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Research Article

A GENERALIZED CLOSED SETS IN TOPOLOGICAL SPACES

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A B S T R A C T

In this paper, we introduce and study a new class of sets namely $\overline{g}$-closed sets which settled in between the class of closed sets and the class of g-closed sets and then we study many basic properties of $\overline{g}$-closed set together with the relationships of some other sets. As applications of $\overline{g}$-closed sets, we introduce some new separation properties, namely $\overline{T}$-spaces, $\overline{T}^*$-spaces and ${}^*\overline{T}$-spaces and then discuss some of their properties. Further we introduce and study new types of continuity namely $\overline{g}$-continuity and $\overline{g}$-irresoluteness.

INTRODUCTION

The study of g-closed sets in a topological space was initiated by Levine [3] in 1970. Levine [1] also introduced the concept of semi-open sets and semi-continuity in topological spaces in 1963. Bhattacharya and Lahiri [7] introduced sg-closed sets in 1987. Arya and Nour [8] defined gs-closed sets in 1990. N. jasted [2] introduced the concepts of α-closed sets for topological spaces in 1965. Maki *et al* generalized α-closed sets to αg-closed sets [13] and αg-closed sets [15] in 1993 and 1994 respectively. Dontchev [16] (resp. Palaniappan and Rao [14], Gnanambal [18]) introduced gsp-closed (resp. rg-closed, gpr-closed) sets in 1995 (resp. 1993, 1997). Veera Kumar introduced $\hat{g}$-closed sets [22], ψ-closed sets [20], *g-closed sets [25], g*-closed sets [21]. Manoj *et al.* introduced the concepts of $\hat{\hat{g}}$-closed sets [24] in 2007.

In this paper we study relationships of $\overline{g}$-closed sets with the above mentioned sets.

Norman Levine [3], Bhattacharya and Lehiri [7] and Devi *et al*. [12] introduced $T_{1/2}$-spaces, semi-$T_{1/2}$ spaces and T_b and T_d-spaces respectively. Devi *et al* [19] again introduce ${}_\alpha T_b$-spaces and ${}_\alpha T_d$-spaces. Veera Kumar introduced T_f-spaces [22], $\hat{T}_b$-spaces and ${}_\alpha\hat{T}_b$-spaces [23], $T^*_{1/2}$-spaces and ${}^*T_{1/2}$-spaces [21]. Recently Manoj *et al*. [24] introduced $\hat{T}_f$-spaces.

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We introduce and study new classes of spaces, namely the class of $\overline{T}$-spaces, the class of $\overline{T}^*$-spaces and the class of ${}^*\overline{T}$-spaces. Further we characterize and study some relationships of these spaces with the above defined spaces.

We also introduced $\overline{g}$-continuous maps, $\overline{g}$-irresolute maps and investigate some of their properties.

Throughout this paper (X, τ), (Y, σ) and (Z, η) represent non-empty topological spaces on which no separation axioms are assumed unless or otherwise mentioned. For a subset A of a space (X, τ), cl(A), int(A), pcl(A) and A^c denote the closure of A, the interior of A, pre-closure of A and the complement of A respectively.

Preliminaries

We recall the following definitions which are useful in the sequel.

Definition: A subset A of a topological space (X, τ) is called semi-open [1] (resp. semi-closed, pre-open [5], pre-closed, α-open [2], α-closed, semi-preopen [6], semi-pre closed, regular open [28], regular closed) if $A \subseteq cl(int(A))$ (resp. $int(cl(A)) \subseteq A$, $A \subseteq int(cl(A))$, $cl(int(A)) \subseteq A$, $A \subseteq int(cl(int(A)))$, $cl(int(cl(A))) \subseteq A$, $A \subseteq cl(int(cl(A)))$, $int(cl(int(A))) \subseteq A$, $A = int(cl(A))$, $A = cl(int(A))$).

