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Weaker Forms of Nano Irresolute and Its Contra Functions

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Abstract

In this paper the concept of some weaker forms of irresolute and contra irresolute functions in Nano Topological spaces are studied and its related characteristics are discussed. Also we introduced the notion called contra nano alpha irresolute function, contra nano semi irresolute function, contra nano pre irresolute function and its properties are examined. Finally, we have revealed some applications related to recent scenario of online teaching and COVID-19 which can be expressed as nano irresolute functions and contra irresolute functions respectively.
Keywords: Ns-irresolute function, Np-irresolute function, contra Nα-irresolute function, contra Ns-irresolute function, contra Np-irresolute function.
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1 Introduction

In 1982 Pawlak [Pawlak, 1982] investigated about approximate operations, equality and inclusion on sets. In [Crossley and Hildebrand, 1972], irresolute functions was introduced and analysed by Crossley and Hildebrand in topological spaces. Weak and Strong forms of irresolute functions in topology were discussed by Maio and Noiri [Maio and Noiri, 1988]. The conception of nano-topology was initiated by Lellis Thivagar [Thivagar and Richard, 2013b],[M. Lellis Thivagar and Richard, 2013] and [M. Lellis Thivagar and Devi, 2017]. Also in [Thivagar and Richard, 2013a], nano continuous functions, nano interior and nano closure was look over by Lellis and Carmel Richard. Bhuvaneshwari and Ezhilarasi[Bhuvaneshwari and Ezhilarasi, 2016] introduced irresolute maps and semi-generalized irresolute maps in nano topological spaces. New functions called Ns-irresolute and Np-irresolute functions are originated and look into its behaviour in this article. Further the notions called contra Nα-irresolute function, contra Ns-irresolute function, contra Np-irresolute function were introduced and examined their properties. Throughout this article we use the notation NTS, N-open, Nα-open, Ns-open, Np-open, Nα-continuous, Ns-continuous, Np-continuous for "Nano Topological spaces, Nano open, Nano α-open, Nano semi-open, Nano Pre-open sets, Nano α-continuous, Nano semi-continuous, Nano pre-continuous" respectively. Similar notation is used for their respective closed sets.

2 Nano Irresolute Functions

Definition 2.1. *Let U_1 and U_2 be NTS with respect to $\tau_R(X)$ and $\tau_{R'}(Y)$. Then $h : U_1 \to U_2$ is called*

1. *Ns-irresolute if $h^{-1}(S)$ is Ns-open set in U_1 for each Ns-open set S in U_2,*
2. *Np-irresolute if $h^{-1}(S)$ is Np-open set in U_1 for each Np-open set S in U_2.*

Example 2.1. *Take $U_1 = \{w,x,y,z\}$ with $U_1/R = \{\{x,z\},\{y,w\}\}$ and $X = \{x,z\}$. Then $\tau_R(X) = \{U_1,\phi,\{x,z\}\}$. Let $U_2 = \{q,r,s,t\}$ with $U_2/R' = \{\{q\},\{r,s\},\{t\}\}$ and $Y = \{q,t\}$. Then $\tau_{R'}(Y) = \{U_2,\phi,\{q,t\}\}$. We define $h : (U_1, \tau_R(X)) \to (U_2, \tau_{R'}(Y))$ as $h(x) = q$, $h(y) = r$, $h(z) = t$, $h(w) = s$. Then the inverse image of any Ns-open in U_2 is Ns-open in U_1 and the inverse image of any Np-open in U_2 is Np-open in U_1. Therefore h is Ns-irresolute and Np-irresolute.*

Theorem 2.1. *Let U_1 and U_2 be the NTS with reference to $\tau_R(X)$ and $\tau_{R'}(Y)$ and $h : U_1 \to U_2$ be a mapping. Then the statements given below are equivalent.*

