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V. Radhika
Research Scholar,
Department of Mathematics,
Nirmala College for Women,
Coimbatore, Tamil Nadu,
India

K. Mohana
Assistant Professor,
Department of Mathematics,
Nirmala College for Women,
Coimbatore, Tamil Nadu,
India

S. Anitha
Research Scholar,
Department of Mathematics,
Nirmala College for Women,
Coimbatore, Tamil Nadu,
India

Correspondence
K. Mohana
Assistant Professor,
Department of Mathematics,
Nirmala College for Women,
Coimbatore, Tamil Nadu,
India

Supra soft πg-closed sets in soft supra topological spaces

V. Radhika, K. Mohana and S. Anitha

Abstract
We introduce the concept of supra soft-πg-closed sets in soft supra topological spaces and we discuss their relationships. Also we discuss their relationships with other supra- soft closed set in detail, supported by examples and counter examples. Further we investigated supra-soft πg separateness and connectedness in soft supra topological space.

Keywords: Supra soft πg- closed sets, Supra soft-πg-connected, Supra soft-πg-separateness

1. Introduction

In 1999, Molodtsov [12] proposed the concept of a soft set which can be seen as a new mathematical approach to vagueness. In fact, a soft set is a parameterized family of subsets of a given universe set. The way of parameterization in problem solving makes soft set theory convenient and simple for application. Maji *et al*. [10] carried out Molodtsov's idea by introducing several operations in soft set theory. Shabir and Naz [12] presented soft topological spaces and they investigated some properties of them. Later, many mathematicians [3, 6, 7, 8, 11, 14] studied some of basic concepts and properties of soft topological spaces.

El-Sheikh and Abd El-Latif [5] introduced the concept of supra soft topological spaces, which is wider and more general than the class of soft topological spaces. They introduced a unification of some types of different kinds of subsets of supra soft topological spaces using the notion of γ-operation and studied the decompositions of some forms of supra soft continuity. After then, Kandil *et al*. [7] studied the concepts of supra generalized closed soft sets and supra generalized closed soft sets with respect to a soft ideal in a supra topological space. To develop soft set theory, the operations of the soft sets are redefined and a uni-int decision making method was constructed by using these new operations [3]. Recently, K. Kannan [9] introduced the concept of g-closed soft sets in a soft topological spaces. El-sheikh and Abd El-latif [3] have extended the notions of g-closed soft sets to supra soft topological spaces. In this paper we introduce and study the concepts of supra soft πg- closed sets in supra soft topological spaces. Also we present supra soft- πg separateness and connectedness in soft supra topological space.

2. Preliminaries

Let X be an initial universe set and E be the set of all possible parameters with respect to X. parameters are often attributes, characteristies or properties of the objects in X. let P(X) denote the power set of X, then a soft set over X is defined as follows.

Definition [2.1] [1]

A pair (F, A) is called a soft set over U where A $\subseteq$ E and F: A $\rightarrow$ P(U) is a set valued mapping. In other words, a soft set over X is a parameterized family of subsets of the universe U. For $\forall e \in$ A, F(e)may be considered as the set of e -approximate elements of the soft set (F,A). It is worth noting that F(e) may be arbitrary. Some of them may be empty, and some may have nonempty intersection.

Definition [2.2] [13]
A soft set (F,A) over U is said to be a null soft set denoted by φ if for all e ∈ A, F(e) =φ. A soft set (F, A) over U is said to be an absolute soft set denoted by A if for all e ∈ A, F(e) =U.

Definition [2.3] [2]

Let Y be a nonempty subset of X, then $\tilde{\tilde{Y}}$ denotes the soft set (Y, E) over X for which Y (e) = Y, for all e ∈E. In particular, (X, E) will be denoted by $\tilde{\tilde{X}}$.

Definition [2.4] [2]
For two soft sets (F, A) and (G, B) over U, we say that (F,A)is a soft subset of (G, B) if A ⊆ B and for all e ∈ A, F(e) and G(e) are identical approximations. We write (F,A) $\tilde{\subset}$ (G,B). (F,A) is said to be a soft super set of(G,B), if (G,B) is a soft subset of (F, A). We denote it by (G,B) $\tilde{\subset}$ (F, A). Then(F,A) and (G,B) are said to be soft equal if (F,A) is a soft subset of (G,B) and(G,B) is a soft subset of (F,A).