Definition: A subset A of a topological space (X, τ) is called g-closed [3] (resp. sg-closed[7], gs-closed[8], gα-closed [13], αg-closed [15], rg-closed [14], gpr-closed [18], gsp-closed [16], $\hat{g}$-closed [22], ψ-closed [20], *g-closed [25], $\hat{\hat{g}}$-closed

[24], g*-closed [21], *gs-closed [26], #gs-closed [27]) if cl(A) ⊆ U (resp. scl(A) ⊆ U, scl(A) ⊆ U, αcl(A) ⊆ U, αcl(A) ⊆ U, cl(A) ⊆ U, pcl(A) ⊆ U, spcl(A) ⊆ U, cl(A) ⊆ U, scl(A) ⊆ U, cl(A) ⊆ U, cl(A) ⊆ U, cl(A) ⊆ U, scl(A) ⊆ U, scl(A) ⊆ U) whenever A ⊆ U and U is open (resp. semi-open, open, α-open, open, regular open, regular open, open, semi-open, sg-open, $\hat{g}$-open, sg-open, g-open, $\hat{g}$-open, *g-open) in (X, τ).

The complement of a g-closed (resp. $\hat{g}$-closed, $\hat{\hat{g}}$-closed, *g-closed) set is called g-open (resp. $\hat{g}$-open, $\hat{\hat{g}}$-open, *g-open) set.

Definition: A function f: (X, τ) → (Y, σ) is called g-continuous[10] (resp. sg-continuous[11], gs-continuous [17], αg-continuous [18], rg-continuous [14], gpr-continuous [18], gsp-continuous [16], *g-continuous [23], g*-continuous [21], $\hat{g}$-continuous [23], $\hat{\hat{g}}$-continuous [24], semi-continuous[1], irresolute [4], gc-irresolute [10], sg-irresolute [11], $\hat{g}$-irresolute [23], $\hat{\hat{g}}$-irresolute [24], *g-irresolute [25]) if $f^{-1}(V)$ is g-closed (resp. sg-closed, gs-closed, αg-closed, rg-closed, gpr-closed, gsp-closed, *g-closed, g*-closed, $\hat{g}$-closed, $\hat{\hat{g}}$-closed, semi-closed, semi-closed, gc-closed, sg-closed, $\hat{g}$-closed, $\hat{\hat{g}}$-closed, *g-closed) set in (X, τ) for every closed (resp. closed, closed, closed, closed, closed, closed, closed, closed, closed, closed, closed, closed, semi-closed, gc-closed, sg-closed, $\hat{g}$-closed, $\hat{\hat{g}}$-closed, *g-closed) set in (Y, σ).

Definition: A space (X, τ) is called $T_{1/2}$ [3] (resp. T_b [12], T_d [12], ${}_{\alpha}T_b$ [19], ${}_{\alpha}T_d$ [19], semi-$T_{1/2}$ [7], T_f [22], $\hat{T}_b$ [23], $T^*_{1/2}$ [21], $^*T_{1/2}$ [21], $\hat{T}_f$ [24]) space if every g-closed (resp. gs-closed, gs-closed, αg-closed, αg-closed, sg-closed, g-closed, gs-closed, g*-closed, g-closed, g-closed) set is a closed (resp. closed, g-closed, closed, g-closed, semi-closed, $\hat{g}$-closed, $\hat{g}$-closed, closed, g*-closed, $\hat{\hat{g}}$-closed) set in (Y, σ).

Basic properties of $\overline{g}$-closed sets

In this section we study the relationship of $\overline{g}$-closed sets with other sets.

Definition: A subset A of topological (X, τ) is called $\overline{g}$-closed set if cl(A) ⊆ U whenever A ⊆ U and U is a $\hat{\hat{g}}$-open set in (X, τ).

The complement of $\overline{g}$-closed set is called $\overline{g}$-open set.

Theorem:

1. Every closed (or *g-closed or g*-closed or $\hat{\hat{g}}$-closed) set is $\overline{g}$-closed set.
2. Every $\overline{g}$-closed set is αg-closed (or g-closed or rg-closed or gpr-closed or gs-closed) set.

Next examples show that converse of the above theorem is not true in general.

Example: Let X = {a, b, c}, τ = {ϕ, {a}, {a, b}, X}. Consider A = {a, c} then A is not a closed set. However A is $\overline{g}$-closed set. The set B = {b, c} is αg-closed, rg-closed, gpr-closed and gs-closed set. However B is not a $\overline{g}$-closed set.

Example: Let X = {a, b, c}, τ = {ϕ, {a}, {b, c}, X}. Consider A = {b} then A is not a *g-closed set and g*-closed set. However A is a $\overline{g}$-closed set. The set B = {a, b} is not a $\hat{\hat{g}}$-closed set. However it is $\overline{g}$-closed set.

Therefore the class of $\overline{g}$-closed sets is properly contained in the class of g-closed sets, the class of αg-closed sets, the class of rg-closed sets, the class of gpr-closed sets, the class of gs-closed sets. Also this new class is properly contains the class of closed sets, the class of *g-closed sets, the class of g*-closed sets and the class of $\hat{\hat{g}}$-closed sets.

Remark: $\overline{g}$-closed set is independent from semi-closed sets, sg-closed sets, α-closed sets, ψ-closed sets, #gs-closed sets and *gs-closed sets.

The following examples support the above results.

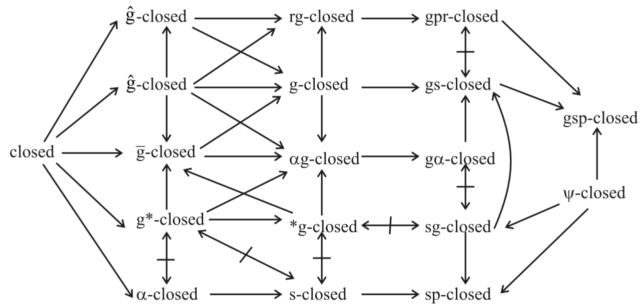
Example: Let X = {a, b, c}, τ = {ϕ, {a}, X}. Consider A = {a, b}, then A is not a semi-closed set. However A is $\overline{g}$-closed set. The set B = {a, b} is a $\overline{g}$-closed set but not sg-closed, ψ-closed and #gs-closed sets.

Example: Let X = {a, b, c}, τ = {ϕ, {a}, {c}, {a, c}, X}. Consider A = {a} then A is not a $\overline{g}$-closed set. However A is semi-closed set. The set B = {a} is sg-closed, ψ-closed and #gs-closed set but not a $\overline{g}$-closed set.

Example: Let X = {a, b, c}, τ = {ϕ, {b}, {b, c}, X}. Consider A = {c} then A is not a $\overline{g}$-closed set. However A is α-closed set. The set B = {a, b} is not α-closed set. However B is $\overline{g}$-closed set.

Example: Let X = {a, b, c}, τ = {ϕ, {a}, {b, c}, X}. Consider A = {a, b} then A is $\overline{g}$-closed set but not *gs-closed set.

The following diagram shows the relationships of $\overline{g}$-closed set with other sets.



Theorem: Intersection of two $\overline{g}$-closed sets is not necessarily $\overline{g}$-closed set.

The following example supports the above theorem.

Example: Let X = {a, b, c, d}, τ = {ϕ, {a, b}, X}. Consider A = {a, c} and B = {a, d} then A and B are $\overline{g}$-closed sets. However their intersection {a} is not a $\overline{g}$-closed set.

Theorem: Union of two $\overline{g}$-closed sets is again a $\overline{g}$-closed sets.

Theorem: If A be a $\overline{g}$-closed set in a space (X, τ) and A $\subseteq$ B $\subseteq$ cl(A) then B is also a $\overline{g}$-closed set.

Theorem: A is $\overline{g}$-closed set of (X, τ) if and only if cl(A) - A does not contain any non-empty $\hat{\hat{g}}$-closed set.

Applications of $\overline{g}$-closed sets

In this section we introduce the following definitions.

Definition: A topological space (X, τ) is called $\overline{T}$-space if every $\overline{g}$-closed set in it is clsoed.

Definition: A topological space (X, τ) is called $\overline{T}^*$-space if every g-closed set in it is **g-closed set.

Theorem: Every T_b-space is $\overline{T}$-space.

The converse of the above theorem is not true as it can be seen from the following example.

Example: In example (3.04), (X, τ) is $\overline{T}$-space but not T_b-space.

Theorem: Every $\hat{T}_b$-space is $\overline{T}$-space.

The converse of the above theorem is not true as it can be seen from the following example.

Example: In example (3.04), (X, τ) is $\overline{T}$-space but not $\hat{T}_b$-space.

Theorem: Every $\overline{T}$-space is $\hat{\hat{T}}_{1/2}$-space.

The converse of the above theorem is not true as it can be seen from the following example.

Example: In example (3.03), (X, τ) is $\hat{\hat{T}}_{1/2}$-space but not $\overline{T}$-space.

Theorem: Every $T_{1/2}$ -space ($_{\alpha}T_b$-space) is $\overline{T}$-space.

Theorem: Every $\hat{T}_f$-space is $\overline{T}^*$-space.

The converse of the above theorem is not true as it can be seen from the following example.

Example: In example (3.03), (X, τ) is $\overline{T}^*$-space but not $\hat{T}_f$-space.

Theorem: Every $^*T_{1/2}$-space and so $^{\alpha}T_c$-space is $\overline{T}^*$-space.

The converse of the above theorem is not true as it can be seen from the following example.

Example: In example (3.03), (X, τ) is $\overline{T}^*$-space but not $^*T_{1/2}$-space.

Theorem: A topological space (X, τ) is $T_{1/2}$-space iff it is $\overline{T}$-space and $\overline{T}^*$-space.

Theorem: Every $\overline{T}$-space is $T^*_{1/2}$-space.

The converse of the above theorem is not true as it can be seen from the following example.

Example: In example (3.02), (X, τ) is $T^*_{1/2}$-space but not $\overline{T}$-space.

Theorem: Every $_{\alpha}T_b$-space is $\overline{T}$-space.

Definition: A space (X, τ) is called $^*\overline{T}$-space if every αg-closed set is $\overline{g}$-closed.

Theorem: Every $_{\alpha}T_b$-space is $^*\overline{T}$-space.

The converse of the above theorem is not true as it can be seen from the following example.

Example: In example (3.02), (X, τ) is $^*\overline{T}$-space but not a $_{\alpha}T_b$-space.

Theorem: Every $^*\overline{T}$-space is $\overline{T}^*$-space.

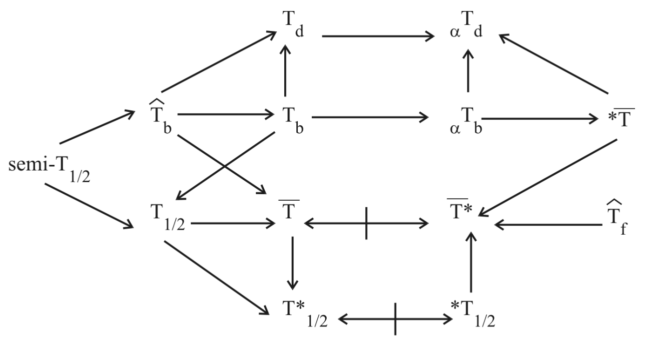
The converse of the above theorem is not true as it can be seen from the following example.

Example: In example (3.01), (X, τ) is $\overline{T}^*$-space but not a $^*\overline{T}$-space.

Theorem: Every $^*\overline{T}$-space is $_{\alpha}T_d$-space.

Remark: $\overline{T}$-space and $^*\overline{T}$-space (or $\overline{T}^*$-space) are independent.

The following diagram shows the relationships between the separation axioms discussed in this section.



Theorem: If (X, τ) is $^*\overline{T}$-space then for each x ϵ X, {x} is either αg-closed or **g-closed.

Theorem: If (X, τ) is $\overline{T}^*$-space then for each x ϵ X, {x} is either closed or **g-closed.

Theorem: A topological space (X, τ) is $\overline{T}$-space iff every singleton of X is either $\hat{\hat{g}}$-closed or open.

$\overline{g}$-continuous and $\overline{g}$-irresolute functions

In this section we introduce the following definitions.

Definition: A function f : (X, τ) $\rightarrow$ (Y, σ) is said to be $\overline{g}$-continuous if the inverse image of every σ-closed set in Y is $\overline{g}$-closed in X.

Example: Let X = {a, b, c} and τ = {ϕ, {a}, {c}, {a, c}, X} and σ = {ϕ, {a}, X}. Define f: (X, τ) $\rightarrow$ (X, σ) by identity mapping then f is $\overline{g}$-continuous mapping.

Definition: A function f : (X, τ) $\rightarrow$ (Y, σ) is said to be $\overline{g}$-irresolute if the inverse image of every $\overline{g}$-closed set in Y is $\overline{g}$-closed in X.

