International Journal of Engineering & Technology, 7 (4.10) (2018) 766-769

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper



On gg-Separation Axioms in Topological Spaces

Govardhana Reddy H G[1]*, Basavaraj M. Ittanagi[2]

[1]*Department of Mathematics, Alliance College of Engineering and Design, Alliance University, Bangalore-562106, India*
[2]*Department of Mathematics, Siddaganga Institute of Technology, Tumakuru-572103, India*
**Corresponding author E-mail: govardhana.reddy@alliance.edu.in*

Abstract

Study and investigate a class of separation axiom namely gg-T_k space (k=0, 1, 2), gg-regular and gg-normal space. Meanwhile, some of their properties are obtained.

Keywords: *gg-T_k spaces (K=0, 1, 2), gg-regular space and gg-normal space.*

1. Introduction

From the literature survey on separation axiom, we observed that there has been significant work on T_0 space, T_1 space, T_2 space, regular space and normal space. In 1980, R. C. Jain [5] introduced a new class of separation axioms namely δT_i space (i=0, 1, 2). Since then different types of separation axioms are investigated. Using g-closed sets of Levine [6], T. Noiri and Papa [7] and Sheik John [8] contributed their work in the field of separation axiom. Recently, Basavaraj M. Ittanagi [1], studied basic properties of gg-closed sets, gg-continuous functions and gg-closed maps in topological spaces. In present paper, gg-T_0, gg-T_1 and gg-T_2 spaces are studied. The relation with existing separation axioms is discussed.

2. Prerequisites

In study, (X, T_1), (Y, T_2) (or X, Y) denote topological spaces. Let $g:X\to Y$ (or simply g) always denote map. For $B\subseteq X$, int(B), cl(B), X-B or B^c represent interior, closure and complement of B respectively. The basic definitions required for this research work are listed below.

Definition 2.1 Let $B \subseteq X$. Then B is said to be
i) g-closed [5] if $cl(B) \subseteq W$ whenever $B \subseteq W$ and W is open.
ii) gg-closed [1] if $gcl(B) \subseteq W$ whenever $B \subseteq W$ and W is regular semiopen. Also, ggC(X) (resp. ggO(X)) always denote family of gg-closed (resp. gg-open) sets in X.
iii) δT_0 space [4] if for every explicit points p, q of X, $q \notin M$, $p \in M$, or $p \notin M$, $q \in M$, where M is a δ -open set of X.
iv) δT_1-space [4] if for every explicit points p, q of X, $q \notin M$, $p \in M$ and $p \notin N$, $q \in N$ where M and N are two δ-open sets of X.
v) δT_2 -space [4] if for every explicit points p, q of X, $q \notin H_1$, $p \in H_1$ and $p \notin H_2$, $q \in H_2$ where H_1, H_2 are two δ -open sets with $H_1 \neq H_2$.

Definition 2.2 A map g is known as gg-continuous [2](gg-irresolute[2]) if $f^{-1}(F) \in ggC(X)$, $\forall$ closed(gg-closed)set F in Y.

3. gg-T_0, gg-T_1 and gg-T_2 Spaces

Definition 3.1 Let X be

i) gg-T_0 if for every explicit points p, q of X, $q \notin M$, $p \in M$ or $p \notin M$, $q \in M$ where M is an open set of X.

ii) gg-T_1 space if for every explicit points p, q of X, $q \notin M$, $p \in M$ and $p \notin N$, $q \in N$ where N, $M \in ggO(X)$.

iii) gg-T_2 space (gg-Housdorff space) if for every explicit points p, q of X, $q \notin H_1$, $p \in H_1$ and $p \notin H_2$, $q \in H_2$ where H_2, $H_1 \in ggO(X)$ $\ni H_2 \neq H_1$.

