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# On $\mathcal{N}_{\alpha g^{\#}\psi}$-Continuous And $\mathcal{N}_{\alpha g^{\#}\psi}$-Irresolute Functions In Neutrosophic Topological Spaces

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***Abstract:** The focus of this paper is to introduce the concept of $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous and $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute functions in neutrosophic topological spaces. Also we analyze their characterizations and investigate their properties.*

***Keywords:** $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set, $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous and $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute.*

**AMS Subject Classification:** 06D72, 03E72.

## I. INTRODUCTION

The neutrosophic set was introduced by Smarandache[6] and explained, neutrosophic set is a generalization of intuitionistic fuzzy set. Salama and Alblowi [7] introduced the new concept of neutrosophic topological space in 2012, which had been investigated recently. Further the fundamental sets like semi-open sets, pre-open sets, α-open sets are introduced in neutrosophic topological spaces then theirs properties are well-read by Ishwarya et al. and Imran et al.[2, 5]. The neutrosophic closed sets and neutrosophic continuous functions were introduced by Salama et al.[8] in 2014. Arokiarani et al.[1] introduced the neutrosophic $\alpha$ closed set in neutrosophic topological spaces. Parimala et al.[4] studied the concept of neutrosophic $\alpha\psi$ closed sets. Recently Vigneshwaran et.al.[3] introduced the concept of $\mathcal{N}_{\alpha g^{\#}\psi}$-closed sets in neutrosophic topological spaces and studied some of its properties. In this article, we introduce the $\mathcal{N}_{\alpha g^{\#}\psi}$ continuous and $\mathcal{N}_{\alpha g^{\#}\psi}$ -irresolute functions in neutrosophic topological spaces and investigate their properties.

## II. PRELIMINARIES

**Definition 2.1**[6] A neutrosophic set $\mathcal{S}$ is an object of the following form

$$\mathcal{A}=\{\langle x, \mathcal{P}_{\mathcal{A}}(s), \mathcal{Q}_{\mathcal{A}}(s), \mathcal{R}_{\mathcal{A}}(s) : s\in\mathcal{S}\rangle\}$$

where $\mathcal{P}_{\mathcal{A}}(s)$, $\mathcal{Q}_{\mathcal{A}}(s)$ and $\mathcal{R}_{\mathcal{A}}(s)$ denote the degree of membership, the degree of indeterminacy and the degree of non-membership for each element $s\in\mathcal{S}$ to the set $\mathcal{A}$, respectively.

**Definition 2.2**[6] A neutrosophic topology in a nonempty set $\mathcal{X}$ is a family $\mathfrak{I}$ of neutrosophic sets in $\mathcal{X}$ satisfying the following axioms:

(i) $0_N, 1_N \in \mathfrak{I}$;
(ii) $\mathcal{A} \cap \mathcal{B} \in \mathfrak{I}$ for any $\mathcal{A}, \mathcal{B} \in \mathfrak{I}$;
(iii) $\cup (\mathcal{A})_i$ for any arbitrary family $(\mathcal{A})_i : i \in J \subseteq \mathfrak{I}$.

**Definition 2.3**[6] Let $\mathcal{A}$ be a neutrosophic set in neutrosophic topological space $\mathcal{X}$. Then
$\mathcal{N}int(\mathcal{A})=\cup\{\mathcal{D} : \mathcal{D}$ is an neutrosophic open set in $\mathcal{X}$ and $\mathcal{D} \subseteq \mathcal{A}\}$ is called a neutrosophic interior of $\mathcal{A}$.
$\mathcal{N}cl(\mathcal{A})=\cap\{\mathcal{E} : \mathcal{E}$ is an neutrosophic closed set in $\mathcal{X}$ and $\mathcal{E} \supseteq \mathcal{A}\}$ is called a neutrosophic closure of $\mathcal{A}$.

**Definition 2.4[3]** A subset $\mathcal{A}$ of $(\mathcal{X}, \mathfrak{I})$ is called a $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set if $\mathcal{N}\alpha cl(\mathcal{A}) \subseteq \mathcal{H}$ whenever $\mathcal{A} \subseteq \mathcal{H}$ and $\mathcal{H}$ is $\mathcal{N}_{g^{\#}\psi}$-open in $(\mathcal{X}, \mathfrak{I})$.

**Definition 2.5**

A function $d : (\mathcal{S}, \mathfrak{I}) \to (\mathcal{T}, \xi)$ is called
(i) a neutrosophic continuous [7] if $d^{-1}(\mathcal{A})$ is a neutrosophic-closed set of $(\mathcal{S}, \mathfrak{I})$ for every neutrosophic closed set $\mathcal{A}$ of $(\mathcal{T}, \xi)$.
(ii) a $\mathcal{N}_r$-continuous [1] if $d^{-1}(\mathcal{A})$ is a $\mathcal{N}_r$-closed set of $(\mathcal{S}, \mathfrak{I})$ for every neutrosophic closed set $\mathcal{A}$ of $(\mathcal{T}, \xi)$.
(iii) a $\mathcal{N}_\alpha$-continuous [1] if $d^{-1}(\mathcal{A})$ is a $\mathcal{N}_\alpha$-closed set of $(\mathcal{S}, \mathfrak{I})$ for every neutrosophic closed set $\mathcal{A}$ of $(\mathcal{T}, \xi)$.
(iv) a $\mathcal{N}_\psi$-continuous [4] if $d^{-1}(\mathcal{A})$ is a $\mathcal{N}_\psi$-closed set of $(\mathcal{S}, \mathfrak{I})$ for every neutrosophic closed set $\mathcal{A}$ of $(\mathcal{T}, \xi)$.