Example: Let X = {a, b, c} and $\tau = \{\phi, \{a\}, \{b, c\}, X\}$ and $\sigma = \{\phi, \{a\}, \{b\}, \{a, b\} X\}$. Define f: $(X, \tau) \to (X, \sigma)$ by identity mapping then f is $\overline{g}$-irresolute mapping.

Theorem:

1. Every $\overline{g}$-irresolute map is $\overline{g}$-continuous map.
2. Every continuous map is $\overline{g}$-continuous map.
3. Every *g-continuous (or g*-continuous or $\hat{\hat{g}}$-continuous) map is $\overline{g}$-continuous map.
4. Every $\overline{g}$-continuous map is αg-continuous (or rg-continuous or gpr-continuous or gs-continuous) map.
5. Every $\overline{g}$-continuous map is g-continuous (or **gs-continuous) map.

The converse of the above theorem is not true as it can be seen from the following example.

Example: The function f in example (5.01) is $\overline{g}$-continuous but not $\overline{g}$-irresolute.

Example: Let X = {a, b, c}, $\tau = \{\phi, \{b\}, \{a, c\}, X\}$ and $\sigma = \{\phi, \{a\}, X\}$. Define f: $(X, \tau) \to (X, \sigma)$ by f(a) = a, f(b) = b and f(c) = c then f is $\overline{g}$-continuous but not continuous.

Example: Let X = {a, b, c}, $\tau = \{\phi, \{a\}, \{b, c\}, X\}$ and $\sigma = \{\phi, \{c\}, \{a, c\}, \{b, c\}, X\}$. Define f: $(X, \tau) \to (X, \sigma)$ by f(a) = b, f(b) = a and f(c) = c then f is $\overline{g}$-continuous but not *g-continuous and $\hat{\hat{g}}$-continuous.

Example: Let X = {a, b, c}, $\tau = \{\phi, \{a\}, \{a, b\}, X\}$ and $\sigma = \{\phi, \{a\}, \{a, b\}, \{a, c\}, X\}$. Define f: $(X, \tau) \to (X, \sigma)$ by identity map then f is αg-continuous, rg-continuous, gpr-continuous, gs-continuous and **gs-continuous but not $\overline{g}$-continuous.

Therefore the class of $\overline{g}$-continuous maps properly contains the class of continuous maps, the class of *g-continuous maps, the class of g*-continuous maps and the class of $\hat{\hat{g}}$-continuous maps and it is properly contained in the class of g-continuous maps, the class of αg-continuous maps, the class of rg-continuous maps, the class of gpr-continuous maps, the class of gs-continuous maps and the class of **gs-continuous maps.

Remarks: The composition of two $\overline{g}$-continuous function need not be $\overline{g}$-continuous again. For consider the following example.

Example: Let X = {a, b, c}, $\tau = \{\phi, \{a\}, \{b\}, \{a, b\}, X\}$, $\sigma = \{\phi, \{b\}, X\}$ and $\eta = \{\phi, \{a\}, \{b, c\}, X\}$. Define f: $(X, \tau) \to (X, \sigma)$ by f(a) = c, f(b) = b and f(c) = a. Define g : $(X, \sigma) \to (X, \eta)$ by g(a) = c, g(b) = b and g(c) = a. then f and g are $\overline{g}$-continuous for {a} is closed in (X, η) but $(gof)^{-1}(\{a\}) = f^{-1}(g^{-1}(\{a\})) = f^{-1}(\{c\}) = \{a\}$ is not a $\overline{g}$-closed set in (X, τ). Hence gof is not a $\overline{g}$-continuous.

Theorem: The composition of two $\overline{g}$-irresolute function is again $\overline{g}$-irresolute.

Theorem: Let f: $(X, \tau) \to (Y, \sigma)$ be an irresolute and closed then A is $\overline{g}$-closed in (X, τ) implies f(A) is $\overline{g}$-closed in (Y, σ).

Remarks: $\overline{g}$-continuity and semi-continuity are independent as seen from the following examples.

Example: Let X = {a, b, c}, $\tau = \{\phi, \{a\}, X\}$ and $\sigma = \{\phi, \{a\}, \{c\}, \{a, c\}, X\}$. Define f: $(X, \tau) \to (X, \sigma)$ by f(a) = a, f(b) = c and f(c) = b. Then f is not a semi-continuous. However f is $\overline{g}$-continuous.