Theorem 3.2
i) If X is T_0, then X is gg-T_0
ii) If X is T_1, then X is gg-T_0 and gg-T_1
iii) If X is T_2, then X is gg-T_2
iv) If X is gg-T_1, then X is gg-T_0
v) If X is gg-T_2, then X is gg-T_1

Proof. i) Given, X is T_0 space. For distinct points of every pair p, q of X $\exists$ open set U where $q \notin U$, $p \in U$, or $p \notin U$, $q \in U$, Then $U \in ggO(X)$ with $q \notin U$, $p \in U$ or $p \notin U$, $q \in U$. Therefore X is gg-T_0 space.
Similarly we can prove ii), iii), iv) and v).

Example 3.3 Let X={n, m, l, k} and $T_1=\{\varphi, \{l, k\}, \{n, m\}, X\}$ be a topology on X. Then
ggC(X)=P(X)=ggO(X).
Here (X, T_1) is a
(i) gg-T_0 space but not a T_0 space. For explicit points k, l of X, no open set M exist $\ni$ $k \in M$, $l \notin M$ or $l \in M$, $k \notin M$.
(ii) gg-T_0 space but not a T_1 space. For explicit points k, l of X, no two open sets M and N exist $\ni$ $k \in M$, $l \notin M$ and $l \in N$, $k \notin N$.
(iii) gg-T_1 space but not a T_1 space. For explicit points k, l of X, no two open sets M and N exist $\ni$ $k \in M$, $l \notin M$ and $l \in N$, $k \notin N$.

Copyright © 2018 Authors. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

(iv) gg-T_2 space but not a T_2 space. For explicit points k, l of X, no two distinct open sets H_1 and H_2 exist $\ni$ k$\in H_1$, l$\notin H_1$ and l$\in H_2$, k$\notin H_2$.

Theorem 3.4
1) If X is δT_0, then it is gg-T_0
2) If X is δT_1, then it is gg-T_1
3) If X is δT_2 , then it is gg-T_2.

Proof. Based on fact, every δ- open set is in ggO(X).

Remark 3.5 Converse of this theorem is untrue.

Example 3.6 Let $T_1=\{\varphi, X, \{l\}, \{m, n\}\}$ be a topology on X={n, m, l}. Then
ggO(X)=P(X)
δ-O(X)= { φ, X, {l}, {m, n}}
Here (X, T_1) is a
(1) gg-T_0 but not a δT_0 space. For explicit points m, n of X, no δ open set exist with n $\notin$ M, m $\in$ M or m$\notin$ M, n $\in$ M
(2) gg-T_1 space but not a δT_1 space. For explicit points m, n of X, no two δ open sets M and N exist with n $\notin$ M, m $\in$ M and m $\notin$ N, n $\in$ N.
(3) gg-T_2 space but not a δT_2 space. For explicit points m, n of X, no two distinct δ-open sets H_1 and H_2 exist with m $\in H_1$, n $\notin H_1$ and n $\in H_2$, m $\notin H_2$.

Theorem 3.7 Let X is gg-T_0 iff ggcl{x_1}$\neq$ ggcl{x_2}, $\forall$ $x_1 \neq x_2$ of X.

Proof. Given that X is gg-T_0. Let x_2, $x_1 \in$ X and $x_2 \neq x_1$, then $\exists$ V$\in$ ggO(X), $x_2 \notin$ V and $x_1 \in$ V implies $x_1 \notin V^c$, x2 $\in V^c$. But ggcl{x_2} is the smallest gg-closed containing x_2. Therefore ggcl({y}) $\subseteq V^c$. Hence x $\notin$ ggcl{x_2}. Thus ggcl{x_1} $\neq$ ggcl{x_2}.
Conversely, suppose ggcl{x_1}$\neq$ ggcl{x_2}, $\forall$ $x_1 \neq x_2$ of X. Let $x_3 \in$ X with $x_3\in$ ggcl({x_1}) but $x_3 \notin$ ggcl({x_2}). If x $\in$ ggcl({y}) then ggcl({x_1}) $\subseteq$ ggcl({x_2}). Hence $x_3 \in$ ggcl({x_2}). This contradicts our assumption. Thus $x_1 \notin$ ggcl({x_2}) implies $x_1 \in$ (ggcl({x_2}))^c implies (ggcl({x_2}))^c is gg-open containing x_1 and not x_2. Therefore X is gg-T_0.

