Journal of Namibian Studies, 35 S1 (2023): 2493-2501 ISSN: 2197-5523 (online)

New Forms Of Contra-Continuity And Contra-Irresolute Maps In Nano Ideal Topological Spaces

J. Joycy Renuka[1] and Dr. J. Arul Jesti[2]

[1]Research Scholar, Reg. No. 19212212092014,
[2]Assistant Professor,
Department of Mathematics, St. Mary's College (Autonomous),
Thoothukudi-628001,
(Affiliated to Manonmaniam Sundaranar University, Abishekapatti,
Tirunelveli-627012)
Tamil Nadu, India
[1]renukajoycy@gmail.com [2]aruljesti@gmail.com

ABSTRACT

The purpose of this paper is to present another class of functions referred to as contra nIgsemi* - continuous and contra nIgsemi*- irresolute functions in nano ideal topological space. Composition and decomposition of these functions under contra nIgsemi*-continuous and contra nIgsemi*- irresolute mappings are examined. Connections among these new classes and different classes of functions are laid out and few characterizations of these new classes of functions are studied.

Key words: contra nIgsemi* - continuous function, contra nIgsemi*- irresolute functions.

I. Introduction:

Continuous and irresolute functions supply new way in the direction of research. In 1996, Dontchev [3] presented another class of functions called contra-continuous functions. Irresolute maps are introduced and studied by Crossley S.G and Hildebrand S.K [2] in 1972. Its significance is large in numerous regions of math and associated sciences. Parimala et al [10] presented the idea of nano ideal generalized closed sets in nano ideal topological spaces and researched a portion of its essential properties. As of late, Dr. J. Arul Jesti and J. Joycy Renuka [6] presented and concentrated on nIgsemi*-closed sets and nIgsemi*-open sets in nano ideal topological spaces. Pretty currently, we [7] characterised $\mathrm{nIgsemi}^*$-continuous and $\mathrm{nIgsemi}^*$-irresolute functions in nano ideal topological spaces. In this paper, the conceptualization of $\mathrm{nIgsemi}^*$-open sets and $\mathrm{nIgsemi}^*$-continuous functions in nano ideal topological spaces are utilized to characterize and examine another class of maps referred to as contra $\mathrm{nIgsemi}^*$-continuity and contra $\mathrm{nIgsemi}^*$-irresolute functions in nano ideal topological spaces. Likewise, the characteristics and behaviours of contra $\mathrm{nIgsemi}^*$-continuity and contra $\mathrm{nIgsemi}^*$-irresolute functions in nano ideal topological spaces are mentioned.

II. PRELIMINARIES

All through this paper $(\mathrm{U}, \tau_{\mathrm{R}}(\mathrm{X}))$ (or U) address nano topological spaces on which no separation axioms are assumed except otherwise referred. For a subset A of a space $(\mathrm{U}, \tau_{\mathrm{R}}(\mathrm{X}))$, $\mathrm{ncl}(\mathrm{A})$ and $\mathrm{nint}(\mathrm{A})$ denote the nano closure of A and the nano interior of A respectively. We bear in mind the subsequent definitions, with the purpose to be utilized in the sequel.

Definition 2.1 [6] A subset A of a nano ideal topological space $(\mathrm{U}, \mathcal{N}, \mathrm{I})$ is said to be **nano ideal generalized semi*-closed** (briefly, $\mathrm{nIgsemi}^*$-closed) if $\mathrm{A}_{\mathrm{n}}^* \subseteq \mathrm{V}$ whenever $\mathrm{A} \subseteq \mathrm{V}$ and V is $\mathrm{nano\ semi}^*$-open.

Definition 2.2 [6] A subset A of a nano ideal topological space $(\mathrm{U}, \mathcal{N}, \mathrm{I})$ is said to be **nano ideal generalized semi*-open** (briefly, $\mathrm{nIgsemi}^*$-open) if X − A is $\mathrm{nIgsemi}^*$-closed.

