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Research Article

$SG\hat{G}$-HOMEOMORPHISMS AND – $\hat{G}SG$ HOMEOMORPHISMS IN TOPOLOGICAL SPACES

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In the present paper we introduce two new types of mappings called $sg\hat{g}$-homeomorphism and $\hat{g}sg$-homeomorphism and then shown that one of these mapping has a group structure. Further we investigate some properties of these two homeomorphisms.

INTRODUCTION

Levine[3] in 1970 generalized the concept of closed sets to generalized closed sets. Bhattacharya and Lahiri[7] in 1987 generalized the concept of closed sets to semi-generalized closed sets with the helps of semi-open sets and obtained various topological properties. Arya and Nour[8] in 1990 have defined generalized semi-open sets with the help of semi-openness and use them to obtain some characterizations of s-normal spaces. Devi, Balachandran and Maki[11] in 1995 defined two new classes of maps called semi-generalized homeomorphisms and generalized semi-homeomorphisms and also defined two new classes of maps called sgc-homeomorphisms and gsc-homeomorphisms. Ahmed and Narli[15] in 2007 defined two new classes of maps called gsg-homeomorphisms and sgs-homeomorphisms. Garg, Chauhan and Agarwal[17] in 2007 introduced two new classes of maps namely gsψ-homeomorphisms and ψgs-homeomorphisms. Garg et al.[18] again in 2007 introduced two new classes of maps called sgψ-homeomorphisms and ψsg-homeomorphisms. Manoj and Shikha[19] in 2007 introduced $\hat{g}gs$-and $gs\hat{g}$-homeomorphisms. In this paper we introduce two new classes of maps called $sg\hat{g}$-homeomorphisms and $\hat{g}sg$-homeomorphisms and then study some of their properties.

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Throughout the present paper, (X, τ) and (Y, σ) denote topological spaces on which no separation axioms are assumed unless explicitly stated. For a subset A of a topological space (X, τ) the cl(A), int(A) and A^C denote the closure of A, the interior of A and the complement of A in X respectively.

Preliminaries

In this section we recall the following definitions.

Definition 2.01: A subset A of a topological space (X, τ) is called semi-open[6] (resp. semi-closed) if $A \subseteq cl(int(A))$ (resp. $int(cl(A)) \subseteq A$). Every closed (resp. open) set is semi-closed (resp. semi-open).

Definition 2.02: A subset A of a topological space (X, τ) is called semi-generalized closed[7] (briefly sg-closed) if $scl(A) \subseteq U$ whenever $A \subseteq U$ and U is semi-open. The complement of sg-closed set is called sg-open set. Every semi-closed set is sg-closed set. The family of all sg-closed sets of any topological space (X, τ) is denoted by sgc (X, τ).

Definition 2.03: A subset A of a topological space (X, τ) is called generalized semi closed[8] (briefly gs-closed) if $scl(A) \subseteq U$ whenever $A \subseteq U$ and U is open. The complement of gs-closed set is called gs-open set. Every closed (semi-closed, g-closed and sg-closed) set is gs-closed set. The family of all gs-closed sets of any topological space (X, τ) is denoted by gsc (X, τ).

Definition 2.04: A subset A of a topological space (X, τ) is called ψ-closed[12] if $scl(A) \subseteq U$ whenever $A \subseteq U$ and U is sg-open. The complement of ψ-closed set is called ψ-open set.

Every closed (semi-closed) set is ψ-closed set and every ψ-closed set is sg-closed (gs-closed) set. The family of all ψ-closed sets of any topological space (X, τ) is denoted by ψc (X, τ).

Definition 2.05: A subset A of a topological space (X, τ) is called $\hat{g}$-closed[13] if cl(A) ⊆ U whenever A ⊆ U and U is semi-open. The complement of $\hat{g}$-closed set is called $\hat{g}$-open set. Every closed set is $\hat{g}$-closed set and every $\hat{g}$-closed set is ψ-closed (sg-closed, gs-closed, g-closed) set. The family of all $\hat{g}$-closed sets of any topological space (X, τ) is denoted by $\hat{g}$c (X, τ).

Definition 2.06: A map f : (X, τ) → (y, σ) is called semi-closed map[6] (resp. sg-closed map[10], gs-closed map[10], ψ-closed map[16], $\hat{g}$-closed map[14]) if the image of each closed set in (X, τ) is semi-closed set (resp. sg-closed set, gs-closed set, ψ-closed set, $\hat{g}$-closed set) in (Y, σ). Every closed map is semi-closed map. Every semi-closed map is ψ-closed map. Every ψ-closed map is sg-closed map, every sg-closed map is gs-closed map and every $\hat{g}$-closed map is ψ-closed map (sg-closed map, gs-closed map, g-closed map).

Definition 2.07 : A map f : (X, τ) → (y, σ) is called $\hat{g}$-continuous[14] (resp. ψ-continuous[12], sg-continuous[4], gs-continuous[11], ψ-irresolute[12], sg-irresolute[9], gs-irresolute[11], gsg-irresolute[15], sgs-irresolute[15], gsψ–irresolute[17], ψgs-irresolute[17], sgψ–irresolute[18], ψsg-irresolute[18], $\hat{g}$-irresolute[13], $\hat{g}gs$-irresolute[19], $gs\hat{g}$-irresolute[19]) if the inverse image of every closed (resp. closed, closed, closed, ψ–closed, sg-closed, gs-closed, gs-closed, sg-closed, gs-closed, ψ-closed, sg-closed, ψ-closed, $\hat{g}$-closed, $\hat{g}$-closed, gs-closed) set in (Y, σ) is $\hat{g}$-closed (resp. ψ-closed, sg-closed, gs-closed, ψ-closed, sg-closed, gs-closed, sg-closed, gs-closed, ψ-closed, gs-closed, ψ-closed, sg-closed, $\hat{g}$-closed, gs-closed, $\hat{g}$-closed) set in (X, τ).

Definition 2.08: A bijective map f : (X, τ) → (y, σ) is called:

(i) semi-homeomorphism (B)[15] (briefly s.h. (B)) if f is continuous and semi-open map.
(ii) (ii) ψ-homeomorphism[16] if f is both ψ-continuous and ψ-open map.
(iii) $\hat{g}$ -homeomorphism[14] if f is both $\hat{g}$-continuous and $\hat{g}$-open map.
(iv) semi-generalized homeomorphism[11] (briefly sg-homeomorphism) if f is both sg-continuous and sg-open.
(v) generalized semi-homeomorphism[11] (briefly gs-homeomorphism) if f is both gs-continuous and gs-open.
(vi) sgc-homeomorphism[11] (resp. gsc-homeomorphism[11], ψ*-homeomorphism[16], $\hat{g}$c-homeomorphism[14], gsg-homeomorphism[15], sgs-homeomorphism[15], gsψ-homeomorphism[17], ψgs- homeomorphism[17], sgψ-homeomorphism[18], ψsg-homeomorphism[18], $\hat{g}gs$-homeomorphism[19], $gs\hat{g}$ -homeomorphism[19]) if f and f^{-1} are sg-irresolute (resp. gs-irresolute, ψ-irresolute, $\hat{g}$ -irresolute, gsg-irresolute, sgs-irresolute, gsψ-irresolute, ψgs-irresolute, sgψ-irresolute, ψsg-irresolte, $\hat{g}gs$-irresolute, $gs\hat{g}$ -irresolute).

Definition 2.09: A space (X, τ) is called $T_{1/2}$-space[3] (resp. T_b-space[10], $\hat{T}_b$-space[14]) if every g-closed set (resp. gs-closed set, gs-closed set) is closed set (resp. closed set, $\hat{g}$-closed set).

Proposition 2.10: In a $T_{1/2}$-space every gs-closed set is semi-closed set [10].

$SG\hat{G}$*-Homeomorphisms*

In this section we introduce $sg\hat{g}$-homeomorphisms and then investigate the group structure of the set of all $gs\hat{g}$-homeomorphisms.

Definition 3.01: A map f: (X, τ) → (Y, σ) is called a $sg\hat{g}$-irresolute map if the set f^{-1}(A) is $\hat{g}$-closed in (X, τ) for every sg-closed set A of (Y, σ).

Definition 3.02: A bijection f: (X, τ) → (Y, σ) is called a $sg\hat{g}$-homeomorphisms if the function f and the inverse function f^{-1} are both $sg\hat{g}$-irresolute maps. If there exists a $sg\hat{g}$-homeomorphism from X to Y, then the spaces (X, τ) and (Y, σ) are called $sg\hat{g}$-homeomorphic. The family of all $sg\hat{g}$-homeomorphism of any topological space (X, τ) is denoted by $sg\hat{g}$h(X, τ).

Remark 3.03: The following examples show that the concepts of homeomorphism and $sg\hat{g}$-homeomorphism are independent of each other.

Example 3.04: Let X = {a, b, c} and τ = {ϕ, {a}, {a, b}, X}. Define f : (X, τ) → (X, τ) by identity mapping then f is a homeomorphism but not a $sg\hat{g}$-homeomorphism for f and f^{-1} are not $sg\hat{g}$-irresolute maps.

Example 3.05: Let X = Y = {a, b, c}, τ = {ϕ, {a}, {b,c}, X} and σ = {ϕ, Y}. Define f: (X, τ) → (Y, σ) by identity mapping then f is $sg\hat{g}$-homeomorphism but not homeomorphism.

Proposition 3.06: Every $sg\hat{g}$-homeomorphism is (i) sgc-homeomorphism (ii) $\hat{g}$c- homeomorphism (iii) ψ*-homeomorphism (iv) sgψ–homeomorphism (v) ψsg-homeomorphism (vi) $\hat{g}gs$-homeomorphism (vii) sgs-homeomorphism (viii) ψgs-homeomorphism.

The converse of the above proposition is not true as at it can be seen from the following examples.

Example 3.07: Let X = Y = {a, b, c}, τ = {ϕ, {a}, {a, b}, X} and σ = {ϕ, {a}, {a, b}, {a, c}, Y}. Define f : (X, τ) → (Y, σ) by identity mapping then f is sgc-homeomorphism but not $sg\hat{g}$-homeomorphism for f is not $sg\hat{g}$-irresolute map.

Example 3.08: Let X = Y = {a, b, c, d}, τ = {ϕ, {a}, {a, b, c}, X} and σ = {ϕ, {a}, {a, b}, {a, b, c}, Y}. Define f: (X, τ) → (Y, σ) by identity mapping then f is $\hat{g}c$-homeomorphism but not $sg\hat{g}$-homeomorphism for f and f^{-1} both are not $sg\hat{g}$-irresolute maps.

Example 3.09: In example (3.07), f is ψ*-homeomorphism but not $sg\hat{g}$-homeomorphism.

Example 3.10: Let X = Y = {a, b, c}, τ = {ϕ, {a}, {a, b}, {a, c}, X} and σ = {ϕ, {a}, Y}. Define f : (X, τ) → (Y, σ) by identity mapping then f is sgψ-homeomorphism but not $sg\hat{g}$-homeomorphism for f^{-1} is not $sg\hat{g}$-irresolute map.

Example 3.11: Let X = Y = {a, b, c}, τ = {ϕ, X} and σ = {ϕ, {a, b}, Y}. Define f: (X, τ) → (Y, σ) by identity mapping then f is ψsg-homeomorphism but not Let X = Y = {a, b, c}, τ = {ϕ, X} and σ = {ϕ, {a, b}, Y}. Define f: (X, τ) → (Y, σ) by identity mapping then f is □sg-homeomorphism but not $sg\hat{g}$-homeomorphism for f^{-1} is not $sg\hat{g}$-irresolute map.

Example 3.12: Let X = Y = {a, b, c, d}, τ = {ϕ, {a}, {a, b, c}, X} and σ = {ϕ, {a}, {b}, {a, b}, {a, d}, {a, b, c}, {a, b, d}, Y}. Define f: (X, τ) → (Y, σ) by identity mapping then f is $\hat{g}gs$-homeomorphism but not $sg\hat{g}$-homeomorphism for f is not $sg\hat{g}$-irresolute map.

Example 3.13: In example (3.10), map f is sgs-homeomorphism but not $sg\hat{g}$-homeomorphism for f^{-1} is not $sg\hat{g}$-irresolute map.

Example 3.14: Let X = Y = {a, b, c, d}, τ = {ϕ, {a}, {b}, {a, b}, {a, d}, {a, b, c}, {a, b, d}, X} and σ = {ϕ, {a}, {a, b}, {a, b, c}, Y}. Define f : (X, τ) → (Y, σ) by identity mapping then f is ψgs-homeomorphism but not $sg\hat{g}$-homeomorphism for f and f^{1} are not $sg\hat{g}$-irresolute map.

Proposition 3.15: Every $gs\hat{g}$-homeomorphism is $sg\hat{g}$-homeomorphism.

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

Example 3.16: Let X = {a, b, c, d} and τ = {ϕ, {a}, {a, b, c}, X}. Define f: (X, τ) → (X, τ) by identity mapping then f is $sg\hat{g}$-homeomorphism but not $gs\hat{g}$-homeomorphism f and for f^{-1} are not $gs\hat{g}$-irresolute maps.

Remark 3.17: $sg\hat{g}$-homeomorphism is independent form gsψ-homeomorphism as it can be seen from the following example.

Example 3.18: In example (3.05), map f is $sg\hat{g}$-homeomorphism but not gs□-homeomorphism.

Example 3.19: Let X = {a, b, c} and τ = {ϕ, {a}, {c}, {a, c}, X}. Define f: (X, τ) → (Y, σ) by identity mapping then f is gsψ-homeomorphism but not $sg\hat{g}$-homeomorphism.

Remark 3.20: gc-homeomorphism, gsc-homeomorphism and gsg-homeomorphism are not necessarily $sg\hat{g}$-homeomorphism as it can be seen from the following examples.

Example 3.21: Let X = {a, b, c} and τ = {ϕ, {a}, {a, b}, X}. Define f: (X, τ) → (Y, σ) by identity mapping then f is gc-homeomorphism but not $sg\hat{g}$-homeomorphism.

Example 3.22: Let X = Y = {a, b, c}, τ = {ϕ, {a}, {a, b}, X} and σ = {ϕ, {a}, {b}, {a, b}, {a, c}, Y}. Define f : (X, τ) → (Y, σ) by identity mapping then f is gsc-homeomorphism but not $sg\hat{g}$-homeomorphism.

Example 3.23: Let X = {a, b, c, d} and τ = {ϕ, {a}, {b}, {a, b}, {a, d}, {a, b, c}, {a, b, d}, X}. Define f: (X, τ) → (X, τ) by identity mapping then f is gsg-homeomorphism but not $sg\hat{g}$-homeomorphism.

Proposition 3.24: Every gsg (sgs)-homeomorphism from $\hat{T}_b$-space onto itself is $sg\hat{g}$-homeomorphism.

Proposition 3.25: If f: (X, τ) → (Y, σ) is $sg\hat{g}$-homeomorphism then every sgc($\hat{g}c$)-homeomorphism from X to Y is $\hat{g}c$ (sgc)-homeomorphism.

Proposition 3.26: If f: (X, τ) → (Y, σ) and g : (Y, σ) → (Z, η) are $sg\hat{g}$-homeomorphism then their composition gof : (X, τ) → (Z, η) is also $sg\hat{g}$-homeomorphism.

Theorem 3.27: If $sg\hat{g}$h(X, τ) is non-empty then the set $sg\hat{g}$h(X, τ) is a group under the composition of maps.

Theorem 3.28: If f: (X, τ) → (Y, σ) be a $sg\hat{g}$-homeomorphism then f induces and isomorphism from the group $sg\hat{g}$ h(X, τ) onto the group $sg\hat{g}$ h(Y, σ).

Theorem 3.29: $sg\hat{g}$-homeomorphism is an equivalence relation in the collection of all topological spaces.
Proof: Reflexivity and symmetry are immediate and transitivity followed from proposition (3.26).

$\hat{G}SG$-*Homeomorphisms*

In this section we introduce $\hat{g}sg$-homeomorphism and investigate its properties.

Definition 4.01: A map f: (X, τ) → (Y, σ) is called $\hat{g}sg$-irresolute map is the set $f^{-1}(A)$ is sg-closed in (X, τ) for every $\hat{g}$-closed set A of (Y, σ).

Definition 4.02: A bijection f : (X, τ) → (Y, σ) is called a $\hat{g}sg$-homeomorphism if the function f and the inverse function f^{-1} are both $\hat{g}sg$-irresolute maps. If there exists a $\hat{g}sg$-homeomorphism from X to Y, then the spaces (X, τ) and (Y, σ) are called $\hat{g}sg$-homeomorphic.

The family of all $\hat{g}sg$-homeomorphism of any topological space is denoted by $\hat{g}sg$ h (X, τ).

Proposition 4.03: Every sgc- homeomorphism is $\hat{g}sg$-homeomorphism.

Proposition 4.04*:* Every (i) $\hat{g}$c-homeomorphism (ii) gsg-homeomorphism (iii) ψ*-homeomorphism (iv) ψsg-homeomorphism (v) sgψ-homeomorphism (vi) gsψ-homeomorphism (vii) $gs\hat{g}$-homeomorphism (viii) $sg\hat{g}$-homeomorphism is $\hat{g}sg$ - homeomorphism.

The following examples show that the converse of the above proposition is not true.

Example 4.05: Let X = Y = {a, b, c,}, τ = {ϕ, {a}, {a, b}, {a, c}, X} and σ = {ϕ, {a}, Y}. Define f : (X, τ) → (Y, σ) by identity mapping then f is $\hat{g}sg$-homeomorphism but not $\hat{g}c$-homeomorphism .

Example 4.06: In example (3.07), map f is $\hat{g}sg$-homeomorphism but not gsg-homeomorphism.

Example 4.07: In example (3.05), map f is $\hat{g}sg$-homeomorphism but not ψ*-homeomorphism for f^{-1} is not a □-irresolute map.

Example 4.08: Let X = {a, b, c,}, τ = {ϕ, {a}, {a, b}, X}. Define f: (X, τ) → (X, τ) by identity mapping then f is $\hat{g}sg$-homeomorphism but not □sg-homeomorphism for f and f^{-1} are not □sg-irresolute maps.

Example 4.09: Let X = {a, b, c,} and τ = {ϕ, {a}, {b, c}, X}. Define f: (X, τ) → (X, τ) by identity mapping then f is $\hat{g}sg$-homeomorphism but not sgψ-homeomorphism for f and f^{-1} are not sg□-irresolute maps.

Example 4.10: In example (4.07), map f is $\hat{g}sg$-homeomorphism but not gsψ-homeomorphism for f is not gs□-irresolute map.

Example 4.11: Let X = Y = {a, b, c,}, τ = {ϕ, {a}, X} and σ = {ϕ, {a}, {a, b}, Y}. Define f: (X, τ) → (Y, σ) by identity mapping then f is $\hat{g}sg$-homeomorphism but not $gs\hat{g}$-homeomorphism.

Example 4.12: In example (3.11), map f is $\hat{g}sg$-homeomorphism but not $sg\hat{g}$-homeomorphism.

Proposition 4.13: Every $\hat{g}sg$- homeomorphism is $\hat{g}gs$-homeomorphism.

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

Example 4.14: Let X = Y = {a, b, c,}, τ = {ϕ, {a}, {a, b}, X} and σ = {ϕ, {a, b}, Y}. Define f: (X, τ) → (Y, σ) by identity mapping then f is $\hat{g}gs$-homeomorphism but not $\hat{g}sg$-homeomorphism for f is not $gs\hat{g}$-irresolute map.

Remark 4.15: $\hat{g}sg$ - homeomorphism is independent form gc-homeomorphism gsc-homeomorphism as it can be seen from the following examples.

Example 4.16: In example (3.07), map f is $\hat{g}sg$-homeomorphism but not gc-homeomorphism.

Example 4.17: Let X = Y = {a, b, c,}, τ = {ϕ, {a}, {b}, {a, b}, X} and σ = {ϕ, {a}, {a, b}, Y}. Define f: (X, τ) → (Y, σ) by identity mapping then f is gc-homeomorphism but not $\hat{g}sg$-homeomorphism for f^{-1} is not $\hat{g}sg$-irresolute map.

Example 4.18: In example (4.11), map f is $\hat{g}sg$-homeomorphism but not gsc-homeomorphism.

Example 4.19: In example (4.22), map f is gsc-homeomorphism but not $\hat{g}sg$-homeomorphism.

Remark 4.20: sgs-homeomorphism and ψgs-homeomorphism are not necessarily $\hat{g}sg$ -homeomorphism as it can be seen from the following example.

Example 4.21: In example (3.22), map f is sgs-homeomorphism and ψgs-homeomorphism but not $\hat{g}sg$ -homeomorphism.

All the above discussion of section (3) and (4) can be summarized by the following diagram.

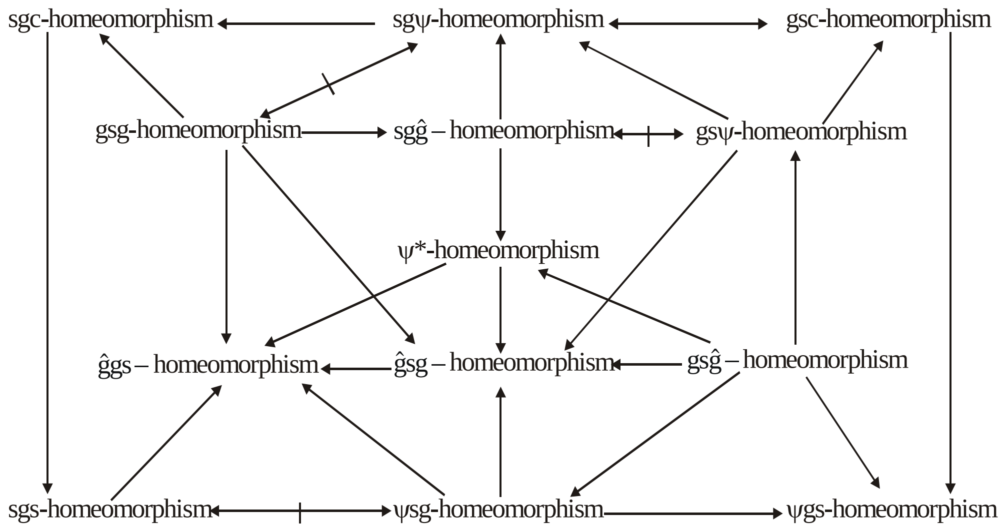

Diagram (4.24)

Where A → B (resp. A ↔ B) represents A implies B but not conversely (resp. A and B are independent).

Theorem 4.22: Every $\hat{g}sg$ -homeomorphism from a T_b-space onto itself is a homeomorphism..

Theorem 4.23 : Every $\hat{g}sg$ -homeomorphism from a $\hat{T}_b$ -space onto itself is a $sg\hat{g}$ -homeomorphism.

References

1. N. Biswas (1969): On some mappings in topological spaces, Bull. Calcutta Math. Soc. 61, 127-135.
2. N. Biswas: On characterization of semi continuous function, *Atti. Accad. Zaz Lincci. Rend Cl. Sci. Fis Math. Natur.* 48(8) (1970), 399-402.
3. N. Levine : Generalized closed sets in topology, *Rend. Circ. Mat. Palermo*, 19 (1970), 89-96.
4. S. G. Crossley and S. K. Hilbebrand: Semi Closure, Texar J. Sci., 22 (1971), 99-112.
5. S. G. Crossley and S. K. Hilbebrand: Semi Topological Properties, Fund. Math.., 74 (1972), 233-254.
6. T. Noiri: A generalization of closed mappings, *Atti. Accad. Zaz Lincci. Rend Cl. Sci. Fis Math. Natur.* 54(8) (1973), 412-415.
7. P. Bhattacharya and B.K. Lahiri: Semi generalized closed sets in topology, *Indian J. Math.* 29, (1987) 376-382.
8. S. P. Arya and N. Tour: Characterizations of s-normal spaces, *Indian J. Pure Applied Math.*, 21(8) (1990), 717-719.
9. P. Sundaram, H. Maki, K. Balachandran.: Semi generalized continuous maps and semi-$T_{1/2}$ spaces, *Bull. Fukuoka Univ. Ed. Part-III*, 40(1991), 33-40.
10. R. Devi, H. Maki and K. Balachandran: Semi generalized closed maps and generalized semi closed maps, Mem, Fac. Sci. Kochi Univ. Ser. A. Math. 14 (1993), 41-54.
11. R. Devi, K. Balachandran and H. Maki: Semi Generalized homomorphism and generalized semi homomorphism in topological spaces, Indian J. Pure Appl. Math., 26(3), (1995), 271-284.
12. M.K.R.S. Veera Kumar : Between semi closed sets and semi pre-closed sets, Rend. Instint. Math. Univ. Trieste (Italy)XXXII (2000), 25-41.
13. M.K.R.S. Veera Kumar : $\hat{g}$ -closed sets and $\hat{G}LC$ -function. *Indian J. Math.*. 43 (2) (2001), 231-247.
14. M.K.R.S. Veera Kumar: On $\hat{g}$ -closed sets in topological spaces, *Bull. of Allahabad Math. Soc.* 18 (2003), 99-112.
15. Z.O. Ahmet and N. Sarkan: De-composition of homