_N in $NTS\mathfrak{R}_N^1$.*

Proof. Let $\lambda_{\dashv}^N$ be Neutrosophic pre-β -irresolute closed mapping, then $\lambda_{\dashv}^N({}^{pre}_{Neu}clA_N)$ is Neutrosophic $N^\beta CS$ in $\mathfrak{R}_N^2$. Therefore $\lambda_{\dashv}^N({}^{pre}_{Neu}clA_N) = {}^{\beta}_{Neu}Cl\lambda_{\dashv}^N({}^{pre}_{Neu}clA_N)$. Also $\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N({}^{pre}_{Neu}clA_N)$. Thus ${}^{\beta}_{Neu}Cl\lambda_{\dashv}^N(A_N) \subseteq {}^{\beta}_{Neu}Cl\lambda_{\dashv}^N ({}^{p}_{Neu}clA_N) = \lambda_{\dashv}^N \; ({}^{pre}_{Neu}clA_N)$. Hence ${}^{\beta}_{Neu}Cl\lambda_{\dashv}^N \; (A_N) \subseteq \lambda_{\dashv}^N ({}^{pre}_{Neu}clA_N)$. Conversely, Let A_N be an $N^PCS\mathfrak{R}_N^1$ in $\mathfrak{R}_N^1$. Then ${}^{\beta}_{Neu}Cl\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N({}^{pre}_{Neu}clA_N) = \lambda_{\dashv}^N(A_N)$. Thus ${}^{\beta}_{Neu}Cl\lambda_{\dashv}^N(A_N) \subseteq \lambda_{\dashv}^N(A_N)$. But $\lambda_{\dashv}^N(A_N) \subseteq {}^{\beta}_{Neu}Cl\lambda_{\dashv}^N(A_N)$. So, ${}^{\beta}_{Neu}Cl\lambda_{\dashv}^N(A_N) = \lambda_{\dashv}^N(A_N)$. Therefore $\lambda_{\dashv}^N(A_N)$ is an Neutrosophic $N^\beta CS\mathfrak{R}_N^2$ in $\mathfrak{R}_N^2$. Hence $\lambda_{\dashv}^N$ is Neutrosophic pre-β -irresolute closed mapping. □

Theorem 5.5. *Let $(\mathfrak{R}_N^1, \mathfrak{I}_N^1)$ and $(\mathfrak{R}_N^2, \mathfrak{I}_N^2)$ be two NTSs. A function 1et $\lambda_{\dashv}^N : \mathfrak{R}_N^1 \to \mathfrak{R}_N^2$ is Neutrosophic pre-α-irresolute (Neutrosophic α -irresolute and Neutrosophic semi-$\alpha-$ irresolute, resp.) closed mapping if and only if for each Neutrosophic set B_N in $\mathfrak{R}_N^2$ and each $N^POS\mathfrak{R}_N^2(N^\alpha OS\mathfrak{R}_N^2$ and $N^{\mathscr{S}}OS\mathfrak{R}_N^2$, resp.) A_N in $\mathfrak{R}_N^1$ with $A_N \supseteq (\lambda_{\dashv}^N)^{-1}(B_N)$ there exists an $N^\alpha OS\mathfrak{R}_N^2$,$C_N$ in $\mathfrak{R}_N^2$ with $C_N \supseteq B_N$ such that $\lambda_{\dashv}^{N^{-1}}(C_N) \subseteq A_N$.*

Proof. Let A_N be any arbitrary $N^POS\mathfrak{R}_N^1(N^\alpha OS\mathfrak{R}_N^1$ and $N^{\mathscr{S}}OS\mathfrak{R}_N^1$, resp.) in $\mathfrak{R}_N^1$. With $A_N \supseteq \lambda_{\dashv}^{N^{-1}}(B_N)$ where B_N is an Neutrosophic set in $\mathfrak{R}_N^2$. Then $\overline{A_N}$ is an

