Neutrosophic Sets and Systems, Vol. 28, 2019
University of New Mexico

On NGSR Closed Sets in Neutrosophic Topological Spaces

Anitha S[1*], Mohana K[2] and Florentin Smarandache[3]

[1]Department of Mathematics, Bishop Ambrose College, Coimbatore, India. E-mail: anitharaj.ps@gmail.com

[2]Department of Mathematics, Nirmala College for Women,Coimbatore, India.e-mail: riyaraju1116@gmail.com

[3]Department of Mathematics, University of New Mexico, Gallup, NM 87301, USA. E-mail: fsmarandache@gmail.com

*Correspondence: Anitha S; anitharaj.ps@gmail.com

Abstract: The intention of this paper is to introduce the concept of GSR-closed sets in terms of neutrosophic topological spaces. Some of the properties of NGSR-closed sets are obtained. In addition, we inspect NGSR-continuity and NGSR-contra continuity in neutrosophic topological spaces.

Keywords: neutrosophic topology, NGSR-closed set, NGSR-continuous, NGSR-contra continuous mappings.

1. Introduction

In 1965, fuzzy concept was proposed by Zadeh [43] and he studied membership function. Chang [14] developed the theory of fuzzy topology in 1967. The notions of inclusion, union, intersection, complement, relation, convexity, and so forth, are expanded to such sets and several properties of these notions are established by various authors.

Atanassov [10, 11, 12] generalized the idea of fuzzy set to intuitionistic fuzzy set by adding the degree of non-membership. The intuitionistic fuzzy topology was advanced by Coker [16] using the notion of intuitionistic fuzzy sets. Intuitionistic fuzzy point was given by Coker et.al [15]. These approaches gave a wide field for exploration in the area of intuitionistic fuzzy topology and its application. Burillo et al.[13]studied the intuitionistic fuzzy relation and their properties. Thakur et.al [44] introduced generalized closed set in intuitionistic fuzzy topology. Various researchers [8, 24, 26, 33, 37, 38] extended the results of generalization of various Intuitionistic fuzzy closed sets in many directions.

The concepts of neutrosophy was introduced by Florentin Smarandache [18, 19, 20] in which he developed the degree of indeterminacy. In comparing with more uncertain ideology, the neutrosophic set can accord with indeterminacy situation. Salama et.al [34,35,36] transformed the idea of neutrosophic crisp set into neutrosophic topological spaces and introduced generalized neutrosophic set and generalized neutrosophic topological Spaces. Ishwarya et.al [22] studied Neutrosophic semi open sets in Neutrosophic topological spaces. Abdel-Basset et.al [1,2,3,4,5,6] gave a novel neutrosophic approach. Many researchers [28, 30, 31, 41, 42] added and studied semi open sets, α open sets, pre-open sets, semi alpha open sets etc., and developed several interesting properties and applications in Neutrosophic Topology. Several authors [7, 25, 27, 32, 39, 44] have contributed in topological spaces.

Mohana K et.al [29] introduced gsr -closed sets in soft topology in 2017. In this article we tend to provide the idea of NGSR-closed sets and NGSR-open sets. Also, we presented NGSR continuous and NGSR-contra continuous mappings.

2 Preliminaries

Definition 2.1. [20] Let X be a non-empty fixed set. A neutrosophic set (NS) A is an object having the form $A = \{\langle x, \mu_A(x), \sigma_A(x), \nu_A(x)\rangle : x \in X\}$ where $\mu_A(x), \sigma_A(x)$ and $\nu_A(x)$ represent the degree of membership, degree of indeterminacy and the degree of nonmembership respectively of each element $x \in X$ to the set A.

A Neutrosophic set $A = \{\langle x, \mu_A(x), \sigma_A(x), \nu_A(x)\rangle : x \in X\}$ can be identified as an ordered triple $\langle \mu_A(x), \sigma_A(x), \nu_A(x)\rangle$ in $]^{-}0, 1^{+}[$ on X.