Throughout this paper neutrosophic $\alpha g^{\#}\psi$ -interior and neutrosophic $\alpha g^{\#}\psi$ -closure is denoted by $\mathcal{N}_{\alpha g^{\#}\psi}$-$i^*$ and $\mathcal{N}_{\alpha g^{\#}\psi}$-$c^*$ respectively.

## III. $\mathcal{N}_{\alpha g^{\#}\psi}$-CONTINUOUS FUNCTION

**Definition: 3.1**

A function $d : (\mathcal{S}, \mathfrak{I}) \to (\mathcal{T}, \xi)$ is called $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous if $d^{-1}(\mathcal{A})$ is a $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set of $(\mathcal{S}, \mathfrak{I})$ for every neutrosophic closed set $\mathcal{A}$ of $(\mathcal{T}, \xi)$.

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**Theorem: 3.2**

Every neutrosophic continuous function is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous function.

**Proof:**

Let $\mathcal{A}$ be a neutrosophic closed set of $(\mathcal{T},\xi)$. Since $d$ is continuous, $d^{-1}(\mathcal{A})$ is neutrosophic closed in $(\mathcal{S},\mathfrak{I})$. But every neutrosophic closed set is a $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set. Hence $d^{-1}(\mathcal{A})$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set in $(\mathcal{S},\mathfrak{I})$. Thus d is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous.

The reverse implication of the above theorem is not true as seen from the following example.

**Example 3.3**

Let $\mathcal{S} = \{p,q,r\}$, $\mathfrak{I}$ ={$0_N$, $\mathcal{D}_1$,$\mathcal{D}_2$, $\mathcal{D}_3$, $\mathcal{D}_4$ $1_N$} be a neutrosophic topology on $(\mathcal{S},\mathfrak{I})$.

$\mathcal{D}_1 = \langle s,(0.3,0.2,0.2),(0.3,0.2,0.2),(0.4,0.6,0.6)\rangle$

$\mathcal{D}_2 = \langle s,(0.2,0.3,0.3),(0.5,0.4,0.4),(0.4,0.4,0.4)\rangle$

$\mathcal{D}_3 = \langle s,(0.3,0.3,0.3),(0.3,0.2,0.2),(0.4,0.4,0.4)\rangle$

$\mathcal{D}_4 = \langle s,(0.2,0.2,0.2),(0.5,0.4,0.4),(0.4,0.6,0.6)\rangle$, and

let $\mathcal{T} = \{p,q,r\}$, $\xi$ ={$0_N$, $\mathcal{F}_1$,$\mathcal{F}_2$, $\mathcal{F}_3$, $\mathcal{F}_4$ $1_N$} be a neutrosophic topology on $(\mathcal{T},\xi)$.

$\mathcal{F}_1 = \langle t,(0.4,0.4,0.4),(0.3,0.2,0.2),(0.3,0.3,0.3)\rangle$

$\mathcal{F}_2 = \langle t,(0.3,0.3,0.3),(0.2,0.2,0.2),(0.4,0.4,0.4)\rangle$

$\mathcal{F}_3 = \langle t,(0.4,0.4,0.4),(0.2,0.2,0.2),(0.3,0.2,0.2)\rangle$

$\mathcal{F}_4 = \langle t,(0.3,0.3,0.3),(0.3,0.2,0.2),(0.4,0.4,0.4)\rangle$

Define $d : (\mathcal{S},\mathfrak{I}) \rightarrow (\mathcal{T},\xi)$ by

$d(p) = p,\ d(q) = q,\ d(r) = r.$

$\mathcal{N}_{\alpha g^{\#}\psi}$-closed sets of $(\mathcal{S},\mathfrak{I})$

$= \langle s,(0.3,0.2,0.2),(0.2,0.2,0.2),(0.4,0.4,0.4)\rangle$.

Here $d^{-1}(\mathcal{F}_3^c)$ is not neutrosophic closed in $(\mathcal{S},\mathfrak{I})$.

Therefore d is not neutrosophic continuous. However d is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous

**Theorem: 3.4**

Every $\mathcal{N}_r$-continuous function is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous function.

**Proof:**

Let $\mathcal{A}$ be a neutrosophic closed set of $(\mathcal{T},\xi)$. Since d is $\mathcal{N}_r$-continuous, $d^{-1}(\mathcal{A})$ is $\mathcal{N}_r$-closed in $(\mathcal{S},\mathfrak{I})$. But every $\mathcal{N}_r$-closed set is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set. Hence $d^{-1}(\mathcal{A})$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set in $(\mathcal{S},\mathfrak{I})$. Thus d is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous.

The reverse implication of the above theorem is not true as seen from the following example.

**Example: 3.5**

Let $\mathcal{S} = \{p,q,r\}$, $\mathfrak{I}$ ={$0_N$, $\mathcal{D}_1$, $\mathcal{D}_2$, $\mathcal{D}_3$, $\mathcal{D}_4$ $1_N$} be a neutrosophic topology on $(\mathcal{S},\mathfrak{I})$.

$\mathcal{D}_1 = \langle s,(0.3,0.2,0.2),(0.3,0.2,0.2),(0.4,0.6,0.6)\rangle$

$\mathcal{D}_2 = \langle s,(0.2,0.3,0.3),(0.5,0.4,0.4),(0.4,0.4,0.4)\rangle$

$\mathcal{D}_3 = \langle s,(0.3,0.3,0.3),(0.3,0.2,0.2),(0.4,0.4,0.4)\rangle$

$\mathcal{D}_4 = \langle s,(0.2,0.2,0.2),(0.5,0.4,0.4),(0.4,0.6,0.6)\rangle$, and

let $\mathcal{T} = \{p,q,r\}$, $\xi$ ={$0_N$, $\mathcal{F}_1$, $\mathcal{F}_2$, $\mathcal{F}_3$, $\mathcal{F}_4$ $1_N$} be a neutrosophic topology on $(\mathcal{T},\xi)$.

$\mathcal{F}_1 = \langle t,(0.4,0.4,0.4),(0.3,0.2,0.2),(0.3,0.3,0.3)\rangle$

$\mathcal{F}_2 = \langle t,(0.3,0.3,0.3),(0.2,0.2,0.2),(0.4,0.4,0.4)\rangle$

$\mathcal{F}_3 = \langle t,(0.4,0.4,0.4),(0.2,0.2,0.2),(0.3,0.2,0.2)\rangle$

$\mathcal{F}_4 = \langle t,(0.3,0.3,0.3),(0.3,0.2,0.2),(0.4,0.4,0.4)\rangle$

Define $d : (\mathcal{S},\mathfrak{I}) \rightarrow (\mathcal{T},\xi)$ by

$d(p) = p,\ d(q) = q,\ d(r) = r.$

$\mathcal{N}_{\alpha g^{\#}\psi}$-closed sets of $(\mathcal{S},\mathfrak{I})$

$= \langle s,(0.3,0.2,0.2),(0.2,0.2,0.2),(0.4,0.4,0.4)\rangle$.

$\mathcal{N}_r$-closed sets of $(\mathcal{S},\mathfrak{I})$

$= \langle s,(0.4,0.4,0.4),(0.3,0.2,0.2),(0.3,0.3,0.3)\rangle$.

Here $d^{-1}(\mathcal{F}_3^c)$ is not $\mathcal{N}_r$-closed in $(\mathcal{S},\mathfrak{I})$.

Therefore $d$ is not $\mathcal{N}_r$ -continuous. However $d$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous

**Theorem: 3.6**

Every $\mathcal{N}_\alpha$ -continuous function is $\mathcal{N}_{\alpha g^{\#}\psi}$ -continuous function.

**Proof:**

Let $\mathcal{A}$ be a neutrosophic closed set of $(\mathcal{T},\xi)$. Since d is $\mathcal{N}_\alpha$-continuous, $d^{-1}(\mathcal{A})$ is $\mathcal{N}_\alpha$-closed in $(\mathcal{S},\mathfrak{I})$. But every $\mathcal{N}_\alpha$-closed set is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set.

Hence $d^{-1}(\mathcal{A})$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set in $(\mathcal{S},\mathfrak{I})$. Thus d is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous.

The reverse implication of the above theorem is not true as seen from the following example.

**Example: 3.7**

Let $\mathcal{S} = \{p,q,r\}$, $\mathfrak{I}$ ={$0_N$, $\mathcal{D}_1$, $\mathcal{D}_2$, $\mathcal{D}_3$, $\mathcal{D}_4$ $1_N$} be a neutrosophic topology on $(\mathcal{S},\mathfrak{I})$.

$\mathcal{D}_1 = \langle s,(0.3,0.2,0.2),(0.3,0.2,0.2),(0.4,0.6,0.6)\rangle$

$\mathcal{D}_2 = \langle s,(0.2,0.3,0.3),(0.5,0.4,0.4),(0.4,0.4,0.4)\rangle$

$\mathcal{D}_3 = \langle s,(0.3,0.3,0.3),(0.3,0.2,0.2),(0.4,0.4,0.4)\rangle$

$\mathcal{D}_4 = \langle s,(0.2,0.2,0.2),(0.5,0.4,0.4),(0.4,0.6,0.6)\rangle$, and

let $\mathcal{T} = \{p,q,r\}$, $\xi$ ={$0_N$, $\mathcal{F}_1$, $\mathcal{F}_2$, $\mathcal{F}_3$, $\mathcal{F}_4$ $1_N$} be a neutrosophic topology on $(\mathcal{T},\xi)$.

$\mathcal{F}_1 = \langle t,(0.4,0.4,0.4),(0.3,0.2,0.2),(0.3,0.3,0.3)\rangle$

$\mathcal{F}_2 = \langle t,(0.3,0.3,0.3),(0.2,0.2,0.2),(0.4,0.4,0.4)\rangle$

$\mathcal{F}_3 = \langle t,(0.4,0.4,0.4),(0.2,0.2,0.2),(0.3,0.2,0.2)\rangle$

$\mathcal{F}_4 = \langle t,(0.3,0.3,0.3),(0.3,0.2,0.2),(0.4,0.4,0.4)\rangle$

Define $d : (\mathcal{S},\mathfrak{I}) \rightarrow (\mathcal{T},\xi)$ by

$d(p) = p,\ d(q) = q,\ d(r) = r.$

$\mathcal{N}_{\alpha g^{\#}\psi}$-closed sets of $(\mathcal{S},\mathfrak{I})$

$= \langle s, (0.3,0.2,0.2), (0.2,0.2,0.2), (0.4,0.4,0.4) \rangle$ .
$\mathcal{N}_{\alpha}$-closed sets of $(\mathcal{S}, \mathfrak{I})$
$= \langle s, (0.4,0.4,0.4), (0.3,0.2,0.2), (0.3,0.3,0.3) \rangle$.
Here $d^{-1}(\mathcal{F}_3^c)$ is not $\mathcal{N}_{\alpha}$-closed set in $(\mathcal{S}, \mathfrak{I})$.
Therefore d is not $\mathcal{N}_{\alpha}$ -continuous. However d is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous

**Theorem: 3.8**

Every $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous function is $\mathcal{N}_{\psi}$-continuous function.

**Proof:**

Let $\mathcal{A}$ be a neutrosophic closed set of $(\mathcal{T}, \xi)$. Since d is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous, $d^{-1}(\mathcal{A})$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed in $(\mathcal{S}, \mathfrak{I})$. But every $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set is $\mathcal{N}_{\psi}$-closed set. Hence $d^{-1}(\mathcal{A})$ is $\mathcal{N}_{\psi}$-closed set in $(\mathcal{S}, \mathfrak{I})$. Thus d is $\mathcal{N}_{\psi}$-continuous.

The reverse implication of the above theorem is not true as seen from the following example.

**Example:3.9**

Let $\mathcal{S} = \{p, q, r\}$, $\mathfrak{I} = \{0_N, \mathcal{D}_1, \mathcal{D}_2, \mathcal{D}_3, \mathcal{D}_4, 1_N\}$ be a neutrosophic topology on $(\mathcal{S}, \mathfrak{I})$.
$\mathcal{D}_1 = \langle s, (0.3,0.2,0.2), (0.3,0.2,0.2), (0.4,0.6,0.6) \rangle$
$\mathcal{D}_2 = \langle s, (0.2,0.3,0.3), (0.5,0.4,0.4), (0.4,0.4,0.4) \rangle$
$\mathcal{D}_3 = \langle s, (0.3,0.3,0.3), (0.3,0.2,0.2), (0.4,0.4,0.4) \rangle$
$\mathcal{D}_4 = \langle s, (0.2,0.2,0.2), (0.5,0.4,0.4), (0.4,0.6,0.6) \rangle$, and
let $\mathcal{T} = \{p, q, r\}$, $\xi = \{0_N, \mathcal{F}_1, \mathcal{F}_2, \mathcal{F}_3, \mathcal{F}_4, 1_N\}$ be a neutrosophic topology on $(\mathcal{T}, \xi)$.
$\mathcal{F}_1 = \langle t, (0.4,0.4,0.4), (0.3,0.2,0.2), (0.3,0.3,0.3) \rangle$
$\mathcal{F}_2 = \langle t, (0.3,0.3,0.3), (0.2,0.2,0.2), (0.4,0.4,0.4) \rangle$
$\mathcal{F}_3 = \langle t, (0.4,0.4,0.4), (0.2,0.2,0.2), (0.3,0.2,0.2) \rangle$
$\mathcal{F}_4 = \langle t, (0.3,0.3,0.3), (0.3,0.2,0.2), (0.4,0.4,0.4) \rangle$
Define $d : (\mathcal{S}, \mathfrak{I}) \rightarrow (\mathcal{T}, \xi)$ by
$d(p) = p$, $d(q) = q$, $d(r) = r$.
$\mathcal{N}_{\alpha g^{\#}\psi}$-closed sets of $(\mathcal{S}, \mathfrak{I})$
$= \langle s, (0.3,0.2,0.2), (0.2,0.2,0.2), (0.4,0.4,0.4) \rangle$ .
$\mathcal{N}_{\psi}$-closed sets of $(\mathcal{S}, \mathfrak{I})$
$= \langle s, (0.2,0.2,0.2), (0.3,0.2,0.2), (0.4,0.4,0.4) \rangle$.
Here $d^{-1}(\mathcal{F}_3^c)$ is not $\mathcal{N}_{\psi}$-closed set in $(\mathcal{S}, \mathfrak{I})$.
Therefore d is not $\mathcal{N}_{\psi}$ -continuous. However d is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous

**Remark:3.10**

The composition of two $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous function need not be a $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous. It can be seen from the following example.

**Example:3.11**

Let $\mathcal{S} = \{p, q, r\}$, $\mathfrak{I} = \{0_N, \mathcal{D}_1, \mathcal{D}_2, \mathcal{D}_3, \mathcal{D}_4, 1_N\}$ be a neutrosophic topology on $(\mathcal{S}, \mathfrak{I})$.
$\mathcal{D}_1 = \langle s, (0.3,0.2,0.2), (0.3,0.2,0.2), (0.4,0.6,0.6) \rangle$
$\mathcal{D}_2 = \langle s, (0.2,0.3,0.3), (0.5,0.4,0.4), (0.4,0.4,0.4) \rangle$
$\mathcal{D}_3 = \langle s, (0.3,0.3,0.3), (0.3,0.2,0.2), (0.4,0.4,0.4) \rangle$
$\mathcal{D}_4 = \langle s, (0.2,0.2,0.2), (0.5,0.4,0.4), (0.4,0.6,0.6) \rangle$, and
let $\mathcal{T} = \{p, q, r\}$, $\xi = \{0_N, \mathcal{F}_1, \mathcal{F}_2, \mathcal{F}_3, \mathcal{F}_4, 1_N\}$ be a neutrosophic topology on $(\mathcal{T}, \xi)$.
$\mathcal{F}_1 = \langle t, (0.4,0.4,0.4), (0.3,0.2,0.2), (0.3,0.3,0.3) \rangle$
$\mathcal{F}_2 = \langle t, (0.3,0.3,0.3), (0.2,0.2,0.2), (0.4,0.4,0.4) \rangle$
$\mathcal{F}_3 = \langle t, (0.4,0.4,0.4), (0.2,0.2,0.2), (0.3,0.2,0.2) \rangle$
$\mathcal{F}_4 = \langle t, (0.3,0.3,0.3), (0.3,0.2,0.2), (0.4,0.4,0.4) \rangle$
Define $d : (\mathcal{S}, \mathfrak{I}) \rightarrow (\mathcal{T}, \xi)$ by
$d(p) = p$, $d(q) = q$, $d(r) = r$.
Define $e : (T, \xi) \rightarrow (V, \omega)$ by $e(p) = q$, $e(q) = q$, $e(r) = p$.
$\mathcal{N}_{\alpha g^{\#}\psi}$-closed sets of $(\mathcal{S}, \mathfrak{I})$
$= \langle s, (0.3,0.2,0.2), (0.2,0.2,0.2), (0.4,0.4,0.4) \rangle$ .
$\mathcal{N}_{\alpha g^{\#}\psi}$-closed sets of $(\mathcal{T}, \xi)$
$= \langle s, (0.4,0.4,0.4), (0.3,0.2,0.2), (0.3,0.3,0.3) \rangle$.
Here $(e \circ d)^{-1}(\mathcal{F}_3^c)$ is not $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set in $(\mathcal{S}, \mathfrak{I})$.
Therefore $e \circ d$ is not $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous.
Therefore d is not $\mathcal{N}_{\alpha g^{\#}\psi}$ -continuous. However d is $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute.

**Theorem:3.12**

Let $d : (\mathcal{S}, \mathfrak{I}) \rightarrow (\mathcal{T}, \xi)$ be a function, then the following statements are equivalent:

(i) The function $d$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous.

(ii) The inverse image of neutrosophic closed set of $(\mathcal{T}, \xi)$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set in $(\mathcal{S}, \mathfrak{I})$.

**Proof:**

(i) $\Longrightarrow$ (ii): Assume $d$ is $\mathcal{N}_{\alpha g^{\#}\psi}$ -continuous. Let $\mathcal{A}$ be a neutrosophic closed subset of $(\mathcal{T}, \xi)$, then $\mathcal{T} - \mathcal{A}$ is neutrosophic open in $(\mathcal{T}, \xi)$ and $d^{-1}(\mathcal{T} - \mathcal{A}) = \mathcal{S} - d^{-1}(\mathcal{A})$, is $\mathcal{N}_{\alpha g^{\#}\psi}$ -open in $(\mathcal{S}, \mathfrak{I})$, which implies that $d^{-1}(\mathcal{A})$ is $\mathcal{N}_{\alpha g^{\#}\psi}$closed in $(\mathcal{S}, \mathfrak{I})$.

(ii) $\Longrightarrow$ (i): Assume, the inverse of each neutrosophic closed set in $(\mathcal{T}, \xi)$ is $\mathcal{N}_{\alpha g^{\#}\psi}$ -closed in $(\mathcal{S}, \mathfrak{I})$. Let $\mathcal{B}$ be a neutrosophic open set in $(\mathcal{T}, \xi)$, then $\mathcal{T} - \mathcal{B}$ is a neutrosophic closed set in $(\mathcal{T}, \xi)$, which implies $d^{-1}(\mathcal{T} - \mathcal{B}) = \mathcal{S} - d^{-1}(\mathcal{B})$ is $\mathcal{N}_{\alpha g^{\#}\psi}$ -closed in $(\mathcal{S}, \mathfrak{I})$. Hence $d^{-1}(\mathcal{B})$ is $\mathcal{N}_{\alpha g^{\#}\psi}$ -open in $(\mathcal{S}, \mathfrak{I})$, which implies that $d$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous.

**Theorem:3.13**

Let $d : (\mathcal{S}, \mathfrak{I}) \rightarrow (\mathcal{T}, \xi)$ be a function, where $(\mathcal{S}, \mathfrak{I})$ and $(\mathcal{T}, \xi)$ are neutrosophic topological spaces, then the following statements are equivalent:

(i) The function $d$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous.

(ii) The inverse image of neutrosophic closed set of $(\mathcal{T}, \xi)$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set in $(\mathcal{S}, \mathfrak{I})$.

(iii) $d(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(\mathcal{A})) \subseteq \mathcal{N}\text{-}c^{*}(d(\mathcal{A}))$ for neutrosophic set $\mathcal{A}$ of $(\mathcal{S}, \mathfrak{I})$.

(iv) $\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(d^{-1}(\mathcal{B})) \subseteq d^{-1}(\mathcal{N}\text{-}c^{*}(\mathcal{B}))$ for each neutrosophic set of $(\mathcal{T}, \xi)$.

**Proof:**

(i) $\Rightarrow$ (ii): Follows from theorem 3.12

(ii) $\Rightarrow$ (iii): Let $\mathcal{A}$ be a neutrosophic set of $(\mathcal{S},\mathfrak{I})$, then $\mathcal{N}\text{-}c^*(d(\mathcal{A}))$ is neutrosophic closed in $(\mathcal{T},\xi)$. By (ii) $d^{-1}(\mathcal{N}\text{-}c^*(d(\mathcal{A})))$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed in $(\mathcal{S},\mathfrak{I})$ and $d^{-1}(\mathcal{N}\text{-}c^*(d(\mathcal{A}))) = \mathcal{N}\text{-}c^*(d^{-1}(\mathcal{N}\text{-}c^*(d(\mathcal{A}))))$. Since $\mathcal{A} \subseteq d^{-1}(d(\mathcal{A}))$ we have $\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^*(\mathcal{A}) \subseteq \mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^*(d^{-1}(d(\mathcal{A}))) \subseteq \mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^*(d^{-1}(\mathcal{N}\text{-}c^*(d(\mathcal{A})))) = d^{-1}(\mathcal{N}\text{-}c^*(d(\mathcal{A})))$, $d(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^*(\mathcal{A})) \subseteq \mathcal{N}\text{-}c^*(d(\mathcal{A}))$.

(iii) $\Rightarrow$ (iv): Let $\mathcal{B}$ be a neutrosophic set of $(\mathcal{T},\xi)$. Then by (iii) we have $d(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^*(d^{-1}(\mathcal{B}))) \subseteq \mathcal{N}\text{-}c^*(d(d^{-1}(\mathcal{B})))$. Hence $\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^*(d^{-1}(\mathcal{B})) \subseteq d^{-1}(\mathcal{N}\text{-}c^*(d(d^{-1}(\mathcal{B})))) \subseteq d^{-1}(\mathcal{N}\text{-}c^*(\mathcal{B}))$, $\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^*(d^{-1}(\mathcal{B})) \subseteq d^{-1}(\mathcal{N}\text{-}c^*(\mathcal{B}))$.

(iv) $\Rightarrow$ (i): Let $\mathcal{B}$ be a neutrosophic set of $(\mathcal{T},\xi)$. Then $\mathcal{B}^c = \mathcal{C}$ is neutrosophic closed subset in $(\mathcal{T},\xi)$ so that $\mathcal{N}\text{-}c^*(\mathcal{C}) = \mathcal{C}$. Now by condition (iv) $\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^*(d^{-1}(\mathcal{C})) \subseteq d^{-1}(\mathcal{N}\text{-}c^*(\mathcal{C})) = d^{-1}(\mathcal{C})$. That is $\mathcal{C}$ is neutrosophic closed, we have $d^{-1}(\mathcal{C}) \supseteq \mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^*(d^{-1}(\mathcal{C})) = \mathcal{N}\text{-}i^*(d^{-1}(\mathcal{C}^c))^c$. Hence $d^{-1}(\mathcal{C})^c$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-open in $(\mathcal{S},\mathfrak{I})$. That is $d^{-1}(\mathcal{C})$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed. Therefore d is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous.

## IV. $\mathcal{N}_{\alpha g^{\#}\psi}$-IRRESOLUTE FUNCTION

**Definition:4.1**

A function $d : (\mathcal{S},\mathfrak{I}) \rightarrow (\mathcal{T},\xi)$ is called $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute if $d^{-1}(\mathcal{A})$ is a $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set of $(\mathcal{S},\mathfrak{I})$ for every $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set $\mathcal{A}$ of $(\mathcal{T},\xi)$.

**Theorem:4.2**

Every $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute function is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous function.

**Proof:**

Let $\mathcal{A}$ be a neutrosophic closed set of $(\mathcal{T},\xi)$. Since every neutrosophic closed set is a $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set. Therefore $\mathcal{A}$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set of $(\mathcal{T},\xi)$. Since $d$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute, $d^{-1}(\mathcal{A})$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set in $(\mathcal{S},\mathfrak{I})$. Thus $d$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous.

The reverse implication of the above theorem is not true as seen from the following example.

**Example:4.3**

Let $\mathcal{S} = \{p,q,r\}$, $\mathfrak{I} = \{0_N, \mathcal{D}_1, \mathcal{D}_2, \mathcal{D}_3, \mathcal{D}_4\ 1_N\}$ be a neutrosophic topology on $(\mathcal{S},\mathfrak{I})$

$\mathcal{D}_1 = \langle s,(0.3,0.2,0.2),(0.3,0.2,0.2),(0.4,0.6,0.6)\rangle$

$\mathcal{D}_2 = \langle s,(0.2,0.3,0.3),(0.5,0.4,0.4),(0.4,0.4,0.4)\rangle$

$\mathcal{D}_3 = \langle s,(0.3,0.3,0.3),(0.3,0.2,0.2),(0.4,0.4,0.4)\rangle$

$\mathcal{D}_4 = \langle s,(0.2,0.2,0.2),(0.5,0.4,0.4),(0.4,0.6,0.6)\rangle$, and

let $\mathcal{T} = \{p,q,r\}$, $\xi = \{0_N, \mathcal{F}_1, \mathcal{F}_2, \mathcal{F}_3, \mathcal{F}_4\ 1_N\}$ be a neutrosophic topology on $(\mathcal{T},\xi)$.

$\mathcal{F}_1 = \langle t,(0.4,0.4,0.4),(0.3,0.2,0.2),(0.3,0.3,0.3)\rangle$

$\mathcal{F}_2 = \langle t,(0.3,0.3,0.3),(0.2,0.2,0.2),(0.4,0.4,0.4)\rangle$

$\mathcal{F}_3 = \langle t,(0.4,0.4,0.4),(0.2,0.2,0.2),(0.3,0.2,0.2)\rangle$

$\mathcal{F}_4 = \langle t,(0.3,0.3,0.3),(0.3,0.2,0.2),(0.4,0.4,0.4)\rangle$

Define $d : (\mathcal{S},\mathfrak{I}) \rightarrow (\mathcal{T},\xi)$ by $d(p) = p$, $d(q) = q$, $d(r) = r$.

$\mathcal{N}_{\alpha g^{\#}\psi}$-closed sets of $(\mathcal{S},\mathfrak{I})$ $= \langle s,(0.3,0.2,0.2),(0.2,0.2,0.2),(0.4,0.4,0.4)\rangle$.

$\mathcal{N}_{\alpha g^{\#}\psi}$-closed sets of $(\mathcal{T},\xi)$ $= \langle s,(0.4,0.4,0.4),(0.3,0.2,0.2),(0.3,0.3,0.3)\rangle$.

Here $d^{-1}(\mathcal{F}_3^c)$ is not $\mathcal{N}_{\psi}$-closed set in $(\mathcal{S},\mathfrak{I})$. Therefore $d$ is not $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute. However $d$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous.

**Theorem:4.4**

Let $d : (\mathcal{S},\mathfrak{I}) \rightarrow (\mathcal{T},\xi)$ and $e : (\mathcal{T},\xi) \rightarrow (\mathcal{V},\omega)$ be any two functions. Then

(i) $eod : (\mathcal{S},\mathfrak{I}) \rightarrow (\mathcal{V},\omega)$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous if $e$ is neutrosophic continuous and $d$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous.

(ii) $eod : (\mathcal{S},\mathfrak{I}) \rightarrow (\mathcal{V},\omega)$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute if both $e$ and $d$ are $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute.

(iii) $eod : (\mathcal{S},\mathfrak{I}) \rightarrow (\mathcal{V},\omega)$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous if $e$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous and $d$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute.

**Proof:**

(i) Let $\mathcal{A}$ be a neutrosophic closed set of $(\mathcal{V},\omega)$. Since e is neutrosophic continuous, $e^{-1}(\mathcal{A})$ is neutrosophic closed in $(\mathcal{T},\xi)$. Since $d$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous, $(eod)^{-1}(\mathcal{A}) = d^{-1}(e^{-1}(\mathcal{A}))$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed in $(\mathcal{S},\mathfrak{I})$. Therefore $eod$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous.

(ii) Let $\mathcal{A}$ be a $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set of $(\mathcal{V},\omega)$. Since $e$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute, $e^{-1}(\mathcal{A})$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed in $(\mathcal{T},\xi)$. Since $d$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute, $(eod)^{-1}(\mathcal{A}) = d^{-1}(e^{-1}(\mathcal{A}))$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed in $(\mathcal{S},\mathfrak{I})$. Therefore $eod$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute.

(iii) Let $\mathcal{A}$ be a neutrosophic closed set of $(\mathcal{V},\omega)$. Since $e$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous, $e^{-1}(\mathcal{A})$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed in $(\mathcal{T},\xi)$. Since $d$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute, $(eod)^{-1}(\mathcal{A}) = d^{-1}(e^{-1}(\mathcal{A}))$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed in $(\mathcal{S},\mathfrak{I})$. Therefore $eod$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous.

**Theorem 4.5.**

If $d : (\mathcal{S},\mathfrak{I}) \rightarrow (\mathcal{T},\xi)$, then the following statements are equivalent.

(i) $d$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute.

(ii) $d^{-1}(\mathcal{B})$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set in $\mathcal{S}$ for each $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set $\mathcal{B}$ in $(\mathcal{T},\xi)$.

(iii) $d(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^*(\mathcal{A})) \subseteq \mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^*(d(\mathcal{A}))$ for each neutrosophic set $\mathcal{A}$ in $(\mathcal{S},\mathfrak{I})$.

(iii) $\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^*(d^{-1}(\mathcal{B})) \subseteq d^{-1}(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^*(\mathcal{B}))$ for each neutrosophic set $\mathcal{B}$ in $(\mathcal{T},\xi)$.

(v) $d^{-1}(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}i^{*}(\mathcal{B})) \subseteq \mathcal{N}_{\alpha g^{\#}\psi}\text{-}i^{*}(d^{-1}(\mathcal{B}))$ for each neutrosophic set $\mathcal{B}$ in $(\mathcal{T}, \xi)$.

**Proof**:

(i) $\Rightarrow$ (ii): It can be proved by using the complement and the definition of $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute. Let $\mathcal{B}$ be $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set in $(\mathcal{T}, \xi)$, then $1-\mathcal{B}$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-open set in $(\mathcal{T}, \xi)$. Since d is $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute, $d^{-1}(1\text{-}\mathcal{B}) = 1-d^{-1}(\mathcal{B})$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-open set in $(\mathcal{S}, \mathfrak{I})$. Hence $d^{-1}(\mathcal{B})$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set in $(\mathcal{S}, \mathfrak{I})$.

(ii) $\Rightarrow$(iii): Let $\mathcal{A}$ be neutrosophic set in $(\mathcal{S}, \mathfrak{I})$. Then $\mathcal{A} \subseteq d^{-1}(d(\mathcal{A})) \subseteq d^{-1}(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(d(\mathcal{A})))$. $\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(d(\mathcal{A}))$ is $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set in $(\mathcal{T}, \xi)$, by (ii) $d^{-1}(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}d(\mathcal{A}))$ is a $\mathcal{N}_{\alpha g^{\#}\psi}$-closed set in $(\mathcal{S}, \mathfrak{I})$. $\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(\mathcal{A}) \subseteq d^{-1}(\mathcal{N}_{\alpha g^{\#}\psi}c^{*}(d(\mathcal{A})))$ and $d(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(\mathcal{A})) \subseteq d(d^{-1}(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(d(\mathcal{A}))))= \mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(d(\mathcal{A}))$. Thus $d(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(\mathcal{A})) \subseteq \mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(d(\mathcal{A}))$.

(iii) $\Rightarrow$ (iv): For any neutrosophic set $\mathcal{B}$ in $(\mathcal{T}, \xi)$, let $d^{-1}(\mathcal{B}) = \mathcal{A}$, by(iii), $d(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(d^{-1}(\mathcal{B}))) \subseteq \mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(d(d^{-1}(\mathcal{B})) \subseteq \mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(\mathcal{B})$ and $(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(d^{-1}(\mathcal{B}))) \subseteq$ $d^{-1}(d(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}d^{-1}(\mathcal{B}))) \subseteq d^{-1}(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(\mathcal{B}))$.

Thus $(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}d^{-1}(\mathcal{B})) \subseteq d^{-1}(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(\mathcal{B}))$.

(iv) $\Rightarrow$ (v): We know that $\mathcal{N}_{\alpha g^{\#}\psi}\text{-}i^{*}(\mathcal{B}) = \mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(\mathcal{B})$ $d^{-1}(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}i^{*}(\mathcal{B})) = d^{-1}(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(\mathcal{B}))=(d^{-1}(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(\mathcal{B}))) \subseteq (\mathcal{N}_{\alpha g^{\#}\psi}\text{-}c^{*}(d^{-1}(\mathcal{B}))= \mathcal{N}_{\alpha g^{\#}\psi}i^{*}(d^{-1}(\mathcal{B})) \subseteq \mathcal{N}_{\alpha g^{\#}\psi}\text{-}i^{*}(d^{-1}(\mathcal{B}))$.

(v) $\Rightarrow$ (i): Let $\mathcal{B}$ be any $\mathcal{N}_{\alpha g^{\#}\psi}$-open set in $(\mathcal{T}, \xi)$. Then $\mathcal{B} = \mathcal{N}_{\alpha g^{\#}\psi}\text{-}i^{*}(\mathcal{B})$. $d^{-1}(\mathcal{N}_{\alpha g^{\#}\psi}\text{-}i^{*}\mathcal{B}) = d^{-1}(\mathcal{B}) \subseteq \mathcal{N}_{\alpha g^{\#}\psi}\text{-}i^{*}(d^{-1}(\mathcal{B}))$. By definition, $d^{-1}(\mathcal{B}) \subseteq \mathcal{N}_{\alpha g^{\#}\psi}\text{-}i^{*}(d^{-1}(\mathcal{B}))$. $(\text{eo } d)^{-1}(\mathcal{B}) = \mathcal{N}_{\alpha g^{\#}\psi}\text{-}i^{*}(d^{-1}(\mathcal{B}))$. Thus $d^{-1}(\mathcal{B})$ is a $\mathcal{N}_{\alpha g^{\#}\psi}$-open set in $(\mathcal{S}, \mathfrak{I})$, which implies d is $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute.

## V. CONCLUSION

In this article we introduced and studied the concept of $\mathcal{N}_{\alpha g^{\#}\psi}$-continuous and $\mathcal{N}_{\alpha g^{\#}\psi}$-irresolute functions in neutrosophic topological spaces. Also we analyzed their basic properties. In future, it motivates to apply this concepts in neutrosophic homeomorphism and neutrosophic mappings.

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