International Journal of Mathematical Archive-4(5), 2013, 274-279
IJMA Available online through www.ijma.info ISSN 2229 – 5046

GENERALIZED ζ^*-CLOSED SETS IN TOPOLOGICAL SPACES

[1]V. Kokilavani, [2]M. Myvizhi* and [3]M. Vivek Prabu

[1]*Assistant Professor, Dept. of Mathematics, Kongunadu Arts and Science College, Coimbatore, Tamilnadu, India*

[2]*Assistant Professor, Dept. of Mathematics, Tejaa Shakthi Institute of Technology for Women Coimbatore, Tamilnadu, India*

[3]*Research Scholar, Kongunadu Arts and Science College – Coimbatore, Tamilnadu, India*

(Received on: 29-03-13; Revised & Accepted on: 30-04-13)

ABSTRACT

In this paper, we introduce the notion of $g\zeta^*$-closed sets in topological spaces and investigate some of their properties and we construct a group of $g\zeta^*c$- homeomorphisms which contains the group of all homeomorphisms as a subgroup.

Keywords: *$g\zeta^*$-closed set, $g\zeta^*$-continuous function, $g\zeta^*$-irresolute and $g\zeta^*$-homeomorphism.*

1. INTRODUCTION

Levine [1, 2] introduced the concept of generalized closed sets and semi-closed sets in topological spaces. Maki *et al.*, introduced generalized α-closed sets (brieflygα-closed sets) [3] and α-generalized closed sets (briefly αg-closed sets) [4] respectively. In section 3 and 4 of this paper, we introduce the concept of $g\zeta^*$-closed set and obtain some properties of this set. In section 5 and 6, we introduce the concept of $g\zeta^*$-continuous functions and $g\zeta^*$-irresolute functions. For a topological space(X,τ), we define groups $g\zeta^*\mathrm{h}(X,\tau)$, $g\zeta^*\mathrm{ch}(X,\tau)$ and they contain the group $\mathrm{h}(X,\tau)$ whose elements are all homeomorphisms from (X,τ) into itself.

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),$cl\ (A)$ and int(A) denote the closure of A and interior of A.

2. PRELIMINARIES

In this section we recall some of the basic definitions.

Definition 2.1: A subset A of space (X,τ) is called
(i) Semi-open set [1] if $A \subseteq cl\ (int\ (A))$.
(ii) Pre-open set [5] if $A \subseteq int\ (cl\ (A))$.
(iii) α-open set [6] if $A \subseteq int\ (cl\ (int\ (A)))$.
The complement of a semi-open (resp.pre-open, α-open) set is called semi-closed (resp.pre-closed, α-closed).

Definition 2.2: A subset A of (X,τ) is called
(i) generalized closed (briefly g-closed)set[2] if$cl\ (A) \subseteq U$ whenever $A \subseteq U$ and U is open set in (X,τ).
(ii) generalized semi-closed (briefly gs-closed) set [7] if $scl\ (A) \subseteq U$ whenever $A \subseteq U$ and U is open set in(X,τ).
(iii) α-generalized closed (briefly αg-closed) set [4] if $\alpha cl\ (A) \subseteq U$ whenever $A \subseteq U$ and U is open set in (X, τ).
(iv) generalized α-closed (briefly $g\alpha$-closed) set [3] if $\alpha cl\ (A) \subseteq U$ whenever $A \subseteq U$ and U is α-open set in(X,τ).
(v) generalized pre-closed set (briefly gp-closed) set [8] if $pcl\ (A) \subseteq U$ whenever $A \subseteq U$ and $U$is open set in(X,τ).
(vi) a generalized #α-closed set (briefly g#α-closed) [16] if $\alpha cl(A) \subseteq U$ whenever $A \subseteq U$ and U is g-open in (X,τ).
(vii) a #generalized α-closed set (briefly #gα-closed) [17] if $\alpha cl(A) \subseteq U$ whenever $A \subseteq U$ and U is a g#α-open in (X,τ).

Corresponding author: [2]*M. Myvizhi**
[2]*Assistant Professor, Dept. of Mathematics, Tejaa Shakthi Institute of Technology for Women, Coimbatore, Tamilnadu, India*

The complements of the above sets are called their respective open sets.

Definition2.3: A function $f: (X,\tau) \rightarrow (Y,\sigma)$ is called
(i) α-continuous [9] if $f^{-1}(V)$ is α-closed in (X,τ) for every closed set V of (Y,σ).
(ii) g-continuous [10] if $f^{-1}(V)$ is g-closed in (X,τ) for every closed set V of (Y,σ).
(iii) gs-continuous [11] if $f^{-1}(V)$ is gs-closed in (X,τ) for every closed set V of (Y,σ).
(iv) $g\alpha$-continuous [3] if $f^{-1}(V)$ is $g\alpha$-closed in (X,τ) for every closed set V of (Y,σ).
(v) αg-continuous [4] if $f^{-1}(V)$ is αg-closed in (X,τ) for every closed set V of (Y,σ).
(vi) g''-continuous [12] if $f^{-1}(V)$ is g''-closed in (X,τ) for every closed set V of (Y,σ).
(vii) gp-continuous [8] if $f^{-1}(V)$ is gp-closed in (X,τ) for every closed set V of (Y,σ).
(viii) $g^{\#}\alpha$-*continuous* [16] if $f^{-1}(V)$ is $g^{\#}\alpha$-closed in (X,τ) for every closed set V of (Y,σ).
(ix) ${}^{\#}g\alpha$-*continuous* [17] if $f^{-1}(V)$ is ${}^{\#}g\alpha$-closed in (X,τ) for every closed set V of (Y,σ).

3. $g\zeta^*$-CLOSED SETS IN TOPOLOGICAL SPACES

We introduce the following definition.

Definition 3.1: [13] A subset A of a space (X,τ) is called $g\zeta^*$-closed if $\alpha cl\,(A) \subseteq U$ whenever $A \subseteq U$ and U is ${}^{\#}g\alpha$-open set in (X,τ)

Proposition 3.2: Every closed set is $g\zeta^*$-closed set but not conversely.

Proof: Let A be a closed set and U be a ${}^{\#}g\alpha$-open set containing A. Since A is closed, we have $\alpha cl(A) \subseteq cl(A) = A \subseteq U$.Therefore $\alpha cl(A) \subseteq U$ and hence A is $g\zeta^*$-closed set.

Remark 3.3: The converse of the above theorem is not true as shown in the following example.

Example 3.4: Let $X = \{a,b,c\}$ and $\tau = \{\emptyset, X, \{a,b\}\}$. The set $\{a,c\}$ is $g\zeta^*$-closed set but not closed set.

Proposition 3.5: Every α-closed set is $g\zeta^*$-closed set but not conversely.

Proof: Let A be an α-closed set and U be a ${}^{\#}g\alpha$-open set containing A. Since A is α-closed, we have $\alpha cl(A) = A \subseteq U$. Therefore $\alpha cl(A) \subseteq U$ and hence A is $g\zeta^*$-closed set.

Example 3.6: Let $X = \{a,b,c\}$ and $\tau = \{\emptyset, X, \{a,b\}\}$. The set $\{b,c\}$ is $g\zeta^*$-closed set but not α-closed set.

Proposition 3.7: Every $g\zeta^*$-closed set is αg-closed set is but not conversely.

Proof: Let A be a $g\zeta^*$-closed set and U be any open set containing A. Since every open set is α-open and every α-open set is ${}^{\#}g\alpha$–open. Therefore every open set is ${}^{\#}g\alpha$–open [14]. We have $\alpha cl(A) \subseteq U$. Hence A is αg-closed set.

Example 3.8: Let $X = \{a,b,c\}$ and $\tau = \{\emptyset, X, \{a\}, \{b,c\}\}$. The set $\{b\}$ is αg-closed but not $g\zeta^*$-closed set.

Proposition 3.9: Every $g\zeta^*$-closed set is $g\alpha$-closed set is but not conversely.

Proof: Let A be a $g\zeta^*$-closed set and U be every α-open set containing A. Since every α-open set is ${}^{\#}g\alpha$–open. We have $\alpha cl(A) \subseteq U$. Hence A is $g\alpha$-closed set.

Example 3.10: Let $X = \{a,b,c\}$ and $\tau = \{\emptyset, X, \{a\}, \{b,c\}\}$. The set $\{a,b\}$ is $g\alpha$-closed but not $g\zeta^*$-closed set.

Proposition 3.11: Every $g\zeta^*$-closed set is gs-closed set is but not conversely.

Proof: Let A be a $g\zeta^*$-closed set and U be an open set containing A. Since every open set is ${}^{\#}g\alpha$–open, we have $scl(A) \subseteq \alpha cl(A) \subseteq U$.Therefore $scl(A) \subseteq U$.Hence A is gs-closed set.