Theorem 3.8 If g is bijective, strongly gg-open and X is gg-T_0, then Y is gg-T_0 space.

Proof Take y_2 and y_1 of Y with $y_2 \neq y_1$. By hypothesis y_1= g(x_1) and y_2= g(x_2) where x_2 and x_1 are explicit points of X. By hypothesis, M$\in$ ggO(X) with $x_1 \in$ M and $x_2 \notin$ M. Therefore g(x_1) $\in$ g(M) and g(x_2) $\notin$ g(M). As X is strongly gg-open, g(M) $\in$ ggO(Y). Therefore g(M) is gg-open set in Y with $y_1 \in$ g(M) and $y_2 \notin$ g(M). Thus Y is a gg-T_0 space.

Theorem 3.9 If g is gg-irresolute, injective, Y is gg-T_0 then X is gg-T_0.

Proof. Take explicit points x_2 and x_1 of X. As g is injective implies g(x_1)$\neq$ g(x_2). As Y is gg-T_0, exists U $\in$ ggO(Y) such that g(x_1) $\in$ U, g(x_2) $\notin$ U or exists a V$\in$ ggO(Y) such that g(x_1) $\notin$ V, g(x_2)$\in$ V with g(x_2)$\neq$ g(x_1). Sine g is gg-irresolute then g^{-1}(U) $\in$ ggO(X) $\ni$ $x_2 \notin g^{-1}$(U), $x_1 \in g^{-1}$(U) or g^{-1}(V)$\in$ ggO(X) $\ni$ $x_1 \notin g^{-1}$(V), $x_2 \in g^{-1}$(V). Hence X is gg-T_0.

Theorem 3.10 Let X is gg-T_1 iff $x_2 \in$ X singleton {x_2}$\in$ ggC(X).

Proof Let X is gg-T_1, $x_1 \in$ X. Then $x_2 \in$ X-{x_1} $\Rightarrow$ $x_1 \neq x_2 \in$ X. But X is gg-T_1 space implies their exist G_1, $G_2 \in$ ggO(X) $\ni$ $x_1 \notin G_1$, $x_2 \in G_2 \subseteq$ (X-{x_1}). Also $x_2 \in G_2 \subseteq$ (X-{x_1}) implies (X-{x_1})$\in$ggO(X). Thus {x_1} is gg-closed.

Conversely, Let $x_1 \neq x_2 \in$ X then {x_1} and {x_2} are gg-closed sets and {x_1}^{c} is gg-open. Clearly $x_1 \notin$ {x_1}^{c} and $x_2 \in$ {x_1}^{c}. Similarly {x_2}^{c} is gg-open, $x_2 \notin$ {x_2}^{c} and $x_1 \in$ {x_2}^{c}. Hence X is gg-T_1 space.

Theorem 3.11 The following results holds
i) If g is gg-continuous, injective, Y is T_1 space, imply X is gg-T_1.
ii) If g is gg-continuous, injective, Y is T_2 space, imply X is gg-T_2 space.
iii) If g is gg-irresolute, injective, Y is gg-T_2 space, imply X is gg-T_2 space.