Definition [2.5] [13]
For two soft sets (F,A) and (G,B) over a common universe U.
The union of two soft sets (F,A) and (G,B) is the soft set (H,C), where C = A ∪ B and for all e ∈ C,

$$H(e)=\begin{cases}F(e) & ,if\ e\in A-B\\ G(e) & ,if\ e\in B-A\\ F(e)\cup G(e) & ,if\ e\in A\cap B\end{cases}$$

We write (F,A) ∪ (G,B)=(H,C).

Definition [2.6] [2]
The intersection (H, C) of two soft sets (F, A) and (G,B) over a common universe U denoted (F,A) ∩(G,B) is defined as C = A ∩B and H(e) = F(e) ∩G(e), for all e∈ C.

Definition [2.7] [4]
For a soft set (F, A) over the universe U, the relative complement of (F, A) is denoted by $(F,A)^c$ and is defined by $(F,A)^c$ = (F^c, A), where F^c: A → P(U) is a mapping defined by F^c(e) = U - F(e), for all e∈ A.

Definition [2.8] [2]
Let $\tilde{\tilde{\tau}}$ be the collection of soft sets over a universe U with a fixed set of parameters E, then $\tilde{\tilde{\tau}}$ is said to be a soft topology on U.

1) $\varphi,\tilde{U}\in\tilde{\tilde{\tau}}$
2) The union of any number of soft sets in $\tilde{\tilde{\tau}}$ belongs to $\tilde{\tilde{\tau}}$.
3) The intersection of any two soft sets in $\tilde{\tilde{\tau}}$ belongs to $\tilde{\tilde{\tau}}$.

The triplet (U, $\tilde{\tilde{\tau}}$, E) is called a soft topological space. Every member of $\tilde{\tilde{\tau}}$ is called a soft open set. A soft set (F, E) is called soft closed in U if $(F,E)^c\in\tilde{\tilde{\tau}}$.

Definition [2.9] [1]
Let μ be the collection of supra soft sets over a universe U with a fixed set of parameters E, then μ is said to be a supra soft topology on U if

1) $\varphi,U\in\mu$
2) The union of any number of soft sets in μ belongs to μ.

The triplet (U, μ, E) is called a supra soft topological space.
Every member of μ is called a supra soft open set. A soft set (F, E) is called supra soft closed in U if (F, E) $^c\in\mu$.

Definition [2.10] [15]
Let (U, μ , E) be a supra soft topological space and (F,E) be a supra soft set over X.
(1) The supra soft closure of (F,E) is the supra soft cl(F,E) = ∩ {(G,E): (G,E) is supra soft closed and (F,E) ⊆(G,E). (2) The supra soft interior of (F,E) is the supra soft int(F,E) = ∪{(H,E): (H,E) is supra soft closed and (H,E) ⊆(F,E)
Clearly, cl(F,E) is the smallest supra soft closed set over X which contains (F,E) and int (F,E) is the largest supra soft open set over X which contained in (F,E).

Definition [2.11] [15]
Let (U, μ , E) be a supra soft topological space over U. A soft set (F, E) is called a supra soft generalized pre-regular closed set (supra soft gpr-closed) in U if pcl(F,E) ⊆ (G, E) whenever (F,E) ⊆ (G,E) and (G,E) is supra soft regular open in U.

3. Supra Soft πg- closed sets in soft supra topological spaces.
Definition: 3.1 Finite union of supra soft regular open set in (X,μ,E) is supra soft-π-open in (X,μ, E).

Definition: 3.2 Let (X, μ, E) be a supra soft topological space. A soft set (F, E) is called a supra soft πg– closed set in X, if cl^μ(F,E) ⊆ (G,E) whenever (F, E) ⊆ (G, E) and (G, E) is a supra soft π-open sets in X.

Definition: 3.3 Let (U, μ , E) be a supra soft topological space and (F,E) be a supra soft set over X.

