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Properties of g^*s^* Closure, g^*s^* Interior and g^*s^* Derived Sets in Topological Spaces

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Abstract

The aim of this paper is to introduce the g^*s^* closure, g^*s^* interior, g^*s^* derived set and discuss some basic properties of the g^*s^* -closure, g^*s^* interior, g^*s^* derived set in a topological space.

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1. Introduction

In 1963, N. Levine [3] introduced semi-open sets in topological space. In 1970, N. Levine [4] initiated the study of generalized closed sets. In 1987, Bhattacharya and Lahiri [2] defined and studied the concepts of semi generalized closed sets. In 1990, Arya and Nour [1] introduced the concept of generalized semi closed sets. In 2000, M.K.R.S.Veerakumar [6] studied the notion of g^* closed sets which is properly placed between closed sets and generalized closed sets. In 2014, R.Rajendiran[5] introduced and discussed the notion of g^*s^* closed sets. In this paper we analyze the various properties of g^*s^* -closure, g^*s^* interior, g^*s^* derived set in a topological space.

2. PRELIMINARIES

Definition 2.1. A subset of a topological space (X,τ) is called

(i) generalized closed (briefly g closed) [4] if $cl(A) \subset U$ whenever $A \subset U$ and U is open in X.

(ii) generalized semi closed (briefly gs closed) [1] $scl(A) \subset U$ whenever $A \subset U$ and U is open in X.

(iii) Semi generalized closed(briefly sg closed)[2] $scl(A) \subset U$ whenever $A \subset U$ and U is semi open in X.

(iv) Generalized star closed (briefly g^* closed)[6] if $cl(A) \subseteq U$ whenever $A \subseteq U$ and U is g open.

(v) g^*s^* closed [5] if $scl(A) \subseteq U$ whenever $A \subseteq U$ and U is g^* open.

3 . g^*s^* Interior and their properties

Definition 3.1. Let (X,τ) be a topological space and $x \in X$. A subset $N\ of\ X$ is said to be g^*s^*neighborhood of x if there exists a g^*s^* open set U in X such that $x \in U \subset N$.

Definition: 3.2. Let A be a subset of a topological space (X,τ), a point $x \in X$ is said to be g^*s^* interior point of A, if there exists a g^*s^* open set U such that $x \in U \subset A$. The set of all g^*s^* interior points of A is called g^*s^*

interior of A and is denoted by $g^*s^*Int(A)$.

Theorem 3.3. Let A be a subset of a space X, then $g^*s^*Int(A)$ is the union of all g^*s^* open sets which are contained in A.

Proof: Let $x \in g^*s^*Int(A)$. Then x is a g^*s^* interior point of A. Hence there exists a g^*s^* open set G such that $x \in G \subset A$. Therefore $x \in \cup\{G/\ G$ is g^*s^* open and $G \subset A\}$. So $g^*s^*Int(A) \subseteq \cup\{G/\ G$ is g^*s^* open and $G \subset A\}$. Conversely, let $x \in \cup\{G/\ G$ is g^*s^* open and $G \subset A\}$. Then x belongs to a g^*s^* open set G contained in A. Hence x is an g^*s^* interior point of A.That is $x \in g^*s^*Int(A)$. So $\cup\{G/\ G$ is g^*s^* open and $G \subset A\} \subseteq g^*s^*Int(A)$. Therefore $g^*s^*Int(A) = \cup\{G/\ G$ is g^*s^* open and $G \subset A\}$.

Theorem. 3.4. Let A be a subset of a space X, then $g^*s^*Int(A) \subset A$.

Proof: Let $x \in g^*s^*Int(A)$. Then there exists a g^*s^* open set G such that $x \in G \subset A$. Hence $x \in A$. Therefore $g^*s^*Int(A) \subset A$.

Theorem 3.5. If A is g^*s^* open in a topological space (X,τ), then $g^*s^*Int(A) = A$.

Proof: For any subset $A\ of\ X, g^*s^*Int(A) \subset A$. Let $x \in A\ .Then\ x \in A \subset A$ and A is g^*s^* open which implies x is a g^*s^* interior of A. Hence $x \in g^*s^*Int(A)$. Therefore $A \subset g^*s^*Int(A)$. Hence $g^*s^*Int(A) = A$.

Theorem 3.6. Let A and B be subsets of a space X . If B is any g^*s^*-open set contained in A, then $B \subset g^*s^*Int(A)$.

Proof: Let $x \in B$. Since B is g^*s^*-open set contained in A, x is a g^*s^* interior point of A. $x \in g^*s^*Int(A)$. Hence $B \subset g^*s^*Int(A)$.

Theorem 3.7. If A is g^*s^* open in a topological space (X,τ), then $g^*s^*Int(A)$ is also a g^*s^* open set in X.

Proof: From the theorem 3.5, if A is g^*s^* open in a topological space (X,τ),then $g^*s^*Int(A) = A$. Therefore $g^*s^*Int(A)$ is a g^*s^* open set in X.

Theorem 3.8. Let A be a subset of a topological space (X,τ), then

$g^*s^*int\big(g^*s^*Int(A)\big) \subset g^*s^*Int(A)$.

Proof: Let $x \in g^*s^*int\big(g^*s^*Int(A)\big)$. Then x is g^*s^* interior point of $g^*s^*Int(A)$. Hence there exists an g^*s^* open set U such that $x \in U \subset g^*s^*Int(A) \subset A$. So that there exists a g^*s^* open set U such that $x \in U \subset A$. Therefore x is a g^*s^* interior point of A That is $x \in g^*s^*Int(A)$. Therefore $g^*s^*int\big(g^*s^*Int(A)\big) \subset g^*s^*Int(A)$.

Theorem. 3.9. If (X,τ) is a topological space, then $g^*s^*Int(\emptyset) = \emptyset$ and $g^*s^*Int(X) = X$.

Proof: $g^*s^*Int(\emptyset) = \cup\,\{\, G/\ G$ is g^*s^* open and $G \subset \emptyset\}$. Since $\emptyset$ is the only g^*s^* open set contained in $\emptyset$, $g^*s^*Int(\emptyset) = \emptyset$.

$g^*s^*Int(X) = \cup\,\{\, G/\ G$ is g^*s^* open and $G \subset X\}$. Since X is g^*s^* open set contained in X, $g^*s^*Int(X) = \mathrm{X} \cup \{\, G/\ G$ is g^*s^* open and $G \subset X\} = X$.

Theorem 3.10. If $A\ and\ B$ are any two subsets of a topological space (X,τ) and $A \subset B$ then $g^*s^*Int(A) \subset g^*s^*Int(B)$.

Proof: Let $x \in X$ and $x \in g^*s^*Int(A)$. Then by the definition of g^*s^* interior, there exists a g^*s^* open set U such that $x \in U \subset A$. Since $A \subset B$, then $x \in U \subset A \subset B$. Hence $x \in g^*s^*Int(B)$. Therefore $g^*s^*Int(A) \subset g^*s^*Int(B)$.

Theorem 3.11. If $A\ and\ B$ are any two subsets of a topological space (X,τ) and $A \cap B = \emptyset$ then $g^*s^*Int(A) \cap g^*s^*Int(B) = \emptyset$

Proof: Given $A \cap B = \emptyset$. To prove that $g^*s^*Int(A) \cap g^*s^*Int(B) = \emptyset$. We prove this by method of contradiction. Assume that $x \neq \emptyset \in g^*s^*Int(A) \cap g^*s^*Int(B)$. Therefore $x \in g^*s^*Int(A)$ and $x \in g^*s^*Int(B)$. Hence there exists an g^*s^* open sets $U\ and\ V$ such that $x \in U \subset A, x \in V \subset B$. So $x \in U \cap V \subset U \subset A\ and\ x \in U \cap V \subset V \subset B$. For this reason $x \in A \cap B$. This is contradiction to $A \cap B = \emptyset$. Consequently, $g^*s^*Int(A) \cap g^*s^*Int(B) = \emptyset$.

Theorem 3.12. If $A\ and\ B$ are any two subsets of a topological space (X,τ) then $g^*s^*Int(A) \cup g^*s^*Int(B) \subset g^*s^*Int(A \cup B)$.