Definition 2.3 [9,10] A subset A of a nano ideal topological space $(\mathrm{U}, \mathcal{N}, \mathrm{I})$ is $\mathbf{n}^*$**-closed** if $\mathrm{A}_{\mathrm{n}}^* \subseteq \mathrm{A}$

Definition 2.4 [5] A map $\mathrm{f} : (\mathrm{U}, \mathrm{N}, \mathrm{I}) \rightarrow (\mathrm{V}, \mathrm{M}, \mathrm{J})$ is said to be $\mathbf{n}^*$**-continuous** if $\mathrm{f}^{-1}(\mathrm{G})$ is n^*-closed in $(\mathrm{U}, \mathrm{N}, \mathrm{I})$ for every n-closed set G of $(\mathrm{V}, \mathrm{M}, \mathrm{J})$.

Definition 2.5 [12] A function defined between two nano topological spaces $\mathrm{F} : (\mathrm{U}, \tau_{\mathrm{R}}(\mathrm{S})) \rightarrow (\mho, \tau_{\mathrm{R}}(\mathrm{T}))$ is defined to be a **nIg-continuous function** if the the inverse image $\mathrm{F}^{-1}(\mathrm{P})$ is a nIg-open set in $(\mathrm{U}, \tau_{\mathrm{R}}(\mathrm{S}))$ for every n-open set P in $(\mho, \tau_{\mathrm{R}}(\mathrm{T}))$.

Definition 2.6. [1] A nano topological space $(\mathrm{U}, \tau_{\mathrm{R}}(\mathrm{X}))$ is said to be **nano-regular space**, if for each nano closed set F and each point $\mathrm{x} \in \mathrm{F}$, there exists disjoint nano open sets G and H such that $\mathrm{x} \in \mathrm{G}$ and $\mathrm{F} \subset \mathrm{H}$.

Remark 2.7 [5] 1. Every n-closed set is n^*-closed but not conversely .

2. Every n^*-closed set is nIg-closed but not conversely [9].

Theorem 2.8. [6] Consider a $(U, \mathcal{N}, I)$, then the implications are true and reverse implications are may not be true.

1. A nano closed is always a $nIgsemi^*$-closed set.
2. A n^*-closed is always a $nIgsemi^*$-closed set.
3. A ng-closed is always a $nIgsemi^*$-closed set.
4. A $nIgsemi^*$-closed is always a nIg-closed set.
5. A nano open set is always a n^*-open set.

Definition 2.9. [7] A map $f : (U, N, I) \to (V, M)$ is called **$nIgsemi^*$-continuous function**, if $f^{-1}(A)$ of each n-open set $A \subseteq (V, M)$ is a nIg $semi^*$-open set in (U, N, I).

Definition 2.10. [7] Consider two nano ideal topological spaces(U, N, I) and (V, M, J) and define a function $f : (U, N, I) \to (V, M, J)$. The function f is defined to be a **$nIgsemi^*$-irresolute function**, if the inverse image $f^{-1}(A)$ is a $nIgsemi^*$-open set in (U, N, I) for every $nIgsemi^*$-open set A in(V, M, J).

