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CONTRA SUPRA*G-CONTINUOUS FUNCTIONS AND CONTRA SUPRA*G - IRRESOLUTE FUNCTIONS IN SUPRA TOPOLOGICAL SPACES

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Abstract

In 1983, Mashhour et al. introduced the supra topological spaces and studied S-continuous functions and S*-continuous functions. In this paper, we introduce the concept of contra supra*g-continuous functions and contra supra*g-irresolute. We obtain the basic properties and their relationship with other forms of contra supra continuous functions in supra topological spaces

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INTRODUCTION

In 1983, Mashhour et al. [1] introduced the supra topological spaces and studied S-continuous functions and S*-continuous functions. In 2011, Ravi et al. [3] introduced and investigated several properties of supra generalized closed sets, supra sg-closed sets and gs-closed sets in supra topological spaces In topological space the arbitrary union condition is enough to have a supra topological space. Here every topological space is a supra topological space but the converse is not always true. Many researchers are Introducing many new notions and investigating the properties and characterizations of such new notions The purpose of this paper is to introduce the concept of contra supra*g-continuous functions and contra supra*g-irresolute and studied its basic properties

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2 PRELIMINARIES

Throughout this paper, X, Y and Z denote the supra topological spaces (X, μ) , (Y, λ) and (Z, η) respectively , which no separation axioms are assumed. For a subset A of a space X, $cl^{\mu}(A)$ and $int^{\mu}(A)$ denote the closure of A and the interior ofA respectively.

Definition 2.1. [1]
A subfamily μ of X is said to be a supra topology on X,
if (i) X, φ ∈ μ ,
(ii) If $A_i \in \mu$ for all i ∈ J, then $\cup A_i \in \mu$. The pair (X, μ) is called the supra topological space.

The elements of μ are called supra open sets in (X, μ) and the complement of a supra open set is called a supra closed set.

Definition 2.2
The supra closure of a set A is denoted by cl^{μ} (A) and is defined as
$cl^{\mu}(A) = \cap\{B : B$ is supra closed and $A \subseteq B\}$.
The supra interior of a set A is denoted by int^{μ} (A) and is defined as
$int^{\mu}(A) = \cup\{B : B$ is supra open and $A \supseteq B\}$.
Defnition 2.3. [1]
Let (X, τ) be a topological space and μ be a supra topology associated with τ , if τ ⊂ μ .
Definition 2.4.
A subset A of a supra topological space X is called
(i) a supra pre-open set [5] if $A\subseteq int^{\mu}(cl^{\mu}(A))$ and a supra pre-closed set if $cl^{\mu}(int^{\mu}(A)) \subseteq A$
(ii) a suprasemi-open set [5] if $A \subseteq cl^{\mu}(int^{\mu}(A))$ and a supra semi closed set if $int^{\mu}(cl^{\mu}(A)) \subseteq A$
(iii) a supra semi-preopen set [5] if $A \subseteq cl^{\mu} (int^{\mu}(cl^{\mu} (A)))$ and a supra semi-preclosed if $int^{\mu}(cl^{\mu} int^{\mu}(A)) \subseteq A$.
(iv) a supra α open set [5] if $A\subseteq int^{\mu}(cl^{\mu}(int^{\mu}(A)))$ and an supra α closed set if $cl^{\mu}(int^{\mu} (cl^{\mu} (A))) \subseteq A$
(v) a supra regular-open set [3] if $A = int^{\mu} (cl^{\mu}(A))$ and a supra regular-closed set if $A = cl^{\mu} (int^{\mu}(A))$.
(vi) a supra ω-closed set[4]if cl(A) ⊆U whenever A⊆U and U is supra semi-open in (X, μ).

Definition 2.5[4]
Let (X, τ) and (Y, σ) be two topological spaces and μ be an associated supra topology with τ . A function
f : (X, τ) → (Y, σ) is called supra*g-continuous if $f^{-1}(V)$ is supra*g-closed in (X, τ) for every closed set V of
(Y, σ).
Definition 2.6[4]
Let (X, τ) and (Y, σ) be two topological spaces and μ be an associated supra topology with τ . A function
f : (X, τ) → (Y, σ) is called supra*g-irresolute if $f^{-1}(V)$ is supra*g-closed in (X, τ) for every supra*g-closed set V of (Y, σ).
Definition 2.7[4]
Let (X, τ) and (Y, σ) be two topological spaces and μ be an associated supra topology with τ . A function
f : (X, τ) → (Y, σ) is called contra Continuous if f^{-1}V) is supra closed in (X, τ) for every supra open set V of
(Y, σ).

3. CONTRA SUPRA*g-CONTINUOUS FUNCTION

In this section, we introduce the notions of contra supra*g-continuous functions and investigate some of the basic properties .
Definition 3.1
A function f : (X, τ) → (Y, σ) is called contra supra*g-continuous functions if $f^{-1}(V)$ is supra*g-

closed in (X, τ) for every supra open set V of (Y, σ).