Proof: Let $x \in g^*s^*Int(A) \cup g^*s^*Int(B)$. Then $x \in g^*s^*Int(A)$ or $x \in g^*s^*Int(B)$. $x \in g^*s^*Int(A)$ implies that there exists a g^*s^*open set U such that $x \in U \subset A \subset A \cup B$. So $\in g^*s^*Int(A \cup B)$. $x \in g^*s^*Int(B)$ implies that there exists a g^*s^* open set V such that $x \in V \subset B \subset A \cup B$. So $x \in g^*s^*Int(A \cup B)$. Consequently $g^*s^*Int(A) \cup g^*s^*Int(B) \subset g^*s^*Int(A \cup B)$.

Theorem 3.13. If A *and* B are two subsets of a topological space (X, τ) then $g^*s^*Int(A \cap B) \subset g^*s^*Int(A) \cap g^*s^*Int(B)$

Proof: Let $x \in g^*s^*Int(A \cap B)$. Then there exists a g^*s^* open set U such that $x \in U \subset A \cap B \subset A$. This implies that $x \in g^*s^*Int(A)$. Also $x \in U \subset A \cap B \subset B$. So $x \in g^*s^*Int(B)$. Hence $x \in g^*s^*Int(A) \cap g^*s^*Int(B)$. Therefore $g^*s^*Int(A \cap B) \subset g^*s^*Int(A) \cap g^*s^*Int(B)$.

4 . g^*s^* closure and their properties

Definition 4.1. For any subset A in the space X, the g^*s^* closure of A, denoted by $g^*s^*Cl(A)$, is defined by the intersection of all g^*s^* closed sets containing A.

Theorem 4.2. For a subset A of a space X, then $A \subset g^*s^*Cl(A)$

Proof: Let $x \in A$. By the definition of g^*s^* closure of , $x \in g^*s^*Cl(A)$. So $A \subset g^*s^*Cl(A)$.

Theorem 4.3. The g^*s^* closure of A is the intersection of all g^*s^* closed sets containing A.

Proof: By the definition of g^*s^* closure of A,
$g^*s^*Cl(A) = \cap \{F / \ F$ is g^*s^* closed and $A \subset F\}$.

Theorem 4.4. If B is any g^*s^* closed set and $A \subset B$ then $g^*s^*Cl(A) \subset B$.

Proof: By the definition of g^*s^* closure, $g^*s^*Cl(A) = \cap \{F / \ F$ is g^*s^* closed and $A \subset F\}$. Therefore $g^*s^*Cl(A)$ is contained in every g^*s^* closed set containing A. Since B is g^*s^* closed set and $A \subset B$, $g^*s^*Cl(A) \subset B$.

Theorem 4.5. If A is g^*s^* closed set in (X, τ) then $A = g^*s^*Cl(A)$.

Proof: By the definition of g^*s^* closure, $A \subset g^*s^*Cl(A)$. Also $A \subset A$ and A is g^*s^* closed set, by theorem 4.4, $g^*s^*Cl(A) \subset A$. Hence $A = g^*s^*Cl(A)$.

Theorem 4.6. In a topological space (X,τ), $g^*s^*Cl(\emptyset)=\emptyset$ and $g^*s^*Cl(X)=X$.

Proof: By the definition of g^*s^* closure, $g^*s^*cl(\emptyset)=$ Intersection of all g^*s^* closed sets containing $\emptyset$. Hence $g^*s^*cl(\emptyset)=\emptyset$. Also $g^*s^*cl(X)=$ Intersection of all g^*s^* closed sets containing X. Hence $g^*s^*cl(X)=X$.

Theorem 4.7. If A and B are any subsets of a space (X,τ) *and* $A\subset B$ *then* $g^*s^*Cl(A)\subset g^*s^*Cl(B)$.

Proof: Let $\boldsymbol{x}\in g^*s^*Cl(A)$. By the definition, $g^*s^*cl(B)= \cap\{F/\ B\subset F\in g^*s^*C(X)\}$. If $B\subset F\in g^*s^*C(X)$, then $g^*s^*cl(B)\subset F$. Since $A\subset B$, A$\subset B\subset F\in g^*s^*C(X)$, we have $g^*s^*cl(A)\subset F$. Therefore $g^*s^*cl(A)\subset F=\cap\{F/\ B\subset F\in g^*s^*C(X)\}=g^*s^*cl(B)$. That is $g^*s^*Cl(A)\subset g^*s^*Cl(B)$.

Theorem 4.8. If A and B are any subsets of a space (X,τ) then $g^*s^*Cl(A)\cup g^*s^*Cl(B)\subset g^*s^*Cl(A\cup B)$.

Proof: Let A and B be subsets of X. Clearly $A\subset A\cup B$ and $B\subset A\cup B$. By theorem 4.7, we have $g^*s^*Cl(A)\subset g^*s^*Cl(A\cup B)$ and $g^*s^*Cl(B)\subset g^*s^*Cl(A\cup B)$. Hence $g^*s^*Cl(A)\cup g^*s^*Cl(B)\subset g^*s^*Cl(A\cup B)$.

Theorem 4.9. If A and B are any subsets of a space (X,τ) *and* $g^*s^*Cl(A)\cap g^*s^*Cl(B)=\emptyset$ then $A\cap B=\emptyset$.

Proof: Let $g^*s^*Cl(A)\cap g^*s^*Cl(B)=\emptyset$. To prove that $A\cap B=\emptyset$. We prove this by the method of contradiction. Assume that $x\in A\cap B$. Then $x\in A\ \&\ x\in B$. Therefore $x\in g^*s^*Cl(A)\ \&\ x\in g^*s^*Cl(B)$. So $x\in g^*s^*Cl(A)\cap g^*s^*Cl(B)$ which is contradiction. Hence $A\cap B=\emptyset$.

Theorem 4.10. If A and B are any subsets of a space (X,τ) *then* $g^*s^*Cl(A\cap B)\subset g^*s^*Cl(A)\cap g^*s^*Cl(B)$.

Proof: Let A and B be subsets of X. Also $A\cap B\subset A\ \&\ A\cap B\subset B$. Therefore by Theorem.4.7, we have $g^*s^*Cl(A\cap B)\subset g^*s^*Cl(A))$ *and* $g^*s^*Cl(A\cap B)\subset g^*s^*Cl(B)$.Therefore $g^*s^*Cl(A\cap B)\subset g^*s^*Cl(A)\cap g^*s^*Cl(B)$.

Theorem 4.11. For an $x\in X$, $x\in g^*s^*Cl(A)$ if and only if $V\cap A\neq\emptyset$ for every g^*s^* open set V containing x.

Proof: Let $x \in X, x \in g^*s^*Cl(A)$. To prove $V \cap A \neq \emptyset$ for every g^*s^* open set V containing x. We prove by contradiction. Suppose that there exists a g^*s^* open set V containing x such that $V \cap A = \emptyset$. Then $A \subset X\backslash V$ and $X\backslash V$is g^*s^* closed set . Hence $g^*s^*cl(A) \subset X\backslash V$. Therefore $g^*s^*cl(A) \cap V = \emptyset$. This implies that $x \notin g^*s^*Cl(A)$ which is contradiction. So $V \cap A \neq \emptyset$ for every g^*s^* open set V containing x.

Conversely, let $V \cap A \neq \emptyset$ for every g^*s^* open set V containing x. To prove that $x \in g^*s^*Cl(A)$. We prove this by contradiction. Assume that $x \notin g^*s^*Cl(A)$.Then there exists a g^*s^* open set V containing x such that $V \cap A = \emptyset$ which is contradiction. Hence $x \in g^*s^*Cl(A)$.

Theorem 4.12. If A is g^*s^* closed set in X then $g^*s^*Cl(A)$ is also g^*s^* closed set in X.

Proof: If A is g^*s^* closed set in X then $g^*s^*Cl(A) = A$. Therefore $g^*s^*Cl(A)$ is also a g^*s^* closed set in X.

Theorem 4.13. If A is a subset of (X, τ) then $g^*s^*Cl(A) \subset g^*s^*Cl\{g^*s^*Cl(A)\}$

Proof: If A is a subset of (X, τ) then $g^*s^*Cl(A)$ is also a a subset of (X, τ). By definition of g^*s^* closure, $g^*s^*Cl(A) \subset g^*s^*Cl\{g^*s^*Cl(A)\}$.

Theorem. 4.14. For any subset A of a space X, $X\backslash g^*s^*Cl(A) = g^*s^*Int(X\backslash A)$.

Proof: For any point $x \in X, x \in X\backslash g^*s^*Cl(A)$ implies $x \notin g^*s^*Cl(A)$. Then there exists g^*s^*open set U containing x, $A \cap U = \emptyset$. So $x \in U \subset X\backslash A$. Thus $x \in g^*s^*Int(X\backslash A)$. Conversely, let $x \in g^*s^*Int(X\backslash A)$. There exists a g^*s^* open set U such that $x \in U \subset X\backslash A$. So $x \notin g^*s^*Cl(A)$. This implies that $\in X\backslash g^*s^*Cl(A)$.