III. Contra $nIgsemi^*$- Continuous Functions

Definition 3.1. A function $f : (U, N, I) \to (V, M, J)$ is referred to as contra **$nIgsemi^*$- continuous** if $f^{-1}(A)$ is a $nIgsemi^*$-closed set of (U, N, I) for every n-open set A of (V, M). **Example 3.2.** Consider the universal set $U = \{a, b, c, d\}$, the approximation space $U/R = \{\{a\}, \{c\}, \{b, d\}\}$, $X = \{a, b\} \subseteq U$ and $I = \{\varphi, \{a\}\}$. The nano topology defined by U is $\tau_R(X) = \{U, \varphi, \{a\}, \{b, d\}, \{a, b, d\}\}$ and $nIgsemi^*$-closed sets are $\{\{a\}, \{c\}, \{a, c\}, \{b, c\}, \{c, d\}, \{b, c, d\}, \{a, c, d\}, \{a, b, c\}, U, \varphi\}$. Let $V = \{a, b, c, d\}$, the approximation space $V/R = \{\{a\}, \{b\}, \{c, d\}\}$ and $Y = \{\{b\}, \{d\}\} \subseteq V$, $J = \{\varphi, \{a\}\}$. The nano topology defined by V is $\Omega_R(Y) = \{U, \varphi, \{b\}, \{c, d\}, \{b, c, d\}\}$and $nIgsemi^*$-closed sets are $\{V, \varphi, \{b\}, \{c\}, \{d\}, \{c, d\}, \{b, d\}, \{b, c\}, \{b, c, d\}, \}$. The function $f : (U, N, I) \to (V, M, J)$ is defined as $f(a) = b, f(b) = a, f(c) = c, f(d) = d$ is contra $nIgsemi^*$-continuous function.

Theorem 3.3. Let $f : (U, N, I) \to (V, M, J)$ be a function. Then the subsequent conditions are equal.

(1) f is contra $nIgsemi^*$ -continuous.

(2) If G is nano open set in V, then $f^{-1}(G)$ is $nIgsemi^*$ -closed set in U.

(3) If G is nano closed set in V, then $f^{-1}(G)$ is $nIgsemi^*$-open-set in U.

(4) For each point u in U and every nano closed set G in V with $f(u) \in G$, there is an $nIgsemi^*$-open set O in U containing u such that $f(O) \subset G$.

Proof. (1) ⇒ (2). Let G be nano open set in V. Then V - G is nano closed set in V. With the aid of meaning of contra nIgsemi*-continuous function, f^{-1} (V - G) is nIgsemi*-open set in U. However, f^{-1} (V - G) = U - f^{-1}(G). This implies f^{-1}(G) is nIgsemi*-closed set in U.

(2) ⇒(3). The assumption of (2), f^{-1}(V - G) is nIgsemi*-closed set in U. But f^{-1}(V - G) = U - f^{-1}(G). This suggests, f^{-1}(G) is nIgsemi*-open set in U.

(3) ⇒ (4). Let u ∈ U and G be any nano closed set in V with f(u) ∈ G. By means of (3), f^{-1}(G) is nIgsemi*-open set in U. Let O = f^{-1}(G). Then there is a nIgsemi*-open set O in U containing u such that f(O) ⊂ G.

(4) ⇒ (1). Let u ∈ U and G be any n-closed set in V with f(u) ∈ G. Then V-G is n-open in V with f(u) ∈ G. By (4), there is a nIgsemi*-open set O in U containing u such that f(O) ⊂ G. This means O = f^{-1}(G) . Hence, U- O = U- f^{-1}(G) = f^{-1}(V-G) which is nIgsemi*-closed set in U.

Proposition 3.4. Every contra nIgsemi*-continuous map is contra nIg-continuous.

Proof. Let $f : (U, N, I) \to (V, M)$ be a contra nIgsemi*-continuous map and let G be any nano open set in (V, M). Then, f^{-1}(G) is nIg semi*-closed set in U Since every nIgsemi*-closed set is nIg-closed, f^{-1}(G) is nIg-closed in U. Hence, f is contra nIg-continuous.

Proposition 3.5. In a nano topological space with an ideal I, If the function $f : (U, N, I) \to (V, M, J)$ is contra nano generalised continuous function then f is nIgsemi*-continuous function.

Proof : Let $f : (U, N, I) \to (V, M)$ be a contra nano generalised continuous function. Let S be a nano open set in V. Since f is contra nano generalised continuous function, f^{-1}(S) is ng-closed in U. It is clear that every ng-closed set is nIgsemi*-closed. In this manner, f^{-1}(S) is nIgsemi*-closed in U which infers f is contra nIgsemi* continuous function.