Definition 2.2. [20] Let $A = \langle \mu_A(x), \sigma_A(x), \nu_A(x)\rangle$ be a NS on X, then the complement C(A) may be defined as

1. $C(A) = \{\langle x, 1 - \mu_A(x), 1 - \nu_A(x)\rangle : x \in X\}$
2. $C(A) = \{\langle x, \nu_A(x), \sigma_A(x), \mu_A(x)\rangle : x \in X\}$
3. $C(A) = \{\langle x, \nu_A(x), 1 - \sigma_A(x), \mu_A(x)\rangle : x \in X\}$

Note that for any two neutrosophic sets A and B,

4. $C(A \cup B) = C(A) \cap C(B)$
5. $C(A \cap B) = C(A) \cup C(B)$.

Definition 2.3. [20] For any two neutrosophic sets $A = \{\langle x, \mu_A(x), \sigma_A(x), \nu_A(x)\rangle : x \in X\}$ and $B = \{\langle x, \mu_B(x), \sigma_B(x), \nu_B(x)\rangle : x \in X\}$ we may have

1. $A \subseteq B \Leftrightarrow \mu_A(x) \leq \mu_B(x), \sigma_A(x) \leq \sigma_B(x)$ and $\nu_A(x) \geq \nu_B(x) \forall\, x \in X$
2. $A \subseteq B \Leftrightarrow \mu_A(x) \leq \mu_B(x), \sigma_A(x) \geq \sigma_B(x)$ and $\nu_A(x) \geq \nu_B(x) \forall\, x \in X$
3. $A \cap B = \langle x, \mu_A(x) \wedge \mu_B(x), \sigma_A(x) \wedge \sigma_B(x)$ and $\nu_A(x) \vee \nu_B(x)\rangle$
4. $A \cap B = \langle x, \mu_A(x) \wedge \mu_B(x), \sigma_A(x) \vee \sigma_B(x)$ and $\nu_A(x) \vee \nu_B(x)\rangle$
5. $A \cup B = \langle x, \mu_A(x) \vee \mu_B(x), \sigma_A(x) \vee \sigma_B(x)$ and $\nu_A(x) \wedge \nu_B(x)\rangle$
6. $A \cup B = \langle x, \mu_A(x) \vee \mu_B(x), \sigma_A(x) \wedge \sigma_B(x)$ and $\nu_A(x) \wedge \nu_B(x)\rangle$

Definition 2.4. [34] A neutrosophic topology (NT) on a non-empty set X is a family τ of neutrosophic subsets in X satisfies the following axioms:

(NT_1) $0_N, 1_N \in \tau$
(NT_1) $G_1 \cap G_2 \in \tau$ for any $G_1, G_2 \in \tau$
(NT_1) $\cup G_i \in \tau\ \forall \{G_i : i \in J\} \subseteq \tau$

Definition 2.5. [34] Let A be an NS in NTS X. Then

Nint(A) = ∪ {G : G is an NOS in X and G ⊆ A} is called a neutrosophic interior of A

Ncl(A) = ∩ {K : K is an NCS in X and A ⊆ K} is called a neutrosophic closure of A

Definition 2.6. [18] A NS A of a NTS X is said to be

(1) a neutrosophic pre-open set (NPOS) if $A \subseteq NInt(NCl(A))$ and a neutrosophic pre-closed(NPCS) if $NCl(NInt(A)) \subseteq A$.

(2) a neutrosophic semi-open set (NSOS) if A ⊆ NCl(NInt(A)) and a neutrosophic semi-closed set (NSCS) if NInt(NCl(A)) ⊆ A.

(3) a neutrosophic α-open set (NαOS) if A ⊆ NInt(NCl(NInt(A))) and a neutrosophic α-closed set (NαCS) if NCl(NInt(NCl(A))) ⊆ A.

(4) a neutrosophic regular open set (NROS) if A = Nint(Ncl(A)) and a neutrosophic regular closed set (NRCS) if Ncl(Nint(A)) = A.

Definition 2.7. [22] Consider a NS A in a NTS (X, τ).Then the neutrosophic semi interior and the neutrosophic
semi closure are defined as

Nsint(A) = ∪{G: G is a N Semi open set in X and G ⊆ A}

Nscl(A) = ∩ {K: K is a N Semi closed set in X and A ⊆ K }

Definition 2.8. [38] A subset A of a neutrosophic topological space (X, τ) is called a neutrosophic α generalized closed (Nαg-closed) set if Nαcl(A) ⊆ U whenever A ⊆ U and U is neutrosophic α-open in (X, τ).