1) The supra soft pre closure of (F, E) is the supra soft pcl(F,E) =∩ {(G,E): (G,E) is supra soft closed and (F,E) ⊆(G,E).
2) The supra soft pre interior of (F, E) is the supra soft pre int(F,E) = ∪{(H,E): (H,E) is supra soft closed and (H,E) ⊆(F,E)

Clearly, cl(F,E) is the smallest supra soft closed set over X which contains (F,E) and int (F,E) is the largest supra soft open set over X which contained in (F,E).

Definition: 3.4 Let (X, μ, E) be a supra soft topological space. A soft supra set (F, E) is called,

1) A supra soft πgp– closed set if pcl^μ (F,E) ⊆ (G,E) whenever (F, E) ⊆ (G, E)and(G, E) is a supra soft π-open sets in X.

2) A supra soft πgr– closed set if rcl^{μ} (F,E) ⊆ (G,E) whenever (F, E) ⊆ (G, E) and (G, E) is a supra soft π-open sets in X.
3) A supra soft gsr– closed set if scl^{μ} (F,E) ⊆ (G,E) whenever (F, E) ⊆ (G, E) and (G, E) is a supra soft regular-open sets in X.
4) A supra soft πgs– closed set if scl^{μ} (F,E) ⊆ (G,E) whenever (F, E) ⊆ (G, E) and(G, E) is a supra soft π-open sets in X.
5) A supra soft πgb– closed set if bcl^{μ} (F,E) ⊆ (G,E) whenever (F, E) ⊆ (G, E) and(G, E) is a supra soft π-open sets in X.

Theorem 3.5: Every supra soft closed set is supra soft πg-closed.

Proof: Let (F, E) ⊆ (G, E) and (G, E) be supra soft π- open. Since (F, E) is supra soft – closed set, we have cl^{μ} (F,E) = (F,E). Thus cl^{μ}(F,E)= (F,E) ⊆ (G,E).Hence (F,E) is supra soft πg- closed.

Remark 3.6: The converse of the above need not be true as seen by the following example.

Example 3.7
Let X = $\{h_1, h_2, h_3, h_4\}$, E = $\{e_1, e_2\}$
$F_1(e_1) = \{h_3\}$, $F_1(e_2) = \{h_1\}$
$F_2(e_1) = \{h_4\}$, $F_2(e_2) = \{h_2\}$
$F_3(e_1) = \{h_3, h_4\}$, $F_3(e_2) = \{h_1, h_2\}$
$F_4(e_1) = \{h_1, h_4\}$, $F_4(e_2) = \{h_2, h_4\}$
$F_5(e_1) = \{h_2, h_3, h_4\}$, $F_5(e_2) = \{h_1, h_2, h_3\}$
$F_6(e_1) = \{h_1, h_3, h_4\}$, $F_6(e_2) = \{h_1, h_2, h_4\}$
$\mu = \{\tilde{\phi}, \tilde{X}, (F_1, E), (F_2, E) \ldots\ldots (F_6, E)\}$ defines a supra soft topology on X.
Where $(A, E) = \{\{\phi\}, \{h_4\}\}$ is supra soft πg- closed set, but not supra softclosed.

Theorem 3.8: Every supra soft πg – closed set is supra soft πgp– closed

Proof: Let (F,E) ⊆ (G,E), where (G,E) is supra soft π – open. Since (F, E) is supra soft πg-closed, we have cl^{μ} (F,E) ⊆ (G,E).Hence pcl^{μ}(F,E) ⊆ cl^{μ}(F,E) ⊆ (G,E). Therefore, pcl^{μ}(F,E) ⊆(G,E).Then (F,E) is supra soft πgp– closed.

Remark 3.9: The converse of the above theoremneed not be true as seen by the following example.

Example 3.10
In example 3.7 $(A,E) = \{\{h_4\}, \{h_4\}\}$ is supra softπgp-closed, but not supra softπg closed.