$N^{P}CS\Re_N^1(N^{\alpha}CS\Re_N^1$ and $N^{\mathscr{S}}CS\Re_N^1$, resp.) in $\Re_N^1$. Since $\lambda_{\dashv}^{N}$ is Neutrosophic pre-α-irresolute (Neutrosophic α -irresolute and Neutrosophic semi-α irresolute, resp.) closed mapping $\lambda_{\dashv}^{N}(\overline{A_N})$ is $N^{\alpha}CS\Re_N^2$ in $\Re_N^2$. Then $\overline{\lambda_{\dashv}^{N}(A_N)} = C_N$ (say) is $N^{\alpha}OS\Re_N^2$ in $\Re_N^2$. Since $\lambda_{\dashv}^{N^{-1}}(B_N) \subseteq A_N$, $B_N \subseteq C_N$. Moreover, obtain $\lambda_{\dashv}^{N^{-1}}(C_N) = \lambda_{\dashv}^{N^{-1}}$ $(\overline{\lambda_{\dashv}^{N}(\overline{A_N})})$ $= \overline{\lambda_{\dashv}^{N^{-1}}(\overline{\lambda_{\dashv}^{N}(A_N)})} \subseteq A_N$. Thus $\lambda_{\dashv}^{N^{-1}}(C_N) \subseteq A_N$. Conversely Let A_N be $N^{P}CS\Re_N^1(N^{\alpha}CS\Re_N^1$ and $N^{\mathscr{S}}CS\Re_N^1$, resp.) in $\Re_N^1$. Then $\overline{\lambda_{\dashv}^{N}(A_N)} = B_N$(say) is an Neutrosophic set in $\Re_N^2$ and $\overline{A_N}$ is $N^{P}OS\Re_N^1(N^{\alpha}OS\Re_N^1$ and $N^{\mathscr{S}}OS\Re_N^1$, resp.) in $\Re_N^1$. Such $that\lambda_{\dashv}^{N^{-1}}(B_N) \subseteq \overline{A_N}$. By hypothesis, there is an $N^{\alpha}OS\Re_N^2, C_N$ of $\Re_N^2$. Such that $B_N \subseteq C_N$ and $\lambda_{\dashv}^{N^{-1}}(C_N) \subseteq \overline{A_N}$. Therefore, $A_N \subseteq \overline{\lambda_{\dashv}^{N^{-1}}(C_N)}$. Hence $\overline{C_N} \subseteq \overline{B_N} = \lambda_{\dashv}^{N}(A_N) \subseteq \lambda_{\dashv}^{N}(\overline{\lambda_{\dashv}^{N^{-1}}(C_N)})\lambda_{\dashv}^{N}(A_N) = \overline{C_N}$. Since $\overline{C_N}$ is $N^{\alpha}CS\Re_N^2$ in $\Re_N^2, \lambda_{\dashv}^{N}(A_N)$ is $N^{\alpha}CS\Re_N^2$. Hence $\lambda_{\dashv}^{N}$ is Neutrosophic pre-α-irresolute (Neutrosophic α - irresolute and Neutrosophic semi-$\alpha-$ irresolute, resp.) closed mapping. □

Theorem 5.6. *$(\Re_N^1, \Im_N^1)$ and $(\Re_N^2, \Im_N^2)$ be two NTSs. A function let $\lambda_{\dashv}^{N} : \Re_N^1 \to \Re_N^2$ is Neutrosophic pre- β-irresolute closed mapping if and only if for each Neutrosophic set B_N in $\Re_N^2$ and each $N^{POS}A_N$ in $\Re_N^1$ with $A_N \supseteq \lambda_{\dashv}^{N^{-1}}(B_N)$ there exists an $N^{\beta}OS$, C_N in $\Re_N^2$ with $C_N \supseteq B_N$ such that $\lambda_{\dashv}^{N^{-1}}(C_N) \subseteq A_N$.*