1. *h is Nα-irresolute.*

2. *h^{-1}(S) is Nα-closed in U_1, for each Nα-closed set S in U_2.*

3. *h(Nαcl(S)) $\subseteq$ Nαcl(h(S)) for each S $\subseteq U_1$.*

4. *Nαcl(h^{-1}(S)) $\subseteq h^{-1}$(Nαcl(S)) for each S $\subseteq U_2$.*

5. *h^{-1}(Nαint(S)) $\subseteq$ (Nαint(h^{-1}(S)) for each S $\subseteq U_2$.*

6. *h is Nα-irresolute for each x $\in U_1$.*

Proof. (i) $\implies$ (ii). It is obvious.
(ii) $\implies$ (iii). Let S $\subseteq$ U_1. Then, Nαcl(h(S)) is a Nα-closed set of U_2. By (ii), h^{-1}(Nαcl(h(S))) is a Nα-closed set in U_1 and Nαcl(S) $\subseteq$ Nαcl(h^{-1}h(S)) $\subseteq$ Nαcl(h^{-1}(Nαcl((h(S)))) = h^{-1}(Nαcl(h(S))). So h(Nαcl(h(S)) $\subseteq$ Nαcl(h(S)).
(iii) $\implies$ (iv). Let S be a subset of U_2. By (iii) h(Nαcl(h^{-1}(S))) $\subseteq$ Nαcl(hh^{-1}(S)) $\subseteq$ Nαcl(S). So Nαcl(h^{-1}(S)) $\subseteq$ $h^{-1}h$(Nαcl(h^{-1}(S))) $\subseteq$ h^{-1}(Nαcl(S)).
(iv) $\implies$ (v). Let S be a subset of U_2. By (iv), h^{-1}(Nαcl(U_2-S)) $\supseteq$ Nαcl(h^{-1}(U_2- S)) = Nαcl(U_1-h^{-1}(S)). Since U_1-Nαcl(U_1-S) = Nαint(S), then h^{-1}(Nαint(S)) = h^{-1}(U_2-Nαcl(U_2-S)) = U_1-h^{-1}(Nαcl(U_2-S)) $\subseteq$ U_1-Nαcl(U_1-h^{-1}(S)) = Nαint(h^{-1}(S)).
(v) $\implies$ (vi). Let S be a Nα-open set of U_2, then S = Nαint(S). By (v), h^{-1}(S)= h^{-1}(Nαint(S)) $\subseteq$ Nαint(h^{-1}(S)) $\subseteq$ h^{-1}(S). So, h^{-1}(S) = Nαint(h^{-1}(S)). Thus, h^{-1}(S) is a Nα-open set of U. Therefore h is Nα-irresolute.
(i) $\implies$ (vi). Let h be Nα-irresolute, x $\in$ U_1 and any Nα-open set S of U_2, such that h(x) $\subseteq$ S. Then x $\in$ h^{-1}(S) = Nαint(h^{-1}(S)). Let B = h^{-1}(S), then B is a Nα-open set of U_1 and so h(B) = hh^{-1}(S) $\subseteq$ S. Thus h is Nα-irresolute for each x $\in$ U_1.
(vi) $\implies$ (i). Let S be a Nα-open set of U_2, x $\in$ h^{-1}(S). Then h(x) $\in$ S. By hypothesis there exists a Nα-open set B of U_1 such that x $\in$ B and h(B) $\subseteq$ S. Hence x $\in$ B $\subseteq$ h^{-1}(h(B)) $\subseteq$ h^{-1}(S) and x $\in$ B = Nαint(B) $\subseteq$ Nαint(h^{-1}(S)). So, h^{-1}(S) $\subseteq$ Nαint(h^{-1}((S)). Hence h^{-1}(S) = Nαint(h^{-1}(S)). Thus h is Nα-irresolute.□

Theorem 2.2. *Let U_1 and U_2 be the NTS with respect to $\tau_R(X)$ and $\tau_{R'}$(Y) and h : $U_1 \to U_2$ be a 1-1 and onto function. Then h is Nα-irresolute iff Nαint(h(S)) $\subseteq$ h(Nαint(S)) for each S $\subseteq$ of U_1.*

Proof. Let S be any subset of U_1. By Theorem 2.1 and since h is 1-1 and onto, h^{-1}(Nαint(h(S))) $\subseteq$ Nαint(h^{-1}(h(S))) = Nαint(S). So, hh^{-1}(Nαint(h(S))) $\subseteq$ h(N αint(S)). Thus Nαint(h(S)) $\subseteq$ h(Nαint(S)).
Conversely, Let S be a Nα-open set of U_2. Then S = Nαint(S). By hypothesis, h(Nαint(h^{-1}(S))) $\supseteq$ Nαint(h(h^{-1}(S))) = Nαint(S) = S. Thus we get $h^{-1}h$(Nαint (h^{-1}(S))) $\supseteq$ h^{-1}(S). Since h is 1-1 and onto, Nαint(h^{-1}(S))=$h^{-1}h$(Nαint(h^{-1}(S))) $\supseteq$ h^{-1}(S). Hence h^{-1}(S) = Nαint(h^{-1}(S)). So h^{-1}(S) is Nα-open set of U. Thus h is Nα-irresolute.□