Example 3.12: Let $X = \{a,b,c\}$ and $\tau = \{\emptyset, X, \{a\}, \{a,b\}\}$. The set $\{a,c\}$ is gs-closed but not $g\zeta^*$-closed set.

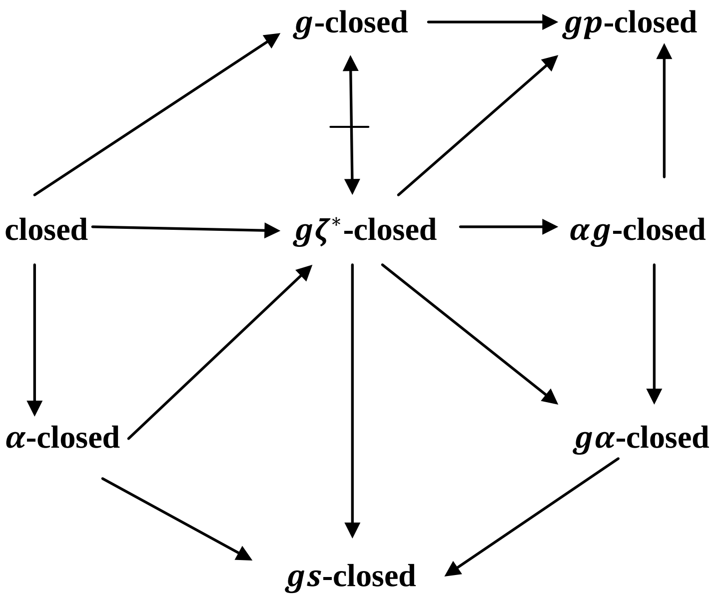
Proposition 3.13: Every $g\zeta^*$-closed set is gp-closed set is but not conversely.

Proof: Let A be a $g\zeta^*$-closed set and U be an open set containing A. Since every open set is ${}^{\#}g\alpha$–open, we have $pcl(A) \subseteq \alpha cl(A) \subseteq U$[15]. Therefore $pcl(A) \subseteq U$.Hence A is gp-closed set.

Example 3.14: Let $X = \{a, b, c\}$ and $\tau = \{\emptyset, X, \{a, b\}\}$. The set $\{b\}$ is gp-closed but not $g\zeta^*$-closed set.

Remark 3.15: The following examples show that $g\zeta^*$-closeness is independent on g-closeness.

Example 3.16: Let $X = \{a, b, c\}$ and $\tau = \{\emptyset, X, \{a\}, \{a, b\}\}$, The set {b} is $g\zeta^*$-closed but not g-closed.



Remark 3.17: The following diagram shows that the relationships of $g\zeta^*$-closed sets with other known existing sets. $A \to B$ represents A *implies* B but not conversely.

4. BASIC PROPERTIES OF $g\zeta^*$ CLOSED SETS

Theorem 4.1: If A and B are $g\zeta^*$-closed in X then, $A \cup B$ is $g\zeta^*$ closed in X.

Proof: Let A and B be any two $g\zeta^*$-closed in X and U be any $^{\#}g\alpha$ –open set containing A and B. we have $\alpha cl(A) \subseteq U$ and $\alpha cl(B) \subseteq U$. Thus $\alpha cl(A) \cup \alpha cl(B) \subseteq U$. Hence $A \cup B$ is $g\zeta^*$-closed in X.

Theorem 4.2: If a set A is $g\zeta^*$-closed, then $\alpha cl(A) - A$ contains no non-empty $^{\#}g\alpha$ –closed set.

Proof: Suppose that A is $g\zeta^*$-closed set. Let U be a $^{\#}g\alpha$ –closed set contained in $\alpha cl(A) - A$. Now U^c is $^{\#}g\alpha$ –open set of (X, τ) such that $A \subseteq U^c$. Since A is $g\zeta^*$ closed set of (X, τ), then $\alpha cl(A) \subseteq U^c$. Thus $U \subseteq (\alpha cl(A))^c$. Also $U \subseteq \alpha cl(A) - A$. Therefore $U \subseteq \left(\alpha cl(A)\right)^c \cap \left(\alpha cl(A)\right) = \emptyset$ and hence $U = \emptyset$.

Theorem 4.3: If A is $^{\#}g\alpha$ –open and $g\zeta^*$-closed subset of (X, τ) then A is an α-closed subset of X.

Proof: Since A is $^{\#}g\alpha$ –open and $g\zeta^*$-closed, $\alpha cl(A) \subseteq A$. Then A is α-closed.