Proof. Let A_N be any arbitrary $N^{P}OS\Re_N^1$ in $\Re_N^1$ with $A_N \supseteq \lambda_{\dashv}^{N^{-1}}(B_N)$ where B_N is an Neutrosophic set in $\Re_N^2$. Then $\overline{A_N}$ is an $N^{P}CS\Re_N^1$ in $\Re_N^1$. Since $\lambda_{\dashv}^{N}$ is Neutrosophic pre-$\beta-$ irresolute closed mapping $\lambda_{\dashv}^{N}(\overline{A_N})$ is Neutrosophic $N^{\beta}CS\Re_N^2$. Then $\overline{\lambda_{\dashv}^{N}(A_N)} = C_N$(say) is Neutrosophic $N^{\beta}OS$ in $\Re_N^2$. Since $\lambda_{\dashv}^{N^{-1}}(B_N) \subseteq A_N$, $B_N \subseteq C_N$. Moreover we have $\lambda_{\dashv}^{N^{-1}}(C_N) = \lambda_{\dashv}^{N^{-1}}\overline{(\lambda_{\dashv}^{N}(\overline{A_N})} = \overline{\lambda_{\dashv}^{N^{-1}}(\lambda_{\dashv}^{N}(\overline{A_N}))}$. Thus $\lambda_{\dashv}^{N^{-1}}(C_N) \subseteq A_N$.

Conversely, Let B_N be $N^{P}CS$ in $\Re_N^1$. Then $\overline{\lambda_{\dashv}^{N}(A_N)} = B_N$(say) is an Neutrosophic set in $\Re_N^2$ and $\overline{A_N}$ is $N^{P}OS\Re_N^1$ in $\Re_N^1$. Such that $\lambda_{\dashv}^{N^{-1}}(B_N) \subseteq \overline{A_N}$. By hypothesis, there is an NeutrosophicOS C_N of $\Re_N^2$ Such that $B_N \subseteq C_N$ and $\lambda_{\dashv}^{N^{-1}}(C_N) \subseteq \overline{A_N}$. Therefore $A_N \subseteq \overline{\lambda_{\dashv}^{N^{-1}}(C_N)}$. Hence $\overline{C_N} \subseteq \overline{B_N} = \lambda_{\dashv}^{N}(A_N) \subseteq \lambda_{\dashv}^{N}(\overline{\lambda_{\dashv}^{N^{-1}}(C_N)}) \subseteq \overline{C_N}$. $\lambda_{\dashv}^{N}(A_N) = \overline{C_N}$. Since $\overline{C_N}$ is Neutrosophic $N^{\beta}CS\Re_N^2, \lambda_{\dashv}^{N}(A_N)$ is $N^{\beta}CS$ in $\Re_N^2$. Hence $\lambda_{\dashv}^{N}$ is Neutrosophic pre-$\beta-$ irresolute closed mapping. □

Theorem 5.7. *Let $\lambda_{\dashv}^{N} : \Re_N^1 \to \Re_N^2$ be a bijective mapping from $NTS(\Re_N^1, \Im_N^1)$To another $NTS(\Re_N^2, \Im_N^2)$. Then the following statements are equivalent:*

1. *$\lambda_{\dashv}^{N}$ is an Neutrosophic α- irresolute open mapping.*
2. *$\lambda_{\dashv}^{N}$ is an Neutrosophic α -irresolute closed mapping.*
3. *$\lambda_{\dashv}^{N^{-1}}$ is an Neutrosophic α-irresolute function.*

Proof. (i) ⇒ (ii):
Let A_N be $N^{\alpha}CS$ in $\Re_N^1$. Then $\overline{A_N}$ is an $N^{\alpha}OS\Re_N^1$. By hypothesis $\lambda_{\dashv}^{N}(\overline{A_N}) = \overline{\lambda_{\dashv}^{N}(A_N)}$ is $N^{\alpha}OS\Re_N^2$. Hence $\lambda_{\dashv}^{N}(A_N)$ is $N^{\alpha}CS\Re_N^2$. Thus $\lambda_{\dashv}^{N}$ is Neutrosophic α -irresolute closed mapping.
(ii) ⇒ (iii):
Let A_N be $N^{\alpha}CS$ in $\Re_N^1$. Then, $\lambda_{\dashv}^{N}(A_N)$ is $N^{\alpha}CS$ in $\Re_N^2$. That is, $(\lambda_{\dashv}^{N^{-1}})^{-1}(A_N) = \lambda_{\dashv}^{N}(A_N)$ is $N^{\alpha}CS$ in $\Re_N^2$. Therefore $\lambda_{\dashv}^{N^{-1}}$ is Neutrosophic α-irresolute function.
(iii) ⇒ (i):
Let A_N be NOS in $\Re_N^1$ and $\lambda_{\dashv}^{N^{-1}}$ is Neutrosophic-irresolute function. So $((\lambda_{\dashv}^{N^{-1}})^{-1}(A_N) = \lambda_{\dashv}^{N}(A_N)$ is $N^{\alpha}OS$ in $\Re_N^2$. Hence $\lambda_{\dashv}^{N}$ is Neutrosophic α-irresolute open mapping. □