Theorem 4.15. For any subset A of a space X, $X\backslash g^*s^*Int(A) = g^*s^*Cl(X\backslash A)$.

Proof: Let $x \in X\backslash g^*s^*Int(A)$. Then $x \notin g^*s^*Int(A)$. That is every g^*s^* open set U containing x is such that $U \not\subset A$. That is every g^*s^* open set U containing x is such that $U \cap A^C \neq \emptyset$. Then by theorem 4.11, $x \in g^*s^*Cl(X\backslash A)$. Therefore $X\backslash g^*s^*Int(A) \subset g^*s^*Cl(X\backslash A)$. Conversely, $x \in g^*s^*Cl(X\backslash A)$.

Then by theorem 4.11, every g^*s^* open set U containing x is such that $U \cap A^C \neq \emptyset$. That is every g^*s^* open set U containing x is such that $U \not\subset A$. This implies that by the definition of g^*s^* interior, $x \notin g^*s^*Int(A)$. That is $x \in X \backslash g^*s^*Int(A)$. So $g^*s^*Cl(X \backslash A) \subset X \backslash g^*s^*Int(A)$. Consequently, $g^*s^*Int(A) = g^*s^*Cl(X \backslash A)$.

Theorem 4.16. For any subset A of a space X, $g^*s^*Cl(A) = X \backslash g^*s^*Int(X \backslash A)$

Proof: $x \in g^*s^*Cl(A)$. Then by theorem 4.11, every g^*s^* open set U containing x is such that $U \cap A \neq \emptyset$. Hence every g^*s^* open set U containing x is such that $U \not\subset X \backslash A$. Therefore $x \notin g^*s^*Int(X \backslash A)$. Hence $x \in X \backslash g^*s^*Int(X \backslash A)$. Therefore $g^*s^*Cl(A) \subset X \backslash g^*s^*Int(X \backslash A)$. Conversely, let $x \in X \backslash g^*s^*Int(X \backslash A)$. Then $x \notin g^*s^*Int(X \backslash A)$. Hence every g^*s^* open set U containing x is such that $U \not\subset X \backslash A$. Then every g^*s^* open set U containing x is such that $U \cap A \neq \emptyset$. So $x \in g^*s^*Cl(A)$. That is $X \backslash g^*s^*Int(X \backslash A) \subset g^*s^*Cl(A)$. Thus $g^*s^*Cl(A) = X \backslash g^*s^*Int(X \backslash A)$.

Theorem 4.17. For any subset A of a space , $g^*s^*Int(A) = X \backslash g^*s^*Cl(X \backslash A)$.

Proof: Let $x \in g^*s^*Int(A)$. Then there exists a g^*s^* open set U such that $x \in U \subset A$. Hence $x \notin g^*s^*Cl(X \backslash A)$. Therefore $x \in X \backslash g^*s^*Cl(X \backslash A)$. Hence $g^*s^*Int(A) \subset X \backslash g^*s^*Cl(X \backslash A)$. Conversely, let $x \in X \backslash g^*s^*Cl(X \backslash A)$. This implies that $x \notin g^*s^*Cl(X \backslash A)$. Then there exists a g^*s^* open set U such that $x \in U \cap X \backslash A = \emptyset$. That is there exists a g^*s^* open set U such that $x \in U \subset A$. So $x \in g^*s^*Int(A)$. Therefore $X \backslash g^*s^*Cl(X \backslash A) \subset g^*s^*Int(A)$. Hence $g^*s^*Int(A) = X \backslash g^*s^*Cl(X \backslash A)$.

5. g^*s^* derived set and their properties

Definition 5.1. Let A be a subset of a topological space (X, τ). A point $x \in X$ is said to be g^*s^* limit point of A if for each g^*s^* open set U containing x, $U \cap \{A \backslash \{x\}\} \neq \emptyset$. The set of all g^*s^* limit points of A is called a

g^*s^* derived set of A and is denoted by $g^*s^*D(A)$.

Theorem 5.2. In a topological space (X,τ), $g^*s^*D(\emptyset)=\emptyset$.