Remark 3.6 Any contra nIgsemi*-continuous function may not be a contra nano generalised continuous function. The subsequent illustration makes sense of this remark.

Example 3.7. Consider the universal set U = {a, b, c, d}, the approximation space U/R = {{a}, {c}, {b, d}}, X = {a, b} ⊆ U with the ideal I = {φ, {a}}. The nano topology defined by U is $\tau_R(X)$ = {U, φ, {a}, {b, d}, {a, b, d}} and nIgsemi*-closed sets are

{U, φ, {a}, {c}, {a, c}, {b, c}, {c, d}, {b, c, d}, {a, c, d}, {a, b, c}}, ng-closed sets are

$\{U, \varphi, \{c\}, \{b, c\}, \{c, d\}, \{a, c\}, \{b, d\}, \{a, b, c\}, \{b, c, d\}, \{a, c, d\}\}$. Let $V = \{a, b, c, d\}$, the approximation space $V/R = \{\{a\}, \{b\}, \{c, d\}\}$ and $Y = \{\{b\}, \{d\}\} \subseteq V$ with the ideal $J = \{\varphi, \{a\}\}$. The nano topology defined by V is $\Omega_R(Y) = \{U, \varphi, \{b\}, \{c, d\}, \{b, c, d\}\}$and $nIgsemi^*$-open sets are $\{\{b\}, \{c\}, \{d\}, \{c, d\}, \{b, d\}, \{b, c\}, \{b, c, d\}, V, \varphi\}$. The function $f: (U, N, I) \to (V, M, J)$ is defined as $f(a) = b, f(b) = a, f(c) = c, f(d) = d$ is a $nIgsemi^*$-continuous function. Now $f^{-1}(b) = \{a\}$ which is not ng-closed in U. Thus contra $nIgsemi^*$-continuous function may not be a contra nano generalised continuous function.

Theorem 3.8. Let $f: (U, N, I) \to (V, M, J)$ be a map and $g: (U, N, I) \to (((U, N, I) \times (V, M, J))$ the graph map of f, defined by $g(u) = (u, f(u))$ for every $u \in U$. If g is contra $nIgsemi^*$-continuous, then f is contra $nIgsemi^*$-continuous.

Proof. Let G be an nano open set in (V, M, J). Then $((U, N, I) \times G)$ is an nano open set in $((U, N, I) \times (V, M, J))$. It follows from theorem 3.3, that $f^{-1}(G) = g^{-1}((U, N, I) \times G)$ is $nIgsemi^*$-closed in (U, N, I). Thus, f is contra $nIgsemi^*$-continuous.

Theorem 3.9. If a map $f: (U, N, I) \to (V, M, J)$ is contra $nIgsemi^*$-continuous and V is nano regular, then f is $nIgsemi^*$-continuous.

Proof. Let u be an arbitrary point of U and G be any n-open set of V containing $f(u)$. Given that V is nano regular, there exists an n-open set W in V containing $f(u)$ such that $A_n^*(W) \subset G$. Since f is contra $nIgsemi^*$-continuous, by theorem 3.3, there exists an $nIgsemi^*$-open set O containing u such that $f(O) \subset A_n^*(W)$. Consequently, $f(O) \subset A_n^*(W) \subset G$. Thus f is $nIgsemi^*$-continuous

IV. Contra $\boldsymbol{nIgsemi^*}$ - Irresolute Functions

Definition 4.1. A function $f: (U, N, I) \to (V, M, J)$ is called **contra $\boldsymbol{nIgsemi^*}$ - irresolute** if $f^{-1}(A)$ is a $nIgsemi^*$-closed set of (U, N, I) for every $nIgsemi^*$-open set A of (V, M, J).