Proof. i) Consider two points x_1, x_2 of X with $x_2 \neq x_1$, then g(x_1)= y_1 and g(x_2)= y_2. Also, g(x_1) $\neq$ g(x_2). Since (Y, σ) is T_1 then $y_1 \in$ M, $y_2 \notin$ M and $y_1 \notin$ N, $y_2 \in$ N. Then $x_1 \in g^{-1}$(M), $x_1 \notin g^{-1}$(N) and $x_2 \in g^{-1}$ (N), $x_2 \notin g^{-1}$ (M). By the definition of gg-continuity, g^{-1}(M) and g^{-1}(N) $\in$ ggO(X). For x_1, $x_2 \in$ X with $x_1 \neq x_2$, $x_1 \in g^{-1}$(M), $x_1 \notin g^{-1}$(N) and $x_2 \notin g^{-1}$(M), $x_2 \in g^{-1}$(N). Therefore (X, T_1) is gg-T_1 space.
Similarly we can prove ii) and iii)

Theorem 3.12 The statements given below are equivalent.
1) X is gg-T_2
2) If $x_1 \in$ X, then $x_2 \neq x_1$, $\exists$ W containing $x_1 \ni x_2 \notin$ ggcl(W).

Proof. (1) $\Longrightarrow$ (2)
Take $x_1 \in$ X and $x_2 \in$ X with $x_1 \neq x_2$, $\exists$ disjoint sets W, V$\in$ ggO(X) $\ni$ $x_1 \in$ W and $x_2 \in$ V. Then $x_1 \in$ W$\subseteq V^c$ and $V^c \in$ ggC(X) and $x_2 \notin V^c$. Thus $x_2 \notin$ ggcl(W).

(2) $\Longrightarrow$ (1)
Let x_1, $x_2 \in$ X with $x_1 \neq x_2$. By (ii), $\exists$ gg-open W containing $x_1 \ni x_2 \notin$ ggcl(W) implies $x_2 \in$ (X-(ggcl(W))). (X-(ggcl(W))) $\in$ ggO(X) and $x_1 \notin$ (X-(ggcl(W))). Also W$\cap$ (X-ggcl(W))=φ. Thus X is gg-T_2.

4. gg-Regular Space

Definition 4.1 Let X is known as gg-regular if $\forall$ F$\in$ ggC(X) and x$\notin$ F, $\exists$ disjoint open sets G and H $\ni$ F$\subseteq$ G, x$\in$ H.
We have the following relationship between gg-regularity and regularity.

Theorem 4.2 Every gg-regular space is regular.

Proof. Given that X is gg-regular. Take F$\in$ ggC(X) and x $\notin$ F. As X is gg-regular, $\exists$ a pair of disjoint open sets U and V $\ni$ F $\subseteq$ U and x $\in$ V. Hence X is a regular.

Remark 4.3 Every regular space is not a gg-regular space.

Example 4.4 Let $T_1=\{\varphi, \{k\}, \{m, l\}, X\}$ be topology on X={m, l, k}. Here (X, T_1) is regular but not a gg-regular space. For the gg-closed set {l} with m $\notin$ {l}, no two disjoint open sets U, H exist $\ni$ {l} $\subseteq$ U, m $\in$ H.

Theorem 4.5 Every regular with ggTc space is gg-regular.

Proof. Given that X is regular, ggTc . Let F $\in$ ggC(X) and x $\in$ X $\ni$ x $\notin$ F. Now X is ggTc space, F is closed, x $\notin$ F. As X is regular, $\exists$ pair of disjoint open sets M and N $\ni$ F$\subseteq$ M and x $\in$ N. Therefore X is gg regular.

Theorem 4.6 If X is gg-regular then it is g-regular space.

Proof. Based on the fact, every g-closed belongs to ggC(X).

Theorem 4.7 If X is gg-regular, then it is w regular space.

Proof. Based on fact, each w closed belongs to ggC(X).

Theorem 4.8 The statements given below are equivalent.
1) X is gg-regular
2) ∀ x∈ X and each gg-open nbhd U ∃ an open nbhd N of X ∋ cl(N) ⊆ U.