Proof: For all g^*s^* open set U and for all $x\in X, U\cap\{\emptyset\backslash x\}=\emptyset$. Hence $g^*s^*D(\emptyset)=\emptyset$.

Theorem 5.3. Let A be a subset of a space (X,τ). If $x\in g^*s^*D(A)$, then $x\in g^*s^*D(A\backslash\{x\})$

Proof: Let $x\in g^*s^*D(A)$. Then for each g^*s^* open set U, $U\cap\{A\backslash\ \{x\}\}\neq\emptyset$. This implies that $U\cap\{(A\backslash\ \{x\})\{x\}\}\neq\emptyset$. Hence $x\in g^*s^*D(A\backslash\{x\})$.

Theorem 5.4. Let A and B be subsets of a space X. If $A\subset B$ then $g^*s^*D(A)\subset g^*s^*D(B)$.

Proof: Let $x\in g^*s^*D(A)$. Then for each g^*s^* open set U containing x, $U\cap\{A\backslash\ \{x\}\}\neq\emptyset$. Since $A\subset B$, $U\cap\{B\backslash\ \{x\}\}\neq\emptyset$. Therefore $x\in g^*s^*D(B)$. Hence $g^*s^*D(A)\subset g^*s^*D(B)$

Theorem 5.5. Let A and B be subsets of a space (X,τ). Then $g^*s^*D(A)\cup g^*s^*D(B)\subset g^*s^*D(A\cup B)$

Proof: Let $x\in g^*s^*D(A)\cup g^*s^*D(B)$. This implies that $x\in g^*s^*D(A)$ or $\in g^*s^*D(B)$. If $x\in g^*s^*D(A)$ then for each g^*s^* open set U containing x, $U\cap\{A\backslash\ \{x\}\}\neq\emptyset$. Since $A\subset A\cup B$, $U\cap\{A\cup B\backslash\ \{x\}\}\neq\emptyset$. This shows that $x\in g^*s^*D(A\cup B)$. Otherwise if $x\in g^*s^*D(B)$ then for each g^*s^* open set U containing x, $U\cap\{B\backslash\ \{x\}\}\neq\emptyset$. Since $B\subset A\cup B$, $U\cap\{A\cup B\backslash\ \{x\}\}\neq\emptyset$. This shows that $x\in g^*s^*D(A\cup B)$.So $g^*s^*D(A)\cup g^*s^*D(B)\subset g^*s^*D(A\cup B)$.

Theorem 5.6. Let A and B be subsets of a space X. Then $g^*s^*D(A\cap B)\subset g^*s^*D(A)\cap g^*s^*D(B)$

Proof: Let $x\in g^*s^*D(A\cap B)$. Then for each g^*s^* open set U containing x, $U\cap\{(A\cap B\backslash\ \{x\}\}\neq\emptyset$. Since $A\cap B\subset A, U\cap\{(A\backslash\ \{x\}\}\neq\emptyset$.This implies that $x\in g^*s^*D(A)$. Also $A\cap B\subset B, U\cap\{(B\backslash\ \{x\}\}\neq\emptyset$.This implies that $x\in g^*s^*D(B)$. Therefore $x\in g^*s^*D(A)\cap g^*s^*D(B)$. Hence $g^*s^*D(A\cap B)\subset g^*s^*D(A)\cap g^*s^*D(B)$.

References

[1]. S.P.Arya and T.Nour, Characterizations of s-normal spaces, Indian J. Pure. Appl. Math., **21**(8)(1990), 717-719.

[2]. P.Bhattacharya and B.K.Lahiri, “Semi-genralized Closed sets in Topology”, Indian J. Math. ,29(1987), 376-382.

[3] Levine, N., Semi-Open Sets and Semi-Continuity in Topological Space, *Amer. Math. Monthly*. 70 (1963), 36-41.

[4] N.Levine, Generalized closed sets in topology, Rend. Circ. Math. Palermo, **19**(2)(1970), 89-96.

[5] R.Rajendiran and M.Thamilselvan, “g^*s^* Closed sets in Topological Spaces”, Int. Jour. of Math. Analysis, 8(29)(2014), 1919-1930

[6] M.K.R.S.Veerakumar, Betweeen closed sets and g closed sets, Mem.Fac.Sci.Kochi.Univ.Ser A, Math 21 (2000), 1-19.

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