Theorem 3.11: Everysupra soft πg – closed set is supra soft πgs closed**.**

Proof: Let (F,E) be supra soft πg- closed and (F,E) ⊆ (G,E), where (G,E) is supra softπ – open.Since(F,E) is supra soft πg closed, wehave cl^{μ}(F,E)⊆(G,E). Also, scl^{μ} (F,E) ⊆cl^{μ} (F,E) ⊆ (G,E).Therefore scl^{μ} (F, E) ⊆ (G, E). Then (F,E) isa supra soft-πgs– closed.

Remark 3.12: The converse of the above need not be true as seen in the following example.

Example 3.13
In example 3.7, $(A,E) = \{\{h_3\}, \{h_1\}\}$ is supra soft πgs-closed, but not supra softπg- closed.

Theorem 3.14: Every supra soft πgr– closed set is supra soft πg closed.

Proof: Let (F, E) ⊆ (G,E) and (G,E) be supra soft π- open. Since (F, E) is supra soft πgr- closed.Wehave rcl^{μ} (F,E) ⊆ (G,E). Hence cl^{μ} (F, E) ⊆rcl^{μ} (F,E) ⊆ (G,E) ⇒ cl^{μ}(F,E) ⊆ (G,E). Then (A, E) is supra soft πg – closed.

Remark 3.15: The converse of the above need not be true as seen in the following example.

Example 3.16:
In example 3.7 $(A, E) = \{\{\phi\}, \{h_4\}\}$ is supra soft πg -closed but not supra softπgr- closed.

Theorem 3.17: Every supra soft πg – closed set is supra soft gsr closed.

Proof: Let (F,E) be supra soft πg- closed and (F,E) ⊆ (G,E). where (G,E) is supra soft regular open.By assumption we have cl^{μ} (F, E) ⊆ (G,E). Hence scl^{μ} (F,E) ⊆cl^{μ} (F,E) ⊆ (G,E).Therefore scl^{μ} (F, E) ⊆ (G, E).Then (F,E) is supra soft gsr – closed.

Remark 3.18: The converse of the above need not be true as seen in the following example.

Example 3.19:
In example 3.7,$(A,E) = \{\{\phi\}, \{h_2, h_4\}\}$ is supra softgsr– closed, but not supra softπg- closed.

Theorem 3.20:
Every supra soft πg – closed set is supra soft πgbclosed.

Proof: Let (F,E) ⊆ (G,E)and (G,E) is supra soft π – open. Since (F,E) be supra soft πg- closed and since every supra soft closed set is supra soft b^{μ} -closed, we have bcl^{μ} (F,E) ⊆cl^{μ}(F,E) ⊆ (G,E).Therefore bcl^{μ} (F, E) ⊆ (G, E).Then (F,E) is supra soft πgb – closed.

Remark 3.21: The converse of the above need not be true.

Example 3.22
In example 3.7, $(A,E) = \{\{h_1, h_4\}, \{h_2, h_4\}\}$ is supra soft πgb-closed but not supra softπg- closed.

Theorem 3.23: Every supra soft πg – closed set is supra soft gpr closed**.**

Proof: Let (F, E) ⊆ (G,E), where (G,E) is supra soft regular-open. Since (F, E) is supra soft πg- closed, we have cl^{μ} (F, E) ⊆ (G, E).Hence pcl^{μ} (F,E) ⊆ cl^{μ}(F,E) ⊆ (G,E). Therefore, pcl^{μ} (F,E) ⊆(G,E).Then (F, E) is supra soft gpr – closed.

Remark 3.24: The converse of the above need not be true as seen in the following example.

Example 3.25: In example 3.7, $(A,E) = \{\{h_3\}, \{h_4\}\}$ is supra softgpr -closed but not supra softπg- closed.

Theorem 3.26: Let *(X,μ,E)* be a supra soft topological space and (F,E) be a supra soft set over X. If a supra soft set (F,E) is a supra soft πg – closed set, then $cl^{\mu}(F,E) - (F,E)$ contains only null supra soft π- closed set.