Proof.
(1) ⟹ (2)
Let U be gg-neighbourhood of x, ∃ a G ∈ ggO(X) ∋ x ∈ G ⊆ U. Now G^c ∈ ggC(X) and x ∉ G^c. From (1), ∃ P, Q ∋ G^c ⊆ P, x ∈ Q, P∩ Q=φ. So Q ⊆ M^c. Now cl(Q) ⊆ cl(p^c)= G^c and G^c ⊆ P. This implies (P^c ⊆ G ⊆ U. Therefore cl(Q) ⊆ U.
(2) ⟹ (1)
Let gg-closed F in X and x ∉ F or x ∈ F^c and X is gg-open and so F^c is a gg-nbhd of x. By hypothesis, ∃ an open nbhd N ∋ x ∈ N, cl(N) ⊆ F^c. This implies F ⊆ {X-cl(N)} and N∩{(X-cl(N))} = φ. Thus X is gg-regular.

Theorem 4.9 Let X is gg-regular iff for every G ∈ ggC(X) and point p ∈ (X-G) then x ∈ U, G ⊆ N and cl(N) ∩ cl(U)= φ where N and U are open sets.

Proof. Given that X is gg-regular. Let G ∈ ggC(X) and x ∉ G. Then p ∈ M and G ⊆ N and M∩ N=φ where M and N are open sets. This implies M∩cl(N)=φ. Since (X, T_1) is gg-regular, p ∈ P and cl(N)⊆ Q, P∩N=φ where P, Q are open. Also cl(P)∩ Q= φ. Let U =M∩P then p ∈ U, G ⊆ N and cl(N) ∩ cl(U) = φ where N, U are open in X.
Conversely, suppose ∀ G ∈ ggC(X) and p ∈ (X-G), we have p ∈ U, G ⊆ N and cl(N)∩cl(U)= φ where N and U are open sets. This implies p ∈ U, G ⊆ N and U∩N= φ. Therefore (X, T_1) is gg-regular.

Theorem 4.10 A subspace Y of gg-regular (X, T_1) is gg-regular.

Proof. Obvious.

Theorem 4.11 Let g is bijective, gg-irresolute and open map from gg-regular X in to Y, then Y is gg-regular.

Proof Take y ∈ Y and F ∈ ggC(X) with y ∉ F. As g is gg-irresolute then g^{-1}(F) ∈ ggC(X). Let y=g(x) then g^{-1}(y)=x and x ∉ g^{-1}(F). Again X is gg-regular, ∃ open sets P and Q ∋ x ∈ P and g^{-1}(F) ⊆ Q, P∩ Q=φ. Given g is open and bijective implies y ∈ g(P), F ⊆ g(Q) and g(Q∩P)=g(φ)= φ. Thus Y is gg-regular.

Theorem 4.12 Let g be bijective, gg-closed map from X into gg-regular Y. If X is ggTc , then it is gg-regular

Proof. Consider x ∈ X, F ∈ ggC(X) with x ∉ F. Then F is closed. Also g is gg-closed implies g(F) ∈ ggC(Y) with g(x) ∉ g(F) in Y. As Y is gg-regular, ∃ P, Q ∋ p ∈ R and g(x) ∈ P and g(F) ⊆ Q. Therefore x ∈ g^{-1}(P) and F ⊆ g^{-1}(Q). Hence X is gg-regular space.

5. gg-Normal Space

Definition 5.1 Let X is known as gg-normal if for each pair D, C ∈ ggC(X), ∃ disjoint open sets P, Q in X ∋ C ⊆ P and D ⊆ Q.

Theorem 5.2 Every gg-normal is normal

Proof. Given that X is a gg-normal. Consider closed D, C which are disjoint in X. Then D, C ∈ ggC(X). Since X is gg-normal, ∃ a pair G, H ∋ C ⊆ G, D ⊆ H. Hence X is normal.

Example 5.3 Let T_1={φ, {l}, {k}, {l, k}, {k, m}, X} be a topology on X={m, k, l}. Here X is normal and not gg-normal. For the disjoint gg-closed sets {m} and {k, l} does not exist disjoint open sets P and Q.

Theorem 5.4 If Y is normal, ggTc space, then Y is gg-normal.

Proof. Given Y is normal. Let a pair of disjoint sets C, D ∈ ggC(Y). Since ggTc space, then C and D are closed. As Y is normal, ∃ a pair of disjoint open sets P, Q in Y ∋ , C ⊆ P and D ⊆ Q. Hence Y is gg-normal.

Theorem 5.5 Every gg-normal is g-normal.

Proof. Given X is gg-normal. Let pair of disjoint sets C, D ∈ ggC(Y). Then ∃ a pair of disjoint P, Q ∋ C ⊆ P and D ⊆ Q. Hence X is g-normal.

Remark 5.6 Every g-normal is not a gg-normal

Example 5.7 Let T_1={φ, {l}, {k}, {k, l}, {k, m}, X} be a topology on X={m, l, k}. Here (X, T_1) is g normal and not a gg-normal space. For the disjoint gg-closed sets {m} and {k, l} does not exist P, Q.

Theorem 5.8 Every gg-normal is w-normal.

Proof. Similar as Theorem 5.5

Remark 5.9 In general, converse is untrue

Example 5.10 Let T_1={φ, {l}, {k}, {k, l}, {m, k}, X} be a topology on X={m, l, k}. Here (X, T_1) is w normal and not a gg-normal space. For the disjoint gg-closed sets {m} and {k, l} does not exist P, Q.

Theorem 5.11 If Y is gg-closed subspace of gg-normal X, then Y is is gg-normal.

Proof. Let X be gg-normal and Y is gg-closed subspace. Let a pair of disjoint sets C, D ∈ ggC(Y). Then ∃ G, H ∈ X ∋ C ⊆ G and D ⊆ H. Then G∩Y and H∩Y are open in Y. Also we have C ⊆ G and D ⊆ H implies C∩Y ⊆ Y∩G and Y∩D ⊆ Y∩H and (G∩Y) ∩ (Y∩H)= Y∩(G∩H)=φ. Hence Y is gg-normal.

Theorem 5.12 Statements given below are equivalent in (X, T_1).
1) X is gg-normal
2) For each C ∈ ggC(X) and each M ∈ ggO(X) with C ⊆ M then C ⊆ N ⊆ cl(N) ⊆ M where N is an open set.
3) For any disjoint sets C, D ∈ ggC(X), ∃ an open set N ∋ C ⊆ N and cl(N)∩D= φ
4) For each disjoint sets C, D ∈ ggC(X), ∃ open sets M, N ∋ C ⊆ M, D ⊆ N, cl(M)∩cl(N)= φ.

Proof. (1)⟹(2)
Take C ∈ ggC(X), M ∈ ggO(X) ∋ C ⊆ M. This implies C and (X-M) are two disjoint sets of ggC(X). By the definition of gg-normal, C ⊆ N and (X-M) ⊆ O where N and O are disjoint open sets. Thuss N ⊆ (X-O) and O∩N=φ. This implies N ⊆ (X-O) and cl(N) ⊆ (X-O)⊆ M and so cl(N) ⊆ M. Therefore C ⊆ N ⊆ cl(N)⊆ M.
(2)⟹(3)
Let a pair of disjoint sets D, C ∈ ggC(X), C ⊆ (X-D) where C and (X-D) are gg-closed and gg-open sets in X respectively. By (2) there exist an open set N with C ⊆ N ⊆ cl(N) ⊆ (X-D). But cl(N) ⊆ (X-D) implies D ∩ cl(N)=φ. Therefore C ⊆ N and cl(N) ⊆ D=φ.
(3)⟹(4)