Theorem 4.4: Let A be a $g\zeta^*$-closed subset of X. If $A \subseteq B \subseteq \alpha cl(A)$, then B is also an $g\zeta^*$-closed subset of X.

Proof: Let U be a $^{\#}g\alpha$ –open set of X such that $B \subseteq U$. Then $A \subseteq U$. Since A is an $g\zeta^*$-closed set $\alpha cl(A) \subseteq U$. Also $B \subseteq \alpha cl(A)$, $\alpha cl(B) \subseteq \alpha cl(A) \subseteq U$. Hence B is also an $g\zeta^*$-closed subset of X.

Theorem 4.5: Let A be an $g\zeta^*$-closed set in X. Then A is α-closed iff $\alpha cl(A) - A$ is closed.

Proof: Necessity: Let A be an $g\zeta^*$-closed subset of X. Then $\alpha cl(A) = A$ and so $\alpha cl(A)$-$A = \emptyset$
which is closed.

Sufficiency: Since A is $g\zeta^*$-closed, by theorem 4.2, $\alpha cl(A) - A$ contains no non-empty $^{\#}g\alpha$-closed set. But $\alpha cl(A) - A$ is closed. This implies $\alpha cl(A) - A = \emptyset$. That is $\alpha cl(A) = A$. Hence A is α-closed.

5. GENERALIZED ζ^*-CONTINUOUS MAP

Definition 5.1: A function$f: (X, \tau) \rightarrow (Y, \sigma)$ is called$g\zeta^*$-continuous if $f^{-1}(V)$is a $g\zeta^*$-closed set of (X, τ) for every closed set V of (Y, σ).

Theorem 5.2: Every α-continuous map is $g\zeta^*$-continuous.

Proof: Let V be a closed set of (Y, σ). Since f is a α-continuous map, $f^{-1}(V)$ is α-closed in (X, τ).

Every α-closed set is$g\zeta^*$-closed set. Therefore$f^{-1}(V)$is a$g\zeta^*$-closed set of (X, τ).

Hence f is a $g\zeta^*$-continuous map.

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

Example 5.3: Let $X = Y = \{a, b, c, d\}, \tau = \{X, \phi, \{a\}, \{b\ , c\}, \{a, b, c\}\}$ and $\sigma = \{Y, \phi, \{a, c\}\}$.

Let $f: (X, \tau) \rightarrow (Y, \sigma)$ be defined by $f(a) = a, f(b) = b, f(c) = c$ and $f(d) = d$.

Therefore f is not α-continuous. However f is $g\zeta^*$-continuous.

Theorem 5.4:
(i) Every g''-continuous map is $g\zeta^*$-continuous.
(ii) Every $g\zeta^*$-continuous map is $g\alpha$-continuous, gp-continuous, gs-continuous, αg-continuous.

Proof: It is obvious.

The converses of the above theorems need not be true by the following example.

Example 5.5: (i) Let $X = Y = \{a, b, c\}, \tau = \{X, \phi, \{b\}\}$ and $\sigma = \{Y, \phi, \{a\}\}$. Let $f: (X, \tau) \rightarrow (Y, \sigma)$ be defined by $f(a) = b, f(b) = a$, and$f(c) = c$. Therefore f is not g''-continuous.

However f is $g\zeta^*$-continuous.

(ii) Let $X = Y = \{a, b, c\}, \tau = \{X, \phi, \{a\}\}$ and $\sigma = \{Y, \phi, \{b\}\}$. Let $f: (X, \tau) \rightarrow (Y, \sigma)$ be defined by $f(a) = a, f(b) = b$ and $f(c) = c$. Therefore f is not $g\zeta^*$-continuous.

However f is gp-continuous, gs-continuous and αg-continuous.

6. GENERALIZED ζ^*-IRRESOLUTE MAP

Definition 6.1: A function$f: (X, \tau) \rightarrow (Y, \sigma)$ is called $g\zeta^*$-irresoluteif $f^{-1}(V)$ is a $g\zeta^*$-closed set of (X, τ) for every $g\zeta^*$-closed set V of (Y, σ).

Theorem 6.2: Every $g\zeta^*$-irresolute map is $g\zeta^*$-continuous.

Proof: Let V be a closed set of (Y, σ) and hence it is $g\zeta^*$-closed set.Since f is $g\zeta^*$-irresolute, $f^{-1}(V)$ is a$g\zeta^*$-closed set of (X, τ).