Lemma 2.1. *Let U_1 be a NTS with respect to $\tau_R(X)$ then*

1. *Nαcl(S) $\subseteq$ Ncl(S) for every subset S of U_1,*
2. *Ncl(S) = Nαcl(S) for every α-open subset S of U_1.*

Theorem 2.3. *Let U_1 and U_2 be the NTS with respect to $\tau_R(X)$ and $\tau_{R'}$(Y) and h : $U_1 \to U_2$ be a Nα-irresolute. Then Ncl(h^{-1}(S)) $\subseteq h^{-1}$(Ncl(S)) for every S $\subseteq U_2$.*

Proof. Let S be any N-open subset of U$_2$. Since h is Nα-irresolute and Nαcl(h^{-1} (S)) is equal to Ncl($h^{-1}(A)$). By Theorem 2.1, Nαcl(h^{-1}(S)) $\subseteq h^{-1}$(Nαcl(S)) and by Lemma 2.1 h^{-1}(Nαcl(S) $\subseteq h^{-1}$(Ncl(S)). Then Nαcl(h^{-1}(S)) $\subseteq h^{-1}$(Ncl(S)). Therefore Ncl(h^{-1}(S)) $\subseteq h^{-1}$(Ncl(S)).□

Theorem 2.4. *Let U_1 and U_2 be the NTS with respect to $\tau_R(X)$ and $\tau_{R'}$(Y).Then h : $U_1 \to U_2$ is a Ns- irresolute iff for each Ns-closed subset h^{-1}(S) is Ns-closed in U_1.*

Proof. If h is Ns-irresolute, then h^{-1}(B) is Ns-open in U$_1$ for each Ns-open set B $\subseteq$ U$_2$. If S is any Ns-closed subset of U$_2$, then U$_2-$S is Ns-open. Thus h^{-1}(U$_2-$S) is Ns-open in U$_1$, but h^{-1}(U$_2-$S) = U$_1-h^{-1}$(S) so that h^{-1}(S) is Ns-closed in U$_1$. Conversely, if for all Ns-closed set S $\subseteq$ U$_2$, h^{-1}(S) is Ns-closed in U$_1$ and if B is any Ns-open subset of U$_2$, then U$_2-$B is Ns-closed. Also h^{-1}(U$_2-$B) = U$_1-h^{-1}$(B) which is Ns-closed in U$_1$. Therefore h^{-1}(B) is Ns-open set in U$_1$. Hence h is Ns-irresolute.□

Theorem 2.5. *If h : $U_1 \to U_2$ and g : $U_2 \to U_3$ is Ns-irresolute(Np-irresolute) then g∘h : $U_1 \to U_3$ is Ns-irresolute(Np-irresolute).*

Proof. (i) If A $\subseteq$ U$_3$ is Ns-open(Np-open), then g^{-1}(S) is Ns-open(Np-open) set in U$_2$ because g is Ns-irresolute(Np-irresolute). Consequently since h is Ns-irresolute(Np-irresolute), $h^{-1}(g^{-1}$(S))= (g∘h)$^{-1}$(S) is Ns-open(Np-open) set in U$_1$. Hence g∘h is Ns-irresolute(Np-irresolute).

Theorem 2.6. *If h : $U_1 \to U_2$ is Nα-irresolute(Ns-irresolute, Np-irresolute) and g : $U_2 \to U_3$ is Nα-continuous(Ns-continuous, Np-continuous) then g∘h : $U_1 \to U_3$ is Nα-continuous(Ns-continuous, Np-continuous).*

Proof. Let S $\subseteq$ U$_3$ is N-open. Since g is Nα-continuous(Ns-continuous, Np-continuous), g^{-1}(S) is Nα-open(Ns-open, Np-open)set in U$_2$. Consequently since h is Nα-irresolute(Ns-irresolute, Np-irresolute), $h^{-1}(g^{-1}$(S)) = (g∘h)$^{-1}$(S) is Nα-open(Ns-open, Np-open) set in U$_1$. Hence g∘h is Nα-continuous(Ns-continuous, Np-continuous).□

Theorem 2.7. *Let U_1 and U_2 be the NTS with respect to $\tau_R(X)$ and $\tau_{R'}(Y)$. A function $h : U_1 \to U_2$ is*

1. *Ns-irresolute and Np-irresolute then h is Nα-irresolute,*
2. *Nα-continuous iff it is Ns-continuous and Np-continuous.*

Proof. It is obvious.