Consider two disjoint gg-closed sets C and D in X. Then from (3), $\exists$ an open set M $\ni$ C $\subseteq$ M and cl(M)$\cap$D=φ. But cl(M) is closed and hence gg-closed set in X. Now cl(M), D belongs to ggC(X). By (3), we have D $\subseteq$ N and cl(M)$\cap$cl(N)= φ where N is open set exist in X.
(4)$\Longrightarrow$(1)
Consider two disjoint gg-closed C, D in X. By hypothesis $\exists$ open sets N, M with C $\subseteq$ M, D $\subseteq$ N, cl(M)$\cap$cl(N)= φ. This implies that C $\subseteq$ M, D $\subseteq$ N. Therefore X is gg-normal.

Theorem 5.13 A map g is bijective open, gg-irresolute from gg-normal X on to Y, then Y is gg-normal.

Proof. Take A, B in ggC(X), which are disjoint. As g is gg-irresolute then $g^{-1}(A)$ and $g^{-1}(B)$ are in ggC(X). As X is gg-normal $g^{-1}(A) \subseteq M$ and $g^{-1}(B) \subseteq N$ where M and N are open sets exist in X. Further, as g is bijective and open, g(M) and g(N) are open with A $\subseteq$ g(M), B $\subseteq$ g(N). Therefore Y is gg-normal.

Theorem 5.14 The statements given below are equivalent in X
(1) X is g-normal
(2) For each disjoint closed sets C, D, $\exists$ disjoint sets M, N $\in$ ggO(X) $\ni$ C $\subseteq$ M, D $\subseteq$ N.

Proof. (i) $\Longrightarrow$ (ii)
Suppose X is g-normal. Let disjoint closed C, D of X. As (X, T_1) is g-normal then $\exists$ disjoint g-open sets M, N $\ni$ C $\subseteq$ M, D $\subseteq$ N.. Then M, N $\in$ ggO(X) with C $\subseteq$ M, D $\subseteq$ N and M$\cap$N= φ.
(ii) $\Longrightarrow$ (i)
Consider two disjoint gg-closed sets C, D $\in$ ggC(X). By hypothesis C $\subseteq$ M, D $\subseteq$ N and N$\cap$M= φ where N, M are disjoint sets in ggO(X). We know that C $\subseteq$ gint(M), D $\subseteq$ gint(N) and gint(M)$\cap$ gint(N) = φ. Therefore (X, T_1) is g-normal.

6. Conclusion

A new class of separation axioms called gg-separation axioms are introduced and studied in (X, T). The relations between gg-separation axioms with existing separation axioms are discussed. The useful results on gg-regular and gg-normal spaces are also presented.

References

[1] Basavaraj M Ittanagi and Govardhana Reddy H G, On gg-Closed Sets in Topological Spaces, International Journal of Mathematical Archive- 8(8), (2017), 126-133.
[2] Basavaraj M Ittanagi and Govardhana Reddy H G, On gg-Continuous and gg-Irresolute Maps in Topological Spaces, Journal of Global Research in Mathematical Archive- 4(11) (2017), 42-52.
[3] Basavaraj M Ittanagi and Govardhana Reddy H G, On gg-Closed and gg-Open Maps in Topological Spaces, On national conference of Analysis and its Applications, 2018, Karnatak University Dharwad, Karnataka, India (presented paper).
[4] R. C. Jain, The role of regularly open sets in general topology spaces, Ph.D. Thesis, Meerut Univ. Inst. Advance Stud. Meerut, India 1980.
[5] N.Levine, Generalized closed sets in topology, Rend. Circ. Mat. Palermo, 19(2) (1970), 89-96.
[6] T. Noiri and V. Popa, On g-regular spaces and some functions, Mem. Fac. Sci. Kochi Univ. Math, 20 (1999) 67-74.
[7] M. Sheik John, A study on generalization of closed sets on continuous maps in topological and bitopological spaces, Ph.D Thesis, Bharathiar University, Coimbatore, (2002).