Example 3.2

Let X = Y = {p,q,r} with τ = {X,φ,{q},{p,q}} and σ = { Y, φ,{p}}.
Let f : (X, τ) → (Y, σ) be the identity function . Here f is contra supra*g-continuous functions.

Example 3.3

Let X = Y = {p,q,r} with τ = {X,φ,{p} } Let f : (X, τ) → (X, τ) be the identity function . Here f is not contra supra*g-continuous functions. Since V = {p} is supra open set in (Y, σ), f^{-1}({p}) = {p} is not in supra*g-closed set in (X, τ).

Theorem 3.4

Every contra continuous function is contra supra*g- continuous.

Proof

Let f: X→ Y be contra continuous. Let V be any supra open in Y. Then the inverse image $f^{-1}(V)$ is supra closed in X. Since every supra closed is supra*g-closed, $f^{-1}(V)$ is supra*g-closed in X. Therefore f is contra supra*g- continuous.

Remark 3.5

The converse of the above theorem is not true and it is shown by the following example.

Example 3.6

Let X = Y = {a,b,c} with τ = {X,φ,{b},{a,b}} and σ = { Y, φ,{a}}.
Let f : (X, τ) → (Y, σ) be the identity function . Here f is contra supra*g-continuous functions and not contra continuous . Since V = {a} is supra open set in (Y, σ), f^{-1}({a}) = {a} is not supra closed in (X, τ).

Remark 3.7

The composition of two contra supra*g-continuous map need not be contra supra*g-continuous. Let us prove the remark by the following example.

Example 3.8

Let X= Y = {a,b,c}. Let τ = {X,φ,{b},{a,b}} , σ = { Y, φ,{a}} and ρ= { Z, φ, {b},{a,b}} . Let f: (X,τ) → (Y,σ) and
g: (Y,σ) →(Z, ρ). Define f(a) = a, f(b) = b , f(c) = c and g(a) = c, g(b) = b, g(c) = a. Both f and g are contra supra*g- continuous. Define gof: (X,τ) → (Z, ρ). Hence {b} is a supra open set of (Z, ρ). Therefore $(gof)^{-1}$({b}) = $g^{-1}(f^{-1}$({b })) = g^{-1}({b}) = {b} is not a supra*g-closed set of (X,τ). Hence g o f is not contra supra*g-continuous

Theorem 3.9

If f:(X, τ) → (Y, σ) is contra supra*g-continuous function and g: (Y, σ) → (Z, ρ) is supra continuous function then composition gof is contra supra*g-continuous function.

Proof

Let V be supra open set in Z. Since g is supra continuous, then $g^{-1}(V)$ is supra open in Y. Since f is contra supra*g-continuous function, then $f^{-1}(g^{-1}(V))=(gof)^{-1}(V)$ is supra*g-closed in X. Therefore gof is contra supra*g-continuous function.

Theorem 3.10

If f:(X, τ) → (Y, σ) is supra*g-irresolute function and g: (Y, σ) → (Z, ρ) is contra supra*g-continuous function then composition gof is contra supra*g-continuous function.

Proof

Let V be supra open set in Z. Since g is contra supra*g-continuous function, then $g^{-1}(V)$ is supra*g-closed in Y. Since f is supra*g-irresolute function, then $f^{-1}(g^{-1}(V))$ is supra*g-closed in X. Therefore gof is contra supra*g-continuous function

Remark 3.11

The concept of supra*g-continuity and contra supra*g-continuity are independent as shown in the following example

Example 3.12

Let X=Y={p, q, r} and τ = {X, φ, {p }} , σ = {Y, φ,{p}, {p,q} }. f:(X, τ) → (Y, σ) be the identity function . Here f is supra*g-continuous but not contra supra*g-continuous function, since V={p} is supra open set in Y but
f^{-1}({p}) = {p} is not supra*g-closed set in X.

Let X=Y={p, q, r} and τ = {X, φ, {p}} , σ = {Y, φ, {p},{q},{p,q} }.f:(X, τ) → (Y, σ) be the function defined by f(p)=r, f(q)=q, f(r)=p. Here f is contra supra*g-continuous but not supra*g-continuous function, since V={q,r} is supra closed set in Y but f^{-1}({q,r}) = {p,q} is not supra*g-closed set in X.

Definition 3.14

A map f:(X, τ) → (Y, σ) is called almost contra supra*g-continuous function if f^{-1}(V) is supra*g-closed in
(X, τ) for every supra regular open set V in (Y, σ).

Theorem 3.15

Every contra supra continuous function is almost contra supra*g-continuous function.