Hence f is a $g\zeta^*$-continuous map.

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

Example 6.3: Let $X = Y = \{a, b, c\}, \tau = \{X, \phi, \{b\ , c\}\}$ and $\sigma = \{Y, \phi, \{a\}\}$. Let $f: (X, \tau) \rightarrow (Y, \sigma)$ be defined by $f(a) = b, f(b) = a$ and $f(c) = c$. Then f is not $g\zeta^*$-irresolute,since$\{c\}$ is a $g\zeta^*$-closed set of (Y, σ), but $f^{-1}(\{c\})$ is not a $g\zeta^*$-closed setof(X, τ).

However f is $g\zeta^*$-continuous.

Theorem 6.4: If $f: (X, \tau) \rightarrow (Y, \sigma)$ and $g: (Y, \sigma) \rightarrow (Z, \eta)$ are $g\zeta^*$-irresolute, then the composition $g \circ f: (X, \tau) \rightarrow (Z, \eta)$ is $g\zeta^*$-irresolute.

Proof: It is obvious.

7. GENERALIZED$\zeta^* c$-HOMEOMORPHISM AND THEIR GROUP STRUCTURE

Definition 7.1: A function $f: (X, \tau) \to (Y, \sigma)$ is said to be
(i) $g\zeta^*$-open if the image $f(U)$ is $g\zeta^*$-open in (Y, σ) for every open set U of (X, τ).
(ii) $g\zeta^*$-closed if the image $f(U)$ is $g\zeta^*$-closed in (Y, σ) for every open set U of (X, τ).
(iii) $g\zeta^* c$-homeomorphism if f is bijective and f and f^{-1} are $g\zeta^*$-irresolute.
(iv) $g\zeta^*$-homeomorphism if f is bijective and f and f^{-1} are $g\zeta^*$-continuous.

Theorem 7.2:
(i) Suppose that f is a bijection, then the following conditions are equivalent.
(a) f is a $g\zeta^*$-homeomorphism.
(b) f is a $g\zeta^*$-open and $g\zeta^*$-continuous.
(c) f is a $g\zeta^*$-closed and $g\zeta^*$-continuous.
(ii) If f is a homeomorphism, then f and f^{-1} are $g\zeta^*$-irresolute.
(iii) Every $g\zeta^* c$-homeomorphism is a $g\zeta^*$-homeomorphism.

Proof:
(i) It is obvious.
(ii) First we prove that f^{-1} is $g\zeta^*$-irresolute. Let A be a $g\zeta^*$-closed set of (X, τ). To show $(f^{-1})^{-1}(A) = f(A)$ is $g\zeta^*$-closed set in (Y, σ). Let U be a $g\zeta^*$-open set such that $f(A) \subseteq U$.

Then $A = (f^{-1}(f(A))) \subseteq f^{-1}(U)$ and $f^{-1}(U)$ is ${}^{\#}g\alpha$ −open. Since A is $g\zeta^*$-closed, $\alpha cl(A) \subseteq f^{-1}(U)$, we have $\alpha cl(f(A)) = f(\alpha cl(A)) \subseteq f(f^{-1}(U)) \subseteq U$ and so $f(A)$ is $g\zeta^*$-closed. Thus f^{-1} is $g\zeta^*$-irresolute. Since f^{-1} is also a homeomorphism $(f^{-1})^{-1} = f$ is $g\zeta^*$-irresolute.
(iii) It is proved by Theorem6.2.

Theorem 7.3: For a topological space (X, τ) we define the following three collections of functions.
(i) $g\zeta^* ch\,(X, \tau) = \{f / f: (X, \tau) \to (X, \tau)$ is a $g\zeta^* c$-homeomorphism$\}$.
(ii) $g\zeta^* h\,(X, \tau) = \{f / f: (X, \tau) \to (X, \tau)$ is a $g\zeta^*$-homeomorphism$\}$.
(iii) $h\,(X, \tau) = \{f / f: (X, \tau) \to (X, \tau)$ is a homeomorphism$\}$.

Theorem 7.4: For a topological space (X, τ) the following properties hold.
(i) $h\,(X, \tau)\ g\zeta^* ch\,(X, \tau)\ g\zeta^* h\,(X, \tau)$.
(ii) The set $g\zeta^* ch\,(X, \tau)$ forms a group under composition of functions.
(iii) The group $h\,(X, \tau)$ is subgroup of $g\zeta^* ch\,(X, \tau)$.
(iv) If f: (X, τ) → (Y, σ) is a $g\zeta^* c$-homeomorphism then it induces an isomorphism $f^*: g\zeta^* ch\,(X, \tau) \to g\zeta^* ch(Y, \sigma)$.