3 Nano Contra Irresolute Functions

Here we introduce contra irresolute functions and its characteristics are discussed. The notations used are NCα-open, NCs-open, NCp-open for "Nano contra α-open, Nano contra semi-open, Nano contra pre-open functions" respectively.

Definition 3.1. *Let U_1 and U_2 be the NTS with respect to $\tau_R(X)$ and $\tau_{R'}(Y)$. Then $h : U_1 \to U_2$ is said to be*

1. *NCα-open if h(S) is Nα-closed in U_2 for each N-open S in U_1,*
2. *NCs-open if h(S) is Ns-closed in U_2 for each N-open S in U_1,*
3. *NCp-open if h(S) is Np-closed in U_2 for each N-open S in U_1.*

Example 3.1.

1. *Let $U_1 = \{j,k,l\}$ with $U_1/R = \{\{l\},\{j,k\}\}$ and $X = \{k,l\}$. Then $\tau_R(X) = \{U_1,\phi,\{l\},\{j,k\}\}$. Let $U_2 = \{x,y,z\}$, $U_2/R' = \{\{y\},\{x,z\}\}$ and $Y = \{y,z\}$. Subsequently $\tau_{R'}(Y) = \{VU_2,\phi,\{y\},\{x,z\}\}$. We label $h : (U_1, \tau_R(X)) \to (U_2, \tau_{R'}(Y))$ as h(j) = x, h(k) = z, h(l) = y. Subsequently h(S) is Nα-closed in U_2 for every N-open set S in U_1. Hence h is NCα-open.*
2. *Let $U_1 = \{j,k,l,m\}$ with $U_1/R = \{\{j\},\{l\},\{k,m\}\}$ and $X = \{j,k\}$. Subsequently $\tau_R(X) = \{U_1,\phi,\{j\},\{k,m\},\{j,k,m\}\}$. Let $U_2 = \{p,q,r,s\}$ with $U_2/R' = \{\{p\},\{s\},\{q,r\}\}$ and $Y = \{p,r\}$. Subsequently $\tau_{R'}(Y) = \{U_2,\phi,\{p\},\{q,r\},\{p, q,r\}\}$. We label $h : (U_1, \tau_R(X)) \to (U_2, \tau_{R'}(Y))$ as h(j) = s, h(k) = r, h(l) = p, h(m) = q. Then h(S) is Ns-closed in U_2 for every N-open set S in U_1. Hence h is NCs-open.*
3. *Let $U_1 = \{j,k,l,m\}$ with $U_1/R = \{\{l\},\{m\},\{j,k\}\}$ and $X = \{j,l\}$. Subsequently $\tau_R(X) = \{U_1,\phi,\{l\},\{j,k\},\{j,k,l\}\}$. Let $U_2 = \{p,q,r,s\}$ with $U_2/R' = \{\{q\},\{r\},\{p,s\}\}$ and $Y = \{p,r\}$. Subsequently $\tau_{R'}(Y) = \{U_2,\phi,\{r\},\{p,s\},\{p,r, s\}\}$. We define $h : (U_1, \tau_R(X)) \to (U_2, \tau_{R'}(Y))$ as h(j) = q, h(k) = s, h(l) = p, h(m) = r. Then h(S) is Np-closed in U_2 for every N-open set S in U_1. Hence h is NCp-open.*

Definition 3.2. *Let U_1 and U_2 be the NTS with respect to $\tau_R(X)$ and $\tau_{R'}(Y)$. Then $h : U_1 \to U_2$ is said to be CNα-irresolute(CNs-irresolute, CNp-irresolute) if $h^{-1}(S)$ is Nα-closed(Ns-closed, Np-closed)set in U_1 for every Nα-open set(Ns-open, Np-open) in U_2 .*

Example 3.2. 1. *Let U_1 = {j,k,l,m} with U_1/R = {{j},{k},{l},{m}} and X = {j}. Then $\tau_R(X)$ = {U_1,ϕ,{j}}. Let U_2 = {w,x,y,z} with U_2/R'={{w},{x},{y },{z}} and Y = {x,y,z}. Then $\tau_{R'}(Y)$ = {V,ϕ,{x,y,z}}. We label h : (U_1, $\tau_R(X)$) $\to$ (U_2, $\tau_{R'}(Y)$) as h(j) = w, h(k) = x, h(l) = y, h(m) = z. Then $h^{-1}(S)$ is Ns-closed in U_1 for every Ns-open set S in U_2 . Therefore h is CNα-irresolute and CNs-irresolute.*