3. NGSR closed sets

Definition 3.1. A NS A in a NTS X is stated to be a neutrosophic gsr closed set (NGSR-Closed set) if Nscl (A) ⊆ U for every A ⊆ U and U is a NROS (Neutrosophic Regular Open set) in X.

The complement C(A) of a NGSR-closed set A is a NGSR-open set in X.

Example 3.2. Let X = {a, b} and $\tau = \{0_1, G, 1_N\}$ be NT in which G_1 ⟨x, (0.4, 0.1), (0.3,0.2), (0.5, 0.5)⟩ and G_2 = ⟨x, (0.4,0,4), (0.4, 0.3), (0.5,0.4)⟩. Here A = ⟨x, (0.4,0.4), (0.3,0.2), (0.4,0.5)⟩ is an NGSR-closed set.

Theorem 3.3. Each NCS is a NGSR-closed set in X.

Proof. Let A ⊆ U wherein U is a NROS in X. Let A be an NCS in X.

We got Nscl(A) ⊆ Ncl(A) ⊆ U. Consequently A is a NGSR-closed set in X.

Example 3.4. Let X = {a, b} and $\tau = \{0_1, G, 1_N\}$ be an NT having G_1 = ⟨x, (0.4, 0.1), (0.3, 0.2), (0.5, 0.5)⟩ and G_2 = ⟨x, (0.4, 0.4), (0.4; 0.3), (0.5, 0.4)⟩ .Here A = ⟨x, (0.4,0.4), (0.3,0.2), (0.4,0.5)⟩ is an NGSR-closed set, however not NCS.

Theorem 3.5. Each Nα − closed set is a NGSR-closed set in X.

Proof. Let A ⊆ U inwhich U is a NROS in X. Let A be an Nα − closed set in X.

Now Nscl(A) ⊆ N ⊆ cl(A) ⊆ U . Consequently A is a NGSR-closed set in X.

Example 3.6. Let X ={a, b} and $\tau = \{0_1, G, 1_N\}$ be an NT in which

G_1 = ⟨x, (0.6,0.2), (0.1,0.5), (0.5, 0.4)⟩ and G_2 = ⟨ x, (0.5, 03), (0.3, 0.2), (0.6,0.4) ⟩

Here A = ⟨x, (0.6,0.3), (0.1,0.6), (0.5,0.4) ⟩ is an NGSR-closed set, but not Nα-closed set as

$$\mathrm{Ncl(Nint(Ncl(A)))} = \mathrm{C(A)} \nsubseteq \mathrm{A}.$$

Theorem 3.7. Each Nsemi-closed set is a NGSR-closed set in X.

Proof. Suppose A is an Nsemi-closed set and $A \subseteq U$ wherein U is a NROS in X. Now $(A) = A \cup Nint(Ncl(A)) \subseteq A \cup A = A$. Therefore A is a NGSR-closed set in X.

Example 3.8. Let X = {a, b} and $\tau = \{0_1, G, 1_N\}$ be an NT in which

$G_1 = \langle x, (0.4,0.5), (0.3,0.2), (0.5,0.5)\rangle$ and $G_2 = \langle x, (0.4, 0.4), (0.4,0.3), (0.5, 0.4)\rangle$

Then $A = \langle x, (0.4,0.4), (0.3,0.2), (0.4,0.5)\rangle$ is an NGSR-closed set, however not Nsemi-closed set as $Nint(Ncl(A)) = G_1 \nsubseteq A$.

Theorem 3.9. Each $N\alpha G - closed$ set is a NGSR-closed set in X.

Proof. Let $A \subseteq U$ where U is a NROS in X. Let A be an $N\alpha G - closed$ set in X. Now $Nscl(A) \subseteq N\alpha cl(A) \subseteq U$. Therefore A is a NGSR-closed set in X.

Example 3.10. Let X = {a, b} and $\tau = \{0_1, G, 1_N\}$ be an NT where

$G_1 = \langle x, (0.6, 0.2), (0.1,0.5), (0.5, 0.4) \rangle$ and $G_2 = \langle x, (0.5, 0.3), (0.3,0.2), (0.6,0.4) \rangle$

Then $A = \langle x, (0.6,0.3), (0.1,0.6), (0.5,0.4) \rangle$ is an NGSR-closed set but not NαG-closed set.