Proof

Let f:(X, τ) → (Y, σ) be a contra supra continuous function. Let V be a supra regular open set in (Y, σ). We know that every supra regular open set is supra open, then V is supra open in (Y, σ). Since f is contra supra continuous function, f^{-1}(V) is supra closed in (X, τ). We know that every supra closed set is supra*g-closed, implies f^{-1}(V) is supra*g-closed in (X, τ). Therefore f is almost contra supra*g-continuous function.

The converse of the above theorem need not be true. It is shown by the following example.

Example 3.16

Let X=Y={p, q, r} and τ = {X, φ, {p}} , σ = {Y, φ, {p},{p,q}}. f:(X, τ) → (Y, σ) be the identity function . Here f is almost contra supra*g- continuous, but it is not contra supra continuous, Since V={p} is supra open in Y but f^{-1}({p}) = {p} is not supra closed in X.

Theorem 3.17

Every contra supra*g-continuous function is almost contra supra*g-continuous function.

Proof

Let f:(X, τ) → (Y, σ) be a contra supra*g-continuous function. Let V be a supra regular open set in (Y, σ). We know that every supra regular open set is supra open, then V is supra open in (Y, σ). Since f is contra supra*g-continuous function, f^{-1}(V) is supra*g-closed in (X, τ). Therefore f is almost contra supra*g-continuous function.

The converse of the above theorem need not be true. It is shown by the following example.

Example 3.18

Let X=Y={p, q, r} and τ = {X, φ, {p}} , σ = {Y, φ, {p},{p,q}}. f:(X, τ) → (Y, σ) be the identity function . Here f is almost contra supra*g-continuous, but it is not contra supra*g-continuous, Since V={p} is supra open in Y but f^{-1}({p}) = {p} is not supra*g-closed in X.

Theorem 3.19

If a map f: X→Y from supra topological space X into a supra topological space Y. The following statement are equivalent.

(a) f is almost contra supra*g-continuous.

(b) For every supra regular closed set F of Y, f^{-1}(F) is supra*g-open in X.

Proof (a) → (b)

Let F be a supra regular closed set in Y, then Y-F is a super regular open set in Y.By (a) f^{-1}(Y-F) = X – f^{-1}(F) is supra*g-closed set in X. This implies f^{-1}(F) is supra*g-open set in X. Therefore (b) holds.

(b) → (a)

Let G be a supra regular open set of Y. The Y-G is supra regular closed set of Y. By (b) f^{-1}(Y-G) is supra*g-open in X. This implies Y- f^{-1}(G) is supra*g - open in X, which implies f^{-1}(G) is supra*g-closed set in X. Therefore (a) holds.

Definition 3.20

A Space (X, τ) is supra*g-locally indiscrete if every supra*g-open (supra*g-closed) set is supra closed(supra open) in (X, τ).

Theorem 3.21

If f:(X, τ) → (Y, σ) is supra*g-continuous function and X is supra*g- locally indiscrete, then f is contra supra*g- continuous.

Proof

Let V be supra open set in Y. Since f is supra*g-continuous function, then f^{-1}(V) is supra*g-open in

X. Since X is supra*g-locally indiscrete, then $f^{-1}(V)$ is supra closed set in X. We know that every supra closed set is supra*g-closed set . Therefore $f^{-1}(V)$ is supra*g-closed set in X. Hence f is contra supra*g-continuous function.

Theorem 3.22

If f:(X, τ) → (Y, σ) is a surjective supra*g-irresolute and g: (Y, σ) → (Z, ρ) be any function such that

gof: (X, τ) → (Z, ρ) is contra supra*g-continuous function, iff g is contra supra*g-continuous.

Proof

Suppose gof is contra supra*g-continuous, Let V be a supra closed set in Z, then $(gof)^{-1}(V) = f^{-1}(g^{-1}(V))$ is supra*g-open in (X, τ). Since f is surjective and supra*g-irresolute, then $f(gof)^{-1}(V)=f(f^{-1}(g^{-1}(V))) = g^{-1}(V)$ is supra N-open in (Y, σ).Hence g is contra supra*g-continuous function.

Conversely, suppose g is contra supra*g-continuous, Let V be supra closed in Z, then $g^{-1}(V)$ is supra*g-open in Y. Since f is surjective and supra*g-irresolute, then $f^{-1}(g^{-1}(V))$ is supra*g-open in X. Hence gof is contra supra*g-continuous function.

4.CONTRA SUPRA*g-IRRESOLUTE FUNCTION

In this section, we introduce the notions of contra supra*g-irresolute function and investigate some of the basic properties .

Definition 4.1

A function f:(X,τ)→(Y,σ) is called contra supra*g-irresolute function if $f^{-1}(V)$ is supra*g-closed in (X,τ) for every supra*g-open set V in (Y,σ).