Example 4.2. Consider the universal set $U = \{a, b, c, d\}$, the approximation space $U/R = \{\{a\}, \{d\}, \{b, c\}\}, X = \{a, d\} \subseteq U$ with the ideal $I = \{\varphi, \{a\}\}$. The nano topology defined by U is $\tau_R(X) = \{U, \varphi, \{a, d\}\}$ and $nIgsemi^*$-closed sets are $\{U, \varphi, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}, \{c, d\}, \{b, d\}, \{b, c, d\}, \{a, c, d\}, \{a, b, d\}, \{a, b, c\}\}$ Let $V = \{a, b, c, d\}$, the approximation space $V/R = \{\{a\}, \{b\}, \{c, d\}\}$, $Y = \{\{b\}, \{d\}\} \subseteq V$ with the ideal $J = \{\varphi, \{a\}\}$. The nano topology defined by V is $\Omega_R(Y) =$

$\{V, \varphi, \{b\}, \{c, d\}, \{b, c, d\}\}$and $nIgsemi^*$-open sets $are\ \{\{b\}, \{c\}, \{d\}, \{c, d\}, \{b, d\}, \{b, c\}, \{b, c, d\}, V, \varphi\}$. The function $f : (U, N, I) \to (V, M, J)$ is defined as $f(a) = d, f(b) = b, f(c) = c, f(d) = a$ is a $nIgsemi^*$-irresolute function.

Theorem 4.3. Let $f : (U, N, I) \to (V, M, J)$ be a function. Then the following conditions are equivalent

(1) f is contra $nIgsemi^*$-irresolute.

(2) If G is nano open set in V, then $f^{-1}(G)$ is $nIgsemi^*$ -closed set in U.

(3) If G is nano closed set in V, then $f^{-1}(G)$ is $nIgsemi^*$-open-set in U.

(4) For each point u in U and each $nIg\ semi^*$-closed set G in V with $f(u) \in G$, there is an $nIgsemi^*$-open set O in U containing u such that $f(O) \subset G$.

Proof. The proof is much like the theorem 3.3

V. Composition of Functions Under Contra $nIgsemi^*$-Continuous and Contra $nIgsemi^*$-Irresolute Functions.

Theorem 5.1. For the functions $f : (U, N, I) \to (V, M, J)$ and $g : (V, M, J) \to (W, O, K)$, $g \circ f$ is $nIgsemi^*$-irresolute, if f is contra $nIgsemi^*$ -irresolute map and g is contra $nIgsemi^*$-irresolute map.

Proof. Let G be $nIgsemi^*$ -open set in W. Considering the fact g is contra $nIgsemi^*$-irresolute, $g^{-1}(G)$ is $nIgsemi^*$-closed set in V. Since f is contra $nIgsemi^*$-irresolute, $(g \circ f)^{-1}(G) = f^{-1}(g^{-1}(G))$ is $nIgsemi^*$-open set in U. Hence $g \circ f$ is $nIgsemi^*$-irresolute.

Theorem 5.2. For the functions $f : (U, N, I) \to (V, M, J)$ and $g : (V, M, J) \to (W, O, K)$, $g \circ f$ is $nIgsemi^*$-continuous , if f is contra $nIgsemi^*$-continuous and g is contra nano continuous function.

Proof: Let $f : (U, N, I) \to (V, M, J)$ be a contra $nIgsemi^*$-continuous function and $g : (V, M, J) \to (W, O, K)$ be a contra nano continuous function. Let S be a nano open set in W. Given that g is contra nano continuous function, $g^{-1}(S)$ nano closed set in V. Since f is contra $nIgsemi^*$-continuous function, $f^{-1}(g^{-1}(S))$ is $nIgsemi^*$-open in U. Hence $g \circ f$ is $nIgsemi^*$-continuous functions.

Theorem 5.3 If the function $f : (U, N, I) \to (V, M, J)$ is $nIgsemi^*$-irresolute map and the function g :(V,M,J) → (W,O,K) is contra $nIgsemi^*$-continuous map, then $g \circ f : (U, N, I) \to (W, O, K)$ is contra $nIgsemi^*$-continuous map.