Proof: Suppose that *(F,E)* is a supra soft πg - closed set. Let (H,E) be a supra soft πclosed subset of $cl^{\mu}(F,E) - (F,E)$.Then $(H,E) \subseteq cl^{\mu}(F,E) \cap (F,E)^c$. So $cl^{\mu}(F,E) \subseteq (H,E)^c$. But (F,E) is asupra soft πg – closed set, $\Rightarrow cl^{\mu}(F,E) \subseteq (H,E)^c$. Consequently,

$(H,E) \subseteq [cl^{\mu}(F,E)]^c$ .... (1)

We have already, $(H,E) \subseteq cl^{\mu}(F,E)$ .... (2)

From (1) and (2), $(H,E) \subseteq cl^{\mu}(F,E) \cap [cl^{\mu}(F,E)]^c = \Phi$. Thus $(H,E) = \Phi$. Therefore $cl^{\mu}(F,E) - (F,E)$ contains only null supra soft π – closed set.

Theorem 3.27

Let (X,μ,E) be a supra soft topological space and (F,E)be a supra soft πg– closed set in X. (F,E) is supra soft π – closed. iff, $cl^{\mu}(int^{\mu}(F,E)) - (F,E)$ is supra soft π– closed.

Proof: Let (F,E) be supra soft πg – closed set. If (F,E) is supra soft π – closed then

$cl^{\mu}(int^{\mu}(F,E)) - (F,E) = \Phi$. Since Φ is always supra soft π – closed. Then $cl^{\mu}(int^{\mu}(F,E)) - (F,E)$ is supra soft π – closed.Conversely, suppose that $cl^{\mu}(int^{\mu}(F,E)) - (F,E)$ is supra soft π – closed. Since (F,E) is supra soft πg closed and $cl^{\mu}(F,E) - (F,E)$ contains supra soft π – closed set.$cl^{\mu}(int^{\mu}(F,E)) - (F,E)$ then $cl^{\mu}(int^{\mu}(F,E) - (F,E) = \Phi$. Hencecl $^{\mu}(int^{\mu}(F,E)) = (F,E)$. Therefore (F,E) is supra soft π – closed.

Theorem 3.28

Let (X,μ,E) be a supra soft topological space, (F,E) and (G,E) supra soft sets over X. If (F,E) is supra soft πg – closed set and $(F,E) \subseteq (G,E) \subseteq cl^{\mu}(F,E)$, then $cl^{\mu}(G,E) - (G,E)$ contains only null supra soft π- closed set.

Proof: If $(F,E) \subseteq (G,E)$, then $(G,E)^c \subseteq (F,E)^c$ .... (1)

If $(G,E) \subseteq cl^{\mu}(F,E)$ then $cl^{\mu}(G,E) = cl^{\mu}(cl^{\mu}(F,E)) = cl^{\mu}(F,E)$ .... (2)

that is, $cl^{\mu}(G,E) \subseteq cl^{\mu}(F,E)$ from (1) and (2).

$[cl^{\mu}(G,E) \cap (G,E)^c] \subseteq [cl^{\mu}(F,E) \cap (F,E)^c] \Leftrightarrow [cl^{\mu}(G,E) - (G,E)] \subseteq [cl^{\mu}(F,E) - (F,E)]$

Now (F,E) is supra soft πg – closed set. Hence $cl^{\mu}(F,E) - (F,E)$ contains only null supra soft π – closed set, neither does $cl^{\mu}(G,E) - (G,E)$.

Definition3.29

Let (X, μ,E) be a supra soft topological spaces. A supra soft set (F,E) is called supra soft πg – open set in X, if $(F,E)^c$ is supra soft πg – closed set.

Theorem 3.30

A supra soft set (F,E) is supra soft πg – open set in a supra soft topological space (X, μ,E), if and only if $(H,E) \subseteq int^{\mu}(F,E)$ whenever (H,E) is supra soft π closed set in X and $(H, E) \subseteq (F, E)$.

Proof: Let $(H, E) \subseteq int^{\mu}(F,E)$ whenever (H,E) is supra soft π – closed set in X. $(H,E) \subseteq (F, E)$ and $(K, E) = (F, E)^c$. Suppose that $(K, E) \subseteq (G, E)$ where (G, E) is supra soft π – open set.

Now $(F, E)^c \subseteq (G, E) \Rightarrow (H,E) = (G, E)^c \subseteq (F, E)$ and (H,E) is supra soft π– closed set.

$\Rightarrow (H,E) \subseteq int^{\mu}(F,E)$.

Also $(H,E) \subseteq int^{\mu}(F,E) \Rightarrow [int^{\mu}(F,E)]^c \subseteq (H, E)^c = (G, E)$

$\Rightarrow [int^{\mu}[(K,E)^c]]^c \subseteq (G, E)$ or equivalently $cl^{\mu}(F,E) \subseteq (G, E)$.

Thus (K,E) is supra soft πg– closed set. Hence we obtain (F,E) is supra soft πg- open set.

Conversely, suppose that (F, E) is supra soft πg – open set, $(H,E) \subseteq (F, E)$ and (H,E) is soft π – closed set. Then, $(H, E)^c$ is supra soft πopen set. Then, $(F, E)^c \subseteq (H, E)^c$. Since $(F, E)^c$ is supra soft πg – closed set,$cl^{\mu}((F,E)^c) \subseteq (H, E)^c$. Therefore, $(H,E) \subseteq (cl^{\mu}[(F,E)^c])^c = int^{\mu}(F,E)$.

Theorem 3.31

Let $(A,E) \subseteq (B,E) \subseteq cl^{\mu}(A,E)$ and (A,E) is a supra soft πg – closed set of (X,E) then (B,E) is also supra soft πg – closed set of (X,E).

Proof: Since (A,E) is supra soft πg – closed set of (X,E). So $cl^{\mu}(A,E) \subseteq U$, whenever $(A,E) \subseteq U$, U being an supra soft π - open set of X. Let $(A,E) \subseteq (B,E) \subseteq cl^{\mu}(A,E)$. ie.,$cl^{\mu}(A,E) = cl(B,E)$. Let if possible there exists an open subset Vof (X,E) such that$(B,E) \subseteq V$. So, $cl^{\mu}(A,E) \subseteq V$. ie., $cl^{\mu}(B,E) \subseteq V$. Hence (B,E) is also a supra soft πg- closed set of (X,E).

Theorem 3.32

If $int^{\mu}(A,E) \subseteq (B,E) \subseteq (A,E)$ and (A,E) is a supra soft πg – open set of (X, μ,E) then (B,E) is also a supra soft πg open set of (X,E).

Proof: $Int^{\mu}(A,E) \subseteq (B,E) \subseteq (A,E)$ implies $(A,E)^c \subseteq (B,E)^c \subseteq cl(A,E)^c$ Given $(A,E)^c$ is supra soft πg – closed.$(B,E)^c$ is supra soft πg – closed. Therefore (B,E) is supra soft πg – open.

4. supra softπg – separateness

Definition: 4.1: Let (U, μ ,E) be a supra soft topological space over U and (F,E) be a supra soft set over U.

(1) The supra soft πg closure of (F,E) is the supra soft $\pi gcl(F,E) = \cap$ {(G,E): (G,E) is supra soft πg closed and $(F,E) \subseteq (G,E)$.

(2) The supra soft πg interior of (F,E) is the supra soft πg $int(F,E) = \cup$ {(H,E): (H,E) is supra soft πg open and $(H,E) \subseteq (F,E)$

Clearly, πgcl(F,E) is the smallest supra soft πgclosed set over U which contains (F,E) and πg int (F,E) is the largest supra soft πgopen set over U which contained in (F,E).

Definition 4.2: Two non-null soft sets (G,E) and (H,E)of a supra soft topological space (X, μ,E) aresaid to be supra soft πg -separated sets if $(G,E) \cap \pi gcl^{\mu}(H,E) = \phi$ and $\pi gcl^{\mu}(G,E) \cap (H,E) = \phi$.

Definition 4.3 :A soft set (F,E) of a supra soft topological space (X, μ,E) is said to be supra soft πg -clopenset if it is both supra soft πg -open set and supra soft πg-closed set.

Remark 4.4

1) Each two supra soft πg -separated sets are always disjoint.
2) Each two disjoint soft sets, in which both of them either supra soft - πg open sets or supra soft- πg closed sets, are supra soft - πg separated.