2. *Let U_1 = {p,q,r} with U_1/R = {{p},{q,r}}and X={q,r}. Then $\tau_R(X)$ = {U_1,ϕ,{q,r}}. Let U_2 = {j,k,l} with U_2/R' = {{j},{k,l}} and Y = {j}. Then $\tau_{R'}(Y)$ = {U_2,ϕ,{j}}. We define h : (U_1,$\tau_R(X)$) $\to$ (U_2, $\tau_{R'}(Y)$) as h(p) = j, h(q) = k, h(r) = l. Then $h^{-1}(S)$ is Np-closed in U_1 for every Np-open set S in U_2 . So h is CNp-irresolute.*

Theorem 3.1. *Consider U_1 and U_2 be the NTS with respect to $\tau_R(X)$ and $\tau_{R'}(Y)$. Then $h : U_1 \to U_2$ is CNα-irresolute iff for each Nα-closed subset S of U_2, $h^{-1}(S)$ is Nα-open in U_1.*

Proof. If h is CNα-irresolute, then for each Nα-open subset B in U_2, h^{-1}(B) is Nα-closed in U_1. If S is any Nα-closed subset in U_2, then U_2- S is Nα-open. Thus $h^{-1}(U_2-$ S) is Nα-closed but $h^{-1}(U_2-$ S) = U_1 $-$ h^{-1}(S) so that h^{-1}(S) is Nα-open in U_1.
Conversely, if, for all Nα-closed subsets S of U_2, h^{-1}(S) is Nα-open in U_1 and if B is any Nα-open subset of U_2, then U_2 $-$ B is Nα-closed. Also $h^{-1}(U_2-$ B) = U_1 $-$ h^{-1}(B) is Nα-open. Thus h^{-1}(B) is Nα-closed in U_1. Hence h is CNα-irresolute.□

Corolary 3.1. *Let U_1 and U_2 be the NTS with respect to $\tau_R(X)$ and $\tau_{R'}(Y)$. Then $h : U_1 \to U_2$ is CNs-irresolute(CNp-irresolute) if and only if for each Ns-closed subset(Np-closed subset) S of U_2, $h^{-1}(S)$ is Ns-open(Np-open) in U_1.*

Theorem 3.2. *If the functions $h : U_1 \to U_2$ and $g : U_2 \to U_3$ are CNα-irresolute then g$\circ$h : $U_1 \to U_3$ is Nα-irresolute.*

Proof. If S $\subseteq$ U_3 is Nα-open, then g^{-1}(S) is Nα-closed in U_2 because g is CNα-irresolute. Consequently since h is CNα-irresolute, $h^{-1}(g^{-1}$(S))= (g$\circ$h)$^{-1}$(S) is Nα-open set in U_1, by corollary 4.6. Hence g$\circ$h is Nα-irresolute.□

Corolary 3.2. *If the functions $h : U_1 \to U_2$ and $g : U_2 \to U_3$ are CNs-irresolute (CNp-irresolute) then g$\circ$h : $U_1 \to U_3$ is Ns-irresolute(Np-irresolute).*

Theorem 3.3. *If the function h : $U_1 \to U_2$ is CNα-irresolute and the function g : $U_2 \to U_3$ is NCα-continuous then g$\circ$h : $U_1 \to U_3$ is Nα-continuous.*

Proof. Let S $\subseteq$ U_3 is N-open. Since g is NCα-continuous, g^{-1}(S) is Nα-closed in U_2. Consequently since h is CNα-irresolute, $h^{-1}(g^{-1}$(S))= (g$\circ$h)$^{-1}$(S) is Nα-open set in U_1, by theorem 4.5. Hence g$\circ$h is Nα-continuous.□

Corolary 3.3. *If the function h : $U_1 \to U_2$ is CNs-irresolute(CNp-irresolute) and the function g : $U_2 \to U_3$ is NCs-continuous(NCp-continuous) then g$\circ$h : $U_1 \to U_3$ is Ns-continuous(Np-continuous).*

Theorem 3.4. *Let U_1 and U_2 be the NTS with respect to $\tau_R(X)$ and $\tau_{R'}$(Y). Then h : $U_1 \to U_2$ is CNs-irresolute and CNp-irresolute then h is CNα-irresolute.*

Proof. It is obvious.