Remark 3.11. The counter examples shows that NGSR-closed set is independent of NPCS.

Example 3.12. Let X = {a, b} and $\tau = \{0_1, G, 1_N\}$ be an NT where

$G_1 = \langle x, (0.6, 0.2), (01, 0.5), (0.5,0.4) \rangle$ and $G_2 = \langle x, (0.5,03.), (0.3, 0.2), (0.6,0.4) \rangle$

Here $A = \langle x, (0.6,0.3), (0.1,0.6), (0.5,0.4) \rangle$ be an NGSR-closed set, but not NPCS as Ncl(Nint(A)) = C(B) $\nsubseteq$ A .

Example 3.13. Let X ={a, b} and $\tau = \{0_1, G, 1_N\}$ be an NT where

$G_1 = \langle x, (0{:}5;\ 0{:}4), (0{:}3;\ 0{:}2), (0{:}5;\ 0{:}6) \rangle$,$G_2 = \langle x, (0{:}8;\ 0{:}7), (0{:}4;\ 0{:}3), (0{:}2;\ 0{:}3) \rangle$ and

$G_3 = \langle x, (0{:}2;\ 0{:}1), (0{:}3;\ 0{:}2), (0{:}8;\ 0{:}9) \rangle$

Then $A = \langle x, (0.5,0.3), (0.3,0.2), (0.5,0.7) \rangle$ is an NPCS, but not NGSR-closed set.

Theorem 3.14. Consider a NTS (X, τ). Then for each A ∈ NGSR-closed set and for each B ∈ NS in X, $A \subseteq B \subseteq Nscl(A)$ implies B ∈ NGSR-closed in (X, τ) .

Proof. Assume that $B \subseteq U$ and U is a NROS in (X, τ) which shows that $A \subseteq B, A \subseteq U$. Via speculation, B ⊆ Nscl(A). Consequently $Nscl(B) \subseteq Nscl(Nscl(A)) = Nscl(A) \subseteq U$, given that A is an NGSR-closed set in (X, τ). As a result B ∈ NGSR-closed in (X, τ).

Theorem 3.15. Consider a NROS A and a NGSR-closed set in (X, τ), then A is a NSemi-closed set in (X, τ).

Proof. Due to the fact A ⊆ A and A is a NROS in (X, τ),Via speculation, Nscl(A) ⊆ A.

However A ⊆ Nscl(A). Therefore Nscl(A) = A. Consequently A is a Nsemi-closed set in (X, τ).

Theorem 3.16. Let (X, τ) be a NTS. Then for each A ∈ NGSR-open X and for every B ∈ NS(X), Nsint (A) ⊆B⊆A implies B ∈ NGSR-open set in X.

Proof. Let A be any NGSR-open set of X and B be any NS of X. By means of speculation Nsint ⊆ B ⊆A. Then C(A) is a NGSR-closed in X and C(A) ⊆ C(B) ⊆Nscl(C(A)). By using Theorem 3.5, C(B) is a NGSRclosed in (X, τ). Thus B is a NGSR-Open in (X, τ). Hence B ∈ NGSR-open in X.

Theorem 3.17. A NS A is a NGSR-open in (X, τ) if and only if F _ Nsint(A) everytime F is a NRCS in (X, τ) and F ⊆ A.

Proof. **Necessity:** Assume that A is a NGSR-open in (X, τ) and F is a NRCS in (X, τ) such that F ⊆ A. Then C(F) is a NROS and C(A) ⊆ C(F). Via speculation C(A) is a NGSR-closed set in (X, τ), we've Nscl(C(A)) ⊆ C(F). Therefore F ⊆ Nsint(A).

Sufficiency: Let U be a NROS in (X, τ) such that C(A) ⊆ U. By hypothesis, C(U) ⊆ Nsint(A). Consequently Nscl(C(A)) ⊆ U and C(A) is an NGSR-closed set in (X, τ). Thus A is a NGSR-open set in (X, τ).

Theorem 3.18. A is Nsemi-closed if it is both Nsemi-open and NGSR-closed.
Proof. Considering A is each Nsemi-open and NGSR-closed set in X, then Nscl(A) ⊆ A. We additionally have A ⊆Nscl(A). Accordingly, Nscl(A) = A. Therefore, A is an Nsemi-closed set in X.

4 On NGSR-Continuity and NGSR-Contra Continuity

Definition 4.1. Let f be a mapping from a neutrosophic topological space (X, τ) to a neutrosophic topological space (Y, σ). Then f is referred to as a neutrosophic gsr-continuous(NGSR-continuous) mapping if $f^{-1}(B)$ is a NGSR-open set in X, for each neutrosophic-open set B in Y .

Theorem 4.2. Consider a mapping $f : (X,\tau) \rightarrow (Y,\sigma)$. Then (1) and (2) are equal.
(1) f is NGSR-continuous
(2) The inverse image of each N-closed set B in Y is NGSR-closed set in X.
Proof. This can be proved with the aid of using the complement and Definition 4.1.

Theorem 4.3. Consider an NGSR-continuous mapping $f : (X,\tau) \rightarrow (Y,\sigma)$ then the subsequent assertions hold:
(1) for all neutrosophic sets A in X, $f(NGSRNcl(A)) \subseteq Ncl(f(A))$
(2) for all neutrosophic sets B in Y, $NGSRNcl\ (f^{-1}(B)) \subseteq f^{-1}(Ncl(B))$.
Proof. (1) Let Ncl(f(A)) be a neutrosophic closed set in Y and f be NGSR-continuous, then it follows that f^{-1} (Ncl(f(A))) is NGSR-closed in X. In view that $A \subseteq f^{-1}\ (Ncl(f(A))), NGSRcl(A) \subseteq f^{-1}\ (Ncl(f(A)))$. Hence, $f(NGSRNcl(A)) \subseteq Ncl(f(A))$.
(2) We get $f(NGSRcl(f^{-1}\ (B))) \subseteq Nclf(f^{-1}\ (B))) \subseteq Ncl(B)$.
Hence, $NGSRcl(f^{-1}\ (B)) \subseteq f^{-1}\ (Ncl(B))$ by way of changing A with B in (1).

Definition 4.4. Let f be a mapping from a neutrosophic topological space (X, τ) to a neutrosophic topological space (Y, σ). Then f is known as neutrosophic gsr-contra continuous(NGSR-contra continuous) mapping if f^{-1} (B) is a NGSR-closed set in X for each neutrosophic-open set B in Y .

Theorem 4.5. Consider a mapping $f : (X,\tau) \rightarrow (Y,\sigma)$. Then the subsequent assertions are equivalent:
(1) f is a NGSR-contra continuous mapping
(2) f^{-1} (B) is an NGSR-closed set in X, for each NOS B in Y.
Proof. (1) $\Longrightarrow$ (2) Assume that f is NGSR-contra continuous mapping and B is NOS in Y. Then B_c is an NCS in Y. It follows that, $f^{-1}(B^c)$ is an NGSR-open set in X. For this reason, f^{-1} (B) is an NGSR-closed set in X.
(2) $\Longrightarrow$ (1) The converse is similar.

Theorem 4.6. Consider a bijective mapping $f : (X,\tau) \rightarrow (Y,\sigma)$. from an

NTS(X, τ)into an NTS(Y, σ).If $Ncl(f(A)) \subseteq f(NGSRint(A))$, for each NS B in X, then the mapping f is NGSR-contra continuous.

Proof. Consider a NCS B in Y. Then $Ncl(B) = B$ and f is onto, by way of assumption, $f(NGSRint(f^{-1}(B))) \subseteq Ncl(f(f^{-1}(B))) = Ncl(B) = B$. Consequently, $f^{-1}(f(NGSRint(f^{-1}(B)))) \subseteq f^{-1}(B)$. Additionally due to the fact that f is an into mapping, we have $NGSRint(f^{-1}(B)) = f^{-1}(f(NGSRint(f^{-1}(B)))) \subseteq f^{-1}(B)$.Consequently, $NGSRint(f^{-1}(B)) = f^{-1}(B)$, so f◎1(B) is an NGSR-open set in X. Hence, f is a NGSR-contra continuous mapping.

5. Conclusion and Future work

Neutrosophic topological space concept is used to deal with vagueness. This paper introduced NGSR closed set and some of its properties were discussed and derived some contradicting examples. This idea can be developed and extended in the real life applications such as in medical field and so on.

6. Acknowledgments

We are thankful to the referees for their valuable suggestions to improve the paper.