Definition 4.2

A function f:(X,τ)→(Y,σ) is called perfectly contra supra*g-irresolute function if $f^{-1}(V)$ is supra*g-closed and supra*g-open in (X,τ) for every supra*g-open set V in (Y,σ).

Theorem 4.3

Every contra supra*g-irresolute function is contra supra*g- continuous

Proof

Let f: (X,τ)→(Y,σ) be a contra supra*g-irresolute function. Let V be a supra open set in (Y,σ). We know that every supra open set is supra*g-open set , then V is supra*g-open in (Y,σ). Since f is contra supra*g-irresolute function, $f^{-1}(V)$ is supra*g-closed in (X,τ). Therefore f is contra supra*g-continuous function.

The converse of the above theorem need not be true. It is shown by the following example.

Example 4.4

Let X=Y= {p,q,r}, τ = {X, φ, {p}} , σ = { Y, φ,{p},{q},{p,q}}.A function f: (X,τ)→(Y,σ) is defined by f(p) = r, f(q) = q, f(r)=p. Here f is contra supra*g-continuous but not contra supra*g-irresolute. Since V = {q,r} is supra*g-open set in (Y,σ) and $f^{-1}(\{q,r\})= \{p,q\}$ is not in supra*g-closed set in (X,τ).

Theorem 4.5

If f: (X,τ)→(Y,σ) is a supra*g-irresolute and g: (Y,σ) →(Z, ρ) is contra supra*g-irresolute function, then

gof : (X,τ) →(Z, ρ) is contra supra*g-irresolute function.

Proof

Let V be any supra*g-open set in Z. Since g is contra supra*g-irresolute then $g^{-1}(V)$ is supra*g-closed set in Y. Since f is supra*g-irresolute $f^{-1}(g^{-1}(V)) = (gof)^{-1}(V)$ is supra*g-closed set in X. Hence gof is contra supra*g-irresolute function.

Theorem 4.6

If f: (X,τ)→(Y,σ) is a contra supra*g-irresolute and g: (Y,σ) →(Z, ρ) is supra*g-irresolute function, then

gof : (X,τ) →(Z, ρ) is contra supra*g-irresolute function.

Proof

Let V be any supra*g-open set in Z. Since g is supra*g-irresolute then $g^{-1}(V)$ is supra*g-open set in Y. Since

f is contra supra*g-irresolute $f^{-1}(g^{-1}(V)) = (gof)^{-1}(V)$ is supra*g-closed set in X. Hence gof is contra supra*g-irresolute function.

Theorem 4.7
Every perfectly contra supra*g-irresolute is contra supra*g-irresolute function.
Proof
Let f: (X,τ)→(Y,σ) be a perfectly contra supra*g-irresolute function. Let V be a supra*g-open set in (Y,σ). Since f is perfectly contra supra*g-irresolute function, f^{-1}(V) is supra*g-closed and supra*g-open in (X,τ). Therefore f is contra supra*g-irresolute function .
The converse of the above theorem need not be true. It is shown by the following example.
Example 4.8
Let X=Y= {p,q,r} and τ = {X, φ,{p},{q},{p,q}}, σ ={Y, φ,{q},{q,r},{p,q}} f: (X,τ)→(Y,σ) be a function defined by f(p) = p, f(q) = r, f(r) = q. Here f is contra supra*g-irresolute function but not perfectly contra supra*g-irresolute function. Since V = {p,r} is supra*g-open set in (Y,σ) and f^{-1}({p,r}) = {p,q} is not supra*g-closed and supra*g-open set in (X,τ)
Theorem 4.9
Every perfectly contra supra*g-irresolute is contra supra*g-irresolute function.
Proof
Let f: (X,τ)→(Y,σ) be a perfectly contra supra*g-irresolute function. Let V be a supra*g-open set in (Y,σ). Since f is perfectly contra supra*g-irresolute function, f^{-1}(V) is supra*g-closed and supra*g-open in (X,τ). Therefore f is supra*g-irresolute function.
The converse of the above theorem need not be true. It is shown by the following example.

Example 4.10
Let X=Y= {a,b,c} and τ = {X, φ,{p}}, σ = {Y, φ,{p},{p,q}} f: (X,τ)→(Y,σ) be a identity function. Here f is supra*g-irresolute function but not perfectly contra supra*g-irresolute function. Since V = {p,r} is supra*g-open set in (Y,σ) and f^{1}({p,r}) = {p,r} is not supra*g-closed and supra*g-open set in (X,τ).

4. CONCLUSION

Many different forms of open functions and closed functions have been introduced over the years. Various interesting problems arise when one considers openness. Its importance is significant in various areas of mathematics and related sciences, this paper we introduce Contra supra*g-continuous functions,Contra supra*g-irresolute functions in supra topological Spaces and investigate some of the basic properties . This shall be extended in the future Research with some applications

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