Proof. As g is contra $nIgsemi^*$-continuous from (V, M, J) to (W, O), for any nano open set in w as a subset of W, we obtain $g^{-1}(w) = G$ is a $nIgsemi^*$-closed set in (V, M, J). Since f is $nIgsemi^*$-irresolute map, we obtain $(g \circ f)^{-1}(w) = f^{-1}(g^{-1}(w)) = f^{-1}(G) = S$ and S is a $nIgsemi^*$-closed in(U, N, I). Hence $g \circ f$ is a contra $nIgsemi^*$-continuous map.

Theorem 5.4. For the functions $f : (U, N, I) \to (V, M, J)$ and $g : (V, M, J) \to (W, O, K)$, $g \circ f$ is contra $nIgsemi^*$-continuous, if f is contra $nIgsemi^*$-continuous and g is n-continuous functions.

Proof: Let S be a nano open set in W. Since g is n-continuous function, $g^{-1}(S)$ is n-open set in V. Since f is contra $nIgsemi^*$-continuous, $f^{-1}(g^{-1}(S))$ is $nIgsemi^*$-closed set in U. Then $(g \circ f)^{-1}(S)$ is $nIgsemi^*$- closed set in U. Hence $g \circ f$ is contra $nIgsemi^*$-continuous function.

Remark 5.5. The composition of two contra $nIgsemi^*$-continuous function need not be contra $nIgsemi^*$-continuous function and this is shown from the following example.

Example 5.6 Let $U = \{a, b, c, d\}$, the approximation space $U/R = \{\{a\}, \{b\}, \{c, d\}\}, X = \{c\} \subseteq U$ with the ideal $I = \{\varphi, \{b\}, \{a, b\}\}$. The nano topology defined by U is $\tau_R(X) = \{U, \varphi, \{c, d\}\}$and $nIgsemi^*\text{-}closed$ sets are{ $U, \varphi, \{a\}, \{b\}, \{a, b\}, \{b, c\}, \{a, c\}, \{a, d\}, \{b, d\}\{a\}, \{b\}\{a, c, d\}$.
Let $V = \{a, b, c, d\}$, the approximation space $V/R = \{\{a\}, \{d\}, \{b, c\}\}$, $Y = \{a, d\} \subseteq V$ with the ideal $J = \{\varphi, \{a\}\}$. The nano topology defined by V is $\Omega_R(\mathrm{Y}) = \{\mathrm{V}, \varphi, \{\mathrm{a}, \mathrm{d}\}\}$ and nIgsemi*-open sets are $\{\mathrm{U}, \varphi, \{a\}, \{b\}, \{c\}, \{c, d\}, \{a, b\}, \{b, d\}, \{b, c\}, \{a, c\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}\}$.
Let $\mathrm{W} = \{a, b, c, d\}$, the approximation space $\mathrm{W/R} = \{\{b\}, \{d\}, \{a, c\}\}, \mathrm{Z} = \{a, d\} \subseteq \mathrm{W}$ with the ideal $\mathrm{K} = \{\varphi, \{d\}\}$. The nano topology defined by W is $\Psi_R(\mathrm{Z}) = \{\mathrm{W}, \varphi, \{d\}, \{a, c\}, \{a, c, d\}\}$and nIgsemi*-closed sets are $\{\mathrm{W}, \varphi, \{b\}, \{d\}, \{b, d\}, \{b, c\}, \{a, b\}, \{b, c, d\}, \{a, b, d\}, \{a, b, c\}\}$. Let the functions f and g can be defined as $f : U \to V$ defined by $f(a) = a$; $f(b) = c$; $f(c) = b$; $f(d) = d$ and $g : V \to W$ is defined by $g(a) = d$; $g(b) = b$; $g(c) = c$; $g(d) = a$. Here the functions f and g are contra nIgsemi*-continuous functions.
Since $(g \circ f)^{-1}(\{a, c\}) = f^{-1}[g^{-1}(\{a, c\})] = f^{-1}(\{c, d\}) = \{c, d\}$ and here $\{c, d\}$ is not a nIgsemi*-

closed set in U, $g \circ f$ is not a nIgsemi*-continuous function.