References

1. M.Abdel-Basset, R.Mohamed, A.E.N.H.Zaied, & F. Smarandache, (2019). A Hybrid Plithogenic Decision-Making Approach with Quality Function Deployment for Selecting Supply Chain Sustainability Metrics. Symmetry, 11(7), 903.
2. M.Abdel-Basset, N.A. Nabeeh, H.A. El-Ghareeb, & A. Aboelfetouh, (2019). Utilising neutrosophic theory to solve transition difficulties of IoT-based enterprises. Enterprise Information Systems, 1-21.
3. M. Abdel-Baset, V.Chang, & A.Gamal, (2019). Evaluation of the green supply chain management practices: A novel neutrosophic approach. Computers in Industry, 108, 210-220.
4. M.Abdel-Basset, M.Saleh, A.Gamal, & F.Smarandache, (2019). An approach of TOPSIS technique for developing supplier selection with group decision making under type-2 neutrosophic number. Applied Soft Computing, 77, 438-452.
5. M.Abdel-Baset, V.Chang, A.Gamal, & F.Smarandache, (2019). An integrated neutrosophic ANP and VIKOR method for achieving sustainable supplier selection: A case study in importing field. Computers in Industry, 106, 94-110.
6. M.Abdel-Basset, G.Manogaran, A.Gamal, & F.Smarandache, (2019). A group decision making framework based on neutrosophic TOPSIS approach for smart medical device selection. Journal of medical systems, 43(2), 38
7. Ahmad Al-Omari.(2007). Regular Generalized ω-Closed Sets, International Journal of Mathematics and Mathematical Sciences,
8. Athar Kharal (2014).A Study of Frontier and Semifrontier in Intuitionistic Fuzzy Topological Spaces", The Scientific World Journal. 1-11.
9. I.Arokiarani, R.Dhavaseelan, S.Jafari , M.Parimala , (2017). On some new notions and functions in neutrosophic topological spaces. Neutrosophic Sets Syst.16, 1619.
10. K.Atanassov,Intuitionistic fuzzy sets ,(1986). Fuzzy Sets Syst., 20, 8796.

11. K.Atanassov,(1988). Review and New Results on Intuitionistic Fuzzy Sets, Preprint IM-MFAIS-Mathematical Foundations of Artificial Intelligence Seminar: Sofia, Bulgaria, 1-88.
12. K.Atanassov and Stoeva, (1983). Intuitionistic fuzzy sets , Polish Symp on interval and fuzzy Math., Poznan, 23-26.
13. P.Burillo, H.Bustince, and C.Arrosad, ,(1995). Intuitionistic fuzzy relations. (Part I), Mathw. Soft Comput., 2, 538.
14. C.L Chang,. (1995) Fuzzy topological spaces, x. J.Math. Anal. Appl, 24, 182-190.
15. D.Coker, M.Demirci,(1995). On intuitionistic fuzzy points, Notes IFS, 1,2, pp. 79-84.
16. D.Coker, (1997). An introduction to intuitionistic fuzzy topological spaces. Fuzzy Sets Syst., 88, 8189.
17. Eom, Yeon Seok, and Seok Jong Lee. (2013). Intuitionistic Fuzzy ẟ-continuous Functions, International Journal of Fuzzy Logic and Intelligent Systems, ,13(4). 336-344.
18. Florentin Smarandache, (1999). A Unifying Field in Logics: Neutrosophic Logic. Neutrosophy, Neutrosophic Set, Neutrosophic Probability; American Research Press: Rehoboth, NM, USA.
19. Florentin Smarandache , (2002).Neutrosophy and Neutrosophic Logic, First International Conference on Neutrosophy, Neutrosophic Logic, Set, Probability, and Statistics University of New Mexico, Gallup, NM 87301, USA.
20. Florentin Smarandache, (2010).Neutrosophic set- a generalization of Intuitionistic fuzzy set, Jour. of Defense Resources Management, , 107-116.
21. Gupta, Ankit, and Ratna Dev Sarma. (2016). A uniform approach to normality for topological spaces, Applied General Topology, 17(1), 7-16.
22. P.Ishwarya and K.Bageerathi, (2016).On Neutrosophic semiopen sets in Neutrosophic topological spaces, International Jour. of Math. Trends and Tech., 214-223.
23. D.Jayanthi, (2018). α Generalized Closed Sets in Neutrosophic Topological Spaces, International Journal of Mathematics Trends and Technology (IJMTT)- Special Issue ICRMIT March .
24. M.Jeyaraman, A.Yuvarani and O.Ravi, (2013). Intuitionistic fuzzy α generalized semi continuous and irresolute mappings, International Journal of Analysis and Applications, 3(2),93-103.
25. Jin Han Park. (2006).Strongly θ-b-continuous functions, Acta Mathematica Hungarica. 10(4):347-359.
26. Joung Kon Jeon, Young Bae Jun, and Jin Han Park, (2005).Intuitionistic fuzzy alpha continuity and intuitionistic fuzzy pre continuity, International Journal of Mathematics and Mathematical Sciences, 19, 3091- 3101.
27. Khalid Y. Al-Zoubi. (2005). On generalized ω-closed sets, International Journal of Mathematics and Mathematical Sciences. (13), 2011-2021.
28. Mani Parimala, Florentin Smarandache, Saeid Jafari, Ramalingam Udhayakumar (2018). On Neutrosophic αψ- Closed Sets, Information. *9*(5), 103.
29. K.Mohana , S.Anitha, V.Radhika , (2017). On Soft gsr-closed sets in Soft topological spaces, Internat. Jour. Of Engineering sci. and computing 7(1), ,4116-4120.
30. N.A.Nabeeh, M.Abdel-Basset, H.A. El-Ghareeb, & A. Aboelfetouh, (2019).Neutrosophic multi-criteria decision making approach for iot-based enterprises. IEEE Access, 7, 59559-59574.
31. Qays Hatem Imran, Smaandache, F., et. al., (2017).On Neutrosophic semi alpha open sets, Neutrosophic sets and systems, 37-42.
32. Sabir Hussain, Bashir Ahmad, Takashi Noiri. (2012). γ*- SEMI-OPEN SETS IN TOPOLOGICAL SPACES, Asian-European Journal of Mathematics , 34(6),997-1008.