Proof:
(i) It is proved by using Theorem 5.2, Theorem 6.2 and a fact that every *continuous* map is α*-continuous.*

(ii) It is proved by using Theorem6.4; for any element, $a, b \in g\zeta^* ch\,(X, \tau)$, the following binary operation
$w: g\zeta^* ch\,(X, \tau) \times g\zeta^* ch\,(X, \tau) \to g\zeta^* ch\,(X, \tau)$ is well defined $w(a, b) = b$ o a.

(iii) By (i), $h\,(X, \tau) \subseteq g\zeta^* ch\,(X, \tau)$ and $h\,(X, \tau) \neq \emptyset$. For any elements $a, b \in h\,(X, \tau)$ and the binary operation w in

(ii), it is shown that $w(a, b^{-1}) = b^{-1}a \in h\,(X, \tau)$.

(iv)We define $f: g\zeta^* ch\,(X, \tau) \to g\zeta^* ch\,(Y, \sigma)$ by $f * (h) = fohof^{-1}$. Then using Theorem6.4, we have that $(h) \in g\zeta^* ch\,(X, \tau)$. It is shown that $f *$ is a required group isomorphism.

REFERENCES

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

[2] N. Levine, Generalized Closed Sets in Topology, *Rend. Circ. Math. Palermo, 19, (1970), 89-96.*

[3] H. Maki, R. Devi, and K. Balachandran, Generalizedα- Closed Sets in Topology, *Bull. Fukuoka Univ. Ed. Part III, 42, (1993), 13-21.*

[4] H. Maki, R. Devi, and K. Balachandran, Associated Topologies of Generalized α- Closed Sets and α-Generalized Closed Sets, *Mem. Fac. Sci. Kochi Univ. Ser-A Math., 14, (1994), 51-63.*

[5] A. S. Mashhour, M.E Abd El-Monsef and S. N. El-Debb, On precontinuous and weak precontinuous mappings, *Proc. Math. and Phys. Soc. Egypt 55, (1982), 47-53.*

[6] O Njastad, On some classes of nearly open sets, *Pacific J Math., 15(1965), 961-970.*

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

[8] H. Maki., Umehara. J. and Noiri.T., Every topological space is pre-$T_{1/2,}$*Mem.Fac.Sci.Kochi.Univ. (Math), 17 (1996), 33-42.*

[9] A. S. Mashhour, I. A. Hasanein, and S. N. El-Deeb, α-Continuous and α-Open Mappings, *Acta Math. Hung., 41(3-4), (1983), 213-218.*

[10] K. Balachandran, P. Sundaram, and H. Maki, On Generalized Continuous Maps in Topological Spaces, *Mem. Fac. Kochi Uni. Ser. A Math., 12, (1991), 5-13.*

[11] R. Devi, H. Maki, and K. Balachandran, Semi-Generalized Homeomorphism and Generalized Semi-Homeomorphism in Topological Spaces, *Indian J. Pure Appl. Math., 26(3), (1995), 271-284.*

[12] Pious Missier, RAVI.O., Jeyashri.S. and Herin Wise Bell.P., g'' -closed sets in topology (submitted).

[13] M. Myvizhi and V. Kokilavani, On separation axioms of $g\zeta^*$-closed sets in topological spaces, *Indian Journal of Science and Technology, 6, (2013), 119-120.*

[14] R. Devi, H. Maki, and V. Kokilavani, The Group Structure of $^{\#}G\,\alpha$-Closed Sets in Topological Spaces, *International Journal of general topology,2(1),(2009),21-30.*

[15] S. Jafari, S. S. Benchalli, P.G. Patil and T. D. Rayanagoudar Pre-g^* closed sets in topological spaces, *Journal of Advanced Studies in Topology Research Article, 3(3), (2012) 55-59.*

[16] K. Nono, R. Devi, M. Devipriya, K. Muthukumaraswamy and H. Maki, On $g^{\#}\alpha$-closed sets and the Digital plane, *Bull. Fukuoka Univ. Ed. Part III, 53, (2004), 15-24.*

[17] R. Devi, H. Maki and V. Kokilavani, The group structure of $^{\#}g\alpha$-closed sets in topological spaces, *International Journal of General Topology, 2(2009), 21-30.*

Source of support: Nil, Conflict of interest: None Declared