Example: Let X = {a, b, c}, $\tau = \{\phi, \{a\}, \{b\}, \{a, b\}, X\}$ and $\sigma = \{\phi, \{a\}, \{a, b\}, \{a, c\}, X\}$. Define f: $(X, \tau) \to (X, \sigma)$ by identity mapping. Then f is not a $\overline{g}$-continuous. However f is semi-continuous.

Remarks: $\overline{g}$-continuity and sg-continuity (or ψ-continuity or #gs-continuity) are independent as seen from the following examples.

Example: Let X = {a, b, c}, $\tau = \{\phi, \{a\}, \{c\}, \{a, c\}, X\}$ and $\sigma = \{\phi, \{a\}, \{c\}, \{a, b\}, \{a, c\}, X\}$. Define f: $(X, \tau) \to (X, \sigma)$ by identity mapping then f is not a $\overline{g}$-continuous, however f is sg-continuous (or ψ-continuous or #gs-continuous).

Example: Let X = {a, b, c}, $\tau = \{\phi, \{a\}, X\}$ and $\sigma = \{\phi, \{a\}, \{b\}, \{a, b\}, X\}$. Define f: $(X, \tau) \to (X, \sigma)$ by identity mapping. Then f is $\overline{g}$-continuous but not sg-continuous (or ψ-continuous or #gs-continuous).

Theorem: If f: $(X, \tau) \to (Y, \sigma)$ is $\overline{g}$-continuous and Y is T_u –space then f is $\overline{g}$-irresolute.

Theorem: Let (X, τ), (Y, σ) and (Z, η) be any three topological spaces. Let f: $(X, \tau) \to (Y, \sigma)$ and g : $(Y, \sigma) \to (Z, \eta)$ be any two functions then gof: $(X, \tau) \to (Z, \eta)$ is

1. $\overline{g}$-continuous if g is continuous and f is $\overline{g}$-continuous.
2. $\overline{g}$-irresolute if g is $\overline{g}$-irresolute and f is $\overline{g}$-irresolute.
3. $\overline{g}$-continuous if g is $\overline{g}$-continuous and f is $\overline{g}$-irresolute.
4. g-continuous if g is $\overline{g}$-continuous and f is gc-irresolute.

Theorem: Let f: $(X, \tau) \to (Y, \sigma)$ be a $\overline{g}$-continuous map. If (X, τ) is T_u-space then f is continuous.

Theorem: Let f: $(X, \tau) \to (Y, \sigma)$ be an αg-continuous map. If (X, τ) is ${}_{\alpha}T_u$-space then f is $\overline{g}$-continuous.

Theorem: Let f: $(X, \tau) \to (Y, \sigma)$ be a g-continuous map. If (X, τ) is T_u^*-space then f is $\overline{g}$-continuous.

Theorem: Let f: $(X, \tau) \to (Y, \sigma)$ be onto, $\overline{g}$-irresolute and closed map. If (X, τ) is T_u-space then (Y, σ) is also a T_u-space.

Theorem: Let f: $(X, \tau) \to (Y, \sigma)$ be $\hat{\hat{g}}$-irresolute and closed map. Then f(A) is a $\overline{g}$-closed set of (Y, σ) for every $\overline{g}$-closed set A of (X, τ).

Theorem: Let f: $(X, \tau) \to (Y, \sigma)$ be onto, gc-irresolute and pre-$\overline{g}$-closed map. If (X, τ) is $\overline{T}^*$-space then (Y, σ) is also a $\overline{T}^*$-space.

Theorem: Let f: $(X, \tau) \to (Y, \sigma)$ be onto, αg-irresolute and pre-$\overline{g}$-closed map. If (X, τ) is ${}^*\overline{T}$-space then (Y, σ) is also a ${}^*\overline{T}$-space.