Theorem 3.5. *Let U_1 and U_2 be the NTS with respect to $\tau_R(X)$ and $\tau_{R'}$(Y). Then h : $U_1 \to U_2$ is CNα-irresolute then it is NCα-continuous.*

Proof. Consider the N-open set T $\subseteq$ U_2. Which implies T is a Nα-open set in U_2. But h is CNα-irresolute So h^{-1}(T) is a Nα-closed set in U_1. It shows that h is NCα-continuous function.□

4 Applications

Finally, we discuss the application of nano irresolute functions and its contra functions.

Example 4.1. *Advances in technology and some pandemic situations allow students to study entirely online. Consider the impact of e-learning on students characteristics, as a function of, the innovative strategies used in online teaching. Let us consider some of the strategies used in online teaching are powerpoint presentation (P), videos (V), mind map (M), Online Quiz (Q), Group discussion (G) and its impact on students characteristics are Intellectually curious (I), Good time management (T), Self-driven (S), Enhanced Communication skills (C). Let U_1=$\{$P,V,M,Q,G$\}$ be the universe of the innovative strategies used in online teaching with U_1/R =$\{\{$P,V$\}$,$\{$M,G$\}$, $\{$Q$\}\}$ and X_1 =$\{$P,Q$\}$. Subsequently $\tau_R(X_1)$=$\{U_1,\phi,\{Q\},\{P,V\},\{P,V,Q\}\}$. Let U_2 =$\{I,T,S,C\}$ be the universe on students characteristics with U_2/R' = $\{\{$I,S$\}$,$\{$T,C$\}\}$ and X_2 = $\{$T,C$\}$. Then $\tau_{R'}(X_2)$ = $\{U_2$, ϕ, $\{$T,C$\}\}$. We define h : (U_1, $\tau_R(X_1)$) $\to$ (U_2, $\tau_{R'}(X_2)$) as h(P) = C, h(V) = C, h(M) = I, h(Q) = T and h(G) = S. Then for every Nα-open set in U_2, inverse image is Nα-open set in U_1 and also for every Ns-open set in U_2, inverse image is Ns-open set in U_1. Hence h is Nα-irresolute* *and Ns-irresolute. Thus, the impact of e-learning on students characteristics, as a function of the innovative strategies used in online teaching, are Nα-irresolute and Ns-irresolute function.*

Example 4.2. *The main cause of illness is the infectious diseases. However, some initial precautions may help to prevent infections. If not, it leads to serious medical conditions and sometimes to death. Consider the precautionary measures to be adopted to prevent affecting from COVID-19, as a function of, its symptoms. Let the symptoms of COVID-19 are Dry cough (K), Fever (F), Shortness of Breath (B), Loss of Taste/Smell (L) and the precautionary measures to be adopted are Sanitizing (S), Social distancing (D), Wearing mask (M), Boosting Immunity power (I). Let* $U_1 = \{K,F,B,L\}$ *be the universe of symptoms of COVID-19 with* $U_1/R = \{\{K\},\{F\},\{B\},\{L\}\}$ *and* $X_1 = \{K\}$. *Then* $\tau_R(X_1) = \{U_1, \phi, \{K\}\}$. *Let* $U_2 = \{S,D,M,I\}$ *be the universe of the precautionary measures to be adopted with* $U_2/R' = \{\{S\},\{D\},\{M\},\{I\}\}$ *and* $X_2 = \{D,M,I\}$. *Then* $\tau_{R'}(X_2) = \{U_2, \phi, \{D,M,I\}\}$. *We define* $h : (U_1, \tau_R(X_1)) \to (U_2, \tau_{R'}(X_2))$ *as* $h(K) = S$, $h(F) = D$, $h(B) = M$ *and* $h(L) = I$. *Then for every Nα-open set in* U_2, *inverse image is Nα-closed set in* U_1 *and also for every Ns-open set in* U_2, *inverse image is Ns-closed set in* U_1. *Thus h is contra Nα-irresolute and contra Ns-irresolute.*
Thus, the precautionary measures to be adopted to prevent affecting from COVID-19, as a function of its symptoms, are contra Nα-irresolute and contra Ns-irresolute function.

5 Conclusions

Through the above discussions we have summarized the conceptulation of irresolute functions and contra irresolute functions in NTS along with examples. Further, We have revealed some applications related to current scenario of online teaching and COVID-19 which can be expressed as nano irresolute functions and contra irresolute functions respectively. Thus these notions can be applied in many real time situations.

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