Theorem 5.7. For the functions $f : (U, N, I) \rightarrow (V, M, J)$ and $g : (V, M, J) \rightarrow (W, O, K)$, We have,

(1) $g \circ f$ is nIg semi*-continuous, if f is contra nIg semi*-continuous and g is contra n*-continuous.

(2) $g \circ f$ is nIg semi*-continuous, if f is contra nIg semi*-irresolute and g is contra n*-continuous.

(3) $g \circ f$ is nIg semi*-continuous, if f is contra nIg semi*-irresolute and g is contra nIg semi*-continuous.

(4) $g \circ f$ is contra nIg semi*-irresolute, if f is contra nIg semi* -irresolute and g is nIg semi*-irresolute.

(5) $g \circ f$ is contra nIg semi*-irresolute, if f is nIg semi* -irresolute and g is contra nIg semi*-irresolute.

Proof: The proof of (1), (2), (3), (4) and (5) are much like theorem 5.1.

Conclusion: Through the above discussion we have summed up the conceptualization of contra nIgsemi*-continuity and contra nIgsemi*-irresolute functions in nano ideal topological spaces. Additionally, We laid out the connections between these new classes and different classes of functions with the use of appropriate illustrations.

References:

[1] Bhuvaneswari, M & Nagaveni, N 2018, 'On nwg-normal and nwg-regular spaces', International Journal of Mathematics Trends and Technology. pp. 1-5.

[2] Crossley, S.G & Hildebrand, S.K, 1972, 'Semi-topological properties', Fund. Math, vol 16, pp. 233-254.

[3] Dontchev, J, 1996, 'On pre-I-open sets and a decomposition of I-continuity', Banyan Math. J, vol 2.

[4] Ganesan, S 'On contra nIg-continuity in nano ideal topological spaces' (communicated).

[5] Jayasudha, J & Rekha priyadharsini, T, 2019, 'On some decompositions of nano ⋆-continuity', international Journal of Mathematics and Statistics Invention, vol 7(1), pp 01-06.

[6] Joycy Renuka, J & Arul Jesti, J, 2022, 'Nano Ideal Generalised Semi*Closed Sets in Nano Ideal Topological Spaces', Turkish Journal of Computer and Mathematics Education, vol 13, no.02, pp 385-393.

[7] Joycy Renuka, J & Arul Jesti, J, 'Nano Ideal Generalised Semi* Continuous and Irresolute Functions in Nano Ideal Topological Spaces'. (Communicated).

[8] Narmatha, V. Inthumathi & Krishnaprakash, S, 2020, 'Decompositions of nano-ri-continuity'. International Journal of Advanced Science and Technology, vol 29, pp 2578–2582.

[9] Parimala, M, Jafari & S Murali, S, 2017, 'Nano ideal generalized closed sets in nano ideal topological spaces', Annales Univ.Sci. Budapest, no 60, pp 3-11.

[10] Parimala, M, Noiri, T & Jafari, S, 2016, 'New types of nano topological spaces via nano ideals', ResearchGate, pp 1-10.

[11] Sandhya, S.M, Jeyashri, S, Ganesan, S & Alexander, C, 2020, 'Contra -Continuity', The International journal of analytical and experimental modal analysis Volume XII, Issue V, ISSN NO:0886-9367.

[12] Vijaya, S, Santhi, P & Yuvarani, A, 2021, 'Contra Nα-I-Continuity over Nano Ideals',Ratio Mathematica, vol 41, pp. 283-290.