33. K.Sakthivel , (2010). Intuitionistic Fuzzy Alpha Generalized Continuous Mappings and Intuitionistic Alpha Generalized Irresolute Mappings.
34. A.A Salama ,S.A Alblowi, (2012).Neutrosophic Set and Neutrosophic Topological Spaces. IOSR J. Math., 3, 3135.
35. A. A. Salama, S. A. Alblowi, (2012).Generalized Neutrosophic Set and Generalized Neutrosophic Topological Spaces, Comp. Sci. Engg., 2, 129-132.
36. A.A Salama , M.Eisa, and M.M Abdelmoghny, (2014). Neutrosophic Relations Database, Int. J. Inf. Sci. Intell. Syst., 3(2), 3346.
37. R.Santhi and K.Sakthivel, (2009).Intuitionistic fuzzy generalized semi continuous mappings, Advances in Theoretical and Applied Mathematics, 5, 73-82.
38. R.Santhi and K.Arun Prakash , (2011).Intuitionistic fuzzy semi-generalized irresolute mappings, Tamkang Journal of Mathematics 42(2) , 119-134.
39. Takashi Noiri, Osama Rashed Sayed. (2005).On Ω-closed sets and Ωs-closed sets in topological spaces, Acta Mathematica Hungarica, 107(4),307-318.
40. S.S Thakur and Rekha Chaturvedi, (2006). Regular generalized closed sets in intuitionistic fuzzy topological spaces, Universitatea Din Bacau Studii Si Cercetar Stiintice,Seria : Matematica, 16, 257-272.
41. V. Venkateswara Rao,Y. Srinivasa Rao, (2017).Neutrosophic Pre-open Sets and Pre-closed Sets in Neutrosophic Topology, International Journal of ChemTech Research, Vol.10 No.10, pp 449-458,.
42. H.Yang, Z.Guo, and X.Liao, (2016). On single valued neutrosophic relations, J. Intell. Fuzzy Syst., 30(2), 120.
43. L.A Zadeh, (1965). Fuzzy Sets, Inf. Control, 8, 338353.
44. A. M. Zahran. (2011).Generalized ψϱ-Operations on Fuzzy Topological Spaces, Abstract and Applied Analysis, 1-12.

Received: 11 April, 2019; Accepted: 23 August, 2019