References

1. Levine N. : Semi open sets and semi continuity in topological spaces, *Amer. Math. Monthly*, 70 (1963), 36-41.
2. Njasted O. : On some classes of nearly open sets, *Pecific J. Math.*, 15 (1965), 961-970.
3. Levine N : Generalized closed sets in topology, *Rend. Circ. Mat. Palermo*, 19 (1970), 89-96.
4. Crossley S.G. and Hilbebrand S.K. : Semi topological properties, *Fund. Math.*, 74 (1974), 233-254.
5. Mashhour A.S., ABDEL-Monsef M.E. and El-deeb S.N. : On pre-continuous and Weak Pre-continuous mapping, *proc. Math., Soc. Egypt*, 53 (1982), 47-53.
6. Andri Jevic D., Semi-preopen sets *Mat. Vesnik*, 38(1) (1986) 24-32.
7. Bhattacharya P. and Lahiri B.K. : Semi generalized closed sets in a topology, *Indian J. Math.* 29 (3), (1987) 375.
8. Arya S.P. and Tour N. : Characterizations of s-normal spaces, *Indian J. Pure Applied Math.*, 21(8) (1990), 717-719.
9. Maki H Sundaram P. and Balachandran K. : On generalized home. in topological spaces *Bul. Fukuoka Univ. Ed. Part III.* 40 (1991), 23-31.
10. Balachandran K., Sundaram P. and Maki H.: On generalized continuous maps in topological space, *Mem. Fac. Sci. Kochi Univ. Ser. A. Math. 12(1991), 5-13.*
11. Sundaram P., Maki H. and Balachandran K.: Semi-generalized continuous maps and semi-$T_{1/2}$ spaces *Bull. Fukukoa Univ. Ed. Part-III*, 40(1991), 33-40.
12. Devi R., Maki H and Balachandran K. : Semi generalized closed maps and generalized semi closed maps *Mem. Fac. Sci. Kochi Univ. Ser. A. Math.* 14, (1993), 41-54.
13. Maki H, Devi R. and Balachandran K. : Generalized α-closed sets in topology, *Bull. Fukuoka Univ. Ed. Part-III*, 42(1993), 13-21.
14. Palaniappan N. and Rao K.C., Regular generalized closed sets, *Kyungpook Math. J.* 33(2), (1993), 211-219.
15. Maki H, Devi R. and Balachandran K. : Associated topologies of generalized α-closed sets and α-generalized closed sets, *Mem, Sci. Kochi Univ. Ser. A. Math.* 15 (1994), 51-63.
16. Dontchev. J. on generalizing semi-preopen sets, *Mem. Fac. Sci. Kochi Univ. Ser. A. Math.* 16(1995), 35-38.
17. Devi R., Maki H and Balachandran K. : Semi generalized homeomorphism and generalized semi homeomorphism in topological spaces, *Indian J. Pure Applied. Math.* 26, (3) (1995), 271-284.
18. Gnanambal Y : On generalized pre-regular closed sets in topological spaces, *Indian J. Pure appl. Math.* 28(3) (1997), 351-360.
19. Devi R., Balachandran K. and Maki H. : Generalized α-closed maps and α-generalized closed maps, *Indian J. Pure Appl. Math.*, 29(1), (1998), 37-49.
20. Veera Kumar M.K.R.S. : Between semi closed sets and semi pre-closed sets, *Rend. Instint. Math. Univ. Trieste (Italy)*XXXII (2000), 25-41.
21. Veera Kumar M.K.R.S. : Between closed sets and g-closed sets, *Mem. Fac Sci. Kochi.Univ. Japan. Ser. Math.* 20 (2000), 1-19.
22. Veera Kumar M.K.R.S. : $\hat{g}$-closed set and $\hat{G}$ LC-functions *Indian J. Math.*, 43 (2001), 231-247.
23. Veera Kumar M.K.R.S. : $\hat{g}$ -closed sets in topological spaces, *Bulletin Allahabad Maths. Soc.* 18 (2003), 99-112.
24. Garg. M., Agarwal S. and Goel C.K., on $\hat{\hat{g}}$-closed sets in topological spaces, *Acta., Cinecia Indica* vol. XXXII M., 4 (2007) 1643-1652.
25. Veera Kumar M.K.R.S. : Between g*-closed sets and g-closed sets, *Antarktika J. Math., (reprint)*
26. Veera Kumar M.K.R.S. : #g-closed sets in topological spaces, *Antarktika J. Math.*, 2(2), (2005), 239-258.
27. Veera Kumar M.K.R.S. : #gs-closed sets in topological spaces, *Antarktika J. Math.*, 2(2), (2005), 201-222.
28. Garg. M., Khare S.K., Agarwal S. and goel c. k. : On **g-closed sets in topological spaces *Ultra Sci.*20(2)M(2008), 403-416.

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