Theorem 5.8. *Let $\lambda_{\dashv}^{N} : \Re_N^1 \to \Re_N^2$ be a mapping from Neutrosophic $TS(\Re_N^1, \Im_N^1)$ to another Neutrosophic $TS(\Re_N^2, \Im_N^2)$. Then the following statements are equivalent:*

1. *$\lambda_{\dashv}^{N}$ is an Neutrosophic pre-α (Neutrosophic semi-α, resp.)-irresolute open mapping.*
2. *$\lambda_{\dashv}^{N}$ is an Neutrosophic $pre-\alpha$(Neutrosophic $semi-\alpha$, resp.)$-$irresolute closed mapping.*

Proof. (i) ⇒ (ii):
Let A_N be $N^{P}CS\Re_N^1(N^{\mathscr{S}}CS\Re_N^1$, resp.) in $\Re_N^1$. Then $\overline{A_N}$ is an $N^{P}OS\Re_N^1(N^{\mathscr{S}}OS\Re_N^1$, resp.) in $\Re_N^1$. By hypothesis $\lambda_{\dashv}^{N}(A_N) = \overline{\lambda_{\dashv}^{N}(A_N)}$is $N^{\alpha}OS\Re_N^2$ in $\Re_N^2$. Hence $\lambda_{\dashv}^{N}(A_N)$ is $N^{\alpha}CS\Re_N^2$. Thus $\lambda_{\dashv}^{N}$ is Neutrosophic pre-α (Neutrosophic semi-α, resp.)-irresolute closed mapping.
(ii) ⇒ (i):
Let A_N be $N^{P}OS\Re_N^1(N^{\mathscr{S}}OS\Re_N^1$, resp.) in $\Re_N^1$. Then $\overline{A_N}$ is an $N^{P}CS\Re_N^1(N^{\mathscr{S}}CS\Re_N^1$, resp.) in $\Re_N^1$. By hypothesis $\lambda_{\dashv}^{N}(A_N) = \overline{\lambda_{\dashv}^{N}(A_N)}$ is $N^{\alpha}CS\Re_N^2$. Hence $\lambda_{\dashv}^{N}(A_N)$ is $N^{\alpha}OS\Re_N^2$ .Thus $\lambda_{\dashv}^{N}$ is Neutrosophic pre-α (Neutrosophic semi-α, resp.)-irresolute open mapping. □

Theorem 5.9. *Let $\lambda_{\dashv}^{N} : \Re_N^1 \to \Re^{2_N}$ be a mapping from Neutrosophic $TS(\Re_N^1, \Im_N^1)$ to another Neutrosophic $TS(\Re_N^2, \Im_N^2)$. Then the following statements are equivalent:*

1. *$\lambda_{\dashv}^{N}$ is an Neutrosophic pre-β-irresolute open mapping.*
2. *$\lambda_{\dashv}^{N}$ is an Neutrosophic pre-β-irresolute closed mapping.*

Proof. Proof is similar □

6. Conclusion

The concepts of Neutrosophic pre-α (Neutrosophic α , Neutrosophic semi-α and Neutrosophic α and β, resp.)-irresolute open and closed mappings have been introduced and studied. The relationships between these mappings with other existing mappings in Neutrosophic topological spaces are investigated.

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