Theorem 4.5: Let (G,E) and (H,E) be non-null soft sets of a supra soft topological space (X,µ,E). Thenthe following statements hold:

1) If (G,E) and H,E are supra soft - πg separated, (G_1,E)⊆(G,E) and (H_1,E)⊆(H,E),then (G_1,E) and (H_1,E) are supra soft - πg separated sets.
2) If (G,E)and(H,E)are supra soft - πg open sets, (U,E) = (G,E) ∩(X,E)– (H,E)and (V,E) = (H,E) ∩ (X,E) – (G,E), then (U,E) and (V,E) are supra soft - πg separated sets.

Proof:

1) Since (G_1,E)⊆ (G,E). Then, $\pi gcl^{\mu}(G_1,E)$⊆ πgcl^{μ} (G,E). Hence (H_1,E) ∩ πgcl^{μ} (G_1,E) ⊆(H,E) ∩ πgcl^{μ}(G,E)= φ. Similarly, (G,E) ∩ $\pi gcl^{\mu}(H_1,E)$ = φ. Thus (G_1,E) and (H_1,E) are supra soft πg-separated sets.
2) Let (G,E) and(H,E) be supra soft πg –open sets. Then(X,E)- (G,E) and (X,E)- (H,E) are supra soft πg –closed sets. Assume that, (U,E) = (G,E) ∩ (X,E) – (H,E)and (V,E) = (H,E) ∩ (X,E) – (G,E). Then

(U,E)⊆(X,E) – (H,E) and (V,E)⊆ (X,E) – (H,E). Hence, πgcl^{μ}(U,E)⊆(X,E) – (H,E) ⊆(X,E) – (V,E) and πgcl^{μ}(V,E)⊆(X,E)– (G,E)⊆ (X,E)– (U,E). Consequently, πgcl^{μ} (U,E) ∩(V,E) = φ and πgcl^{μ} (V,E) ∩ (U_E) = φ. Therefore, (U, E) and (V,E)are supra soft πg-separated sets.

Theorem 4.6. Any two supra soft sets (G,E) and (H,E) of a supra soft topological space (X,µ,E) are supra soft πg-separated sets if and only if there exist supra soft πg-open sets (U, E) and (V,E) such that (G,E)⊆ (U,E), (H,E) ⊆ (V,E) and (G,E) ∩ (V,E)= φ, (H,E) ∩(U,E) = φ

Proof:

Necessity: Let (G,E) and (H,E) be supra soft πg-separated sets. Then, (G, E)∩πgcl^{μ}(H, E) =φ. And πgcl^{μ} (G, E) ∩ (H, E) =φ. Let V, E) = (X, E)- πgcl^{μ}(G, E) and (U, E) = (X, E) - πgcl^{μ} (H, E). Thus, (U, E) and (V, E) are supra soft πg-open sets such that (G, E) ⊆(U, E), (H, E) ⊆(V, E), (G, E) ∩(V, E) = φ and (H, E) ∩ (U, E)= φ.

Sufficient: Let (U,E), (V,E) be supra soft πg-open sets such that (G, E) ⊆ (U, E), (H, E) ⊆ (V, E) and (G, E) ∩(V, E) = φ, (H, E) ∩ (U, E) = φ.Since (X, E)- (H, E) and (X, E)- (U, E) are supra soft πg-closed sets. Then,πgcl^{μ}(G, E) ⊆(X, E)- (V, E) ⊆(X, E)- (H, E) and πgcl^{μ}(H, E)⊆(X, E)- (U, E) ⊆(X, E)- (G, E). Thus, πgcl^{μ} (G, E)∩ (H, E) = φ and πgcl^{μ} (H, E) ∩ (G, E) = φ.

This means that, (G, E) and (H, E) are supra soft πg –separated sets.

5. Supra soft πg- connected

Definition 5.1: Let (X,µ,E) be a supra soft topological space. A supra soft πg-separation of X is a pair of non-null proper supra soft πg-open sets in µ such that (F,E) ∩ (G,E) = φ and X = (F,E) ∪ (G,E).

Definition 5.2: A supra soft topological space (X,µ,E) is said to be supra soft πg -connected if and onlyif there is no supra soft πg -separations of X. If (X, µ, E) has such supra soft πg -separations, then (X, µ, E) is said to be supra soft πg -disconnected.

Remark 5.3

1) φ is always supra soft πg -connected.
2) If (G, E), (H, E) are non-null supra soft πg -separated sets. Then, the pair (G, E), (H, E) is called the supra soft πg -disconnection of X.

Theorem 5.4: Let (X,µ,E) be a supra soft topological space, then the following statements are equivalent:

1) X is supra soft πg -connected.
2) X can not be expressed as a supra soft union of two non-null disjoint supra soft πg -open sets.
3) X can not be expressed as a supra soft union of two non-null disjoint suprasoft πg -closed sets.
4) There is no proper supra soft πg -clopen set in (X,µ,E).
5) X can not be expressed as a supra soft union of two non-null supra soft πg -separated sets.

Proof:

(1) ⇔(2)**:** It is obvious from Definition 5.2.

(2) ⇒(3)**:** Suppose that X= (F,E) ∪ (G,E),for some supra soft πg -closed sets (F,E) and(G,E) such that (F,E) ∩(G,E) = φ.Then, (F,E) = $(G,E)^c$. Which is supra soft πg-open set, X= (G,E)∪$(G,E)^c$ and(G,E) ∩ $(G,E)^c$= φ, which is a contradiction with (2).

(3) ⇒(4)**:** Suppose that there is a proper supra soft πg-clopen subset (F,E) of X.

Then, $(F,E)^c$ is supra soft πg-clopen set, where X= (F,E) ∪$(F,E)^c$ and(F,E) ∩$(F,E)^c$ = φ. which is a contradiction with (3).

(4) ⇒(3)**:** Suppose that X= (F,E)∪ (G,E) for some supra soft πg-closed sets (F,E) and (G,E) such that (F,E) ∩(G,E)= φ. Then, (F,E) =$(G,E)^c$ and(G,E) =$(F,E)^c$. Thus, (F,E) and(G,E)are proper supra soft πg-clopen sets, which is a contradiction with (4).

(3) ⇒(5)**:** Suppose that X = (H,E)∪ (G, E) for some supra soft πg-separated sets (H,E) and (G,E). Then, (G,E) ∩ πgcl^{μ} (H,E) = φ and πgcl^{μ} (G,E) ∩ (H,E) = φ. It follows that,

(H,E) ∩(G,E) =φ. Hence, (H,E) =$(G,E)^c$and (G,E) = $(H,E)^c$. Therefore,

πgcl^{μ}(H,E)⊆ (G^c,E)= (H,E)and $\pi gcl^{\mu}(G_E)$ H^c_E=(G,E). But,(H,E)⊆πgcl^{μ}(H,E)and(G,E)⊆ πgcl^{μ}(G,E) Thus, (H,E) and (G,E)are supra πg-closed soft sets, which is a, contradiction with (3).

(5) ⇒(1)**:** Suppose that X = (F,E) ∪(G,E) for some suprasoft πg-open sets(F,E) and (G,E) such that (F,E) ∩(G,E) =φ. Then (F,E) = $(G,E)^c$ and (G,E) = (F,E). Thus, (F,E) and (G,E) are supra soft πg-clopen sets. Hence, (F,E) and (G,E) are supra soft πg-separated sets, which is a contradiction with (5).

Corollary 5.5: Let (X, µ, E)be a supra soft topological space, then the following statements are equivalent:

1) X is supra soft πg-connected.
2) If X= (F, E) ∪ (G, E),for some supra soft πg-open sets(F,E) and (G,E) such that (F, E) ∩ (G, E)=φ. Then, either (F, E) = φ or (G,E) = φ.
3) If X= (F,E)∪ (G,E) for somesupra soft πg-closed sets (F,E) and(G,E) such that (F,E) ∩(G,E) = φ. Then, either (F,E) =φor (G,E) =φ.

Proof:
Obvious from Theorem 5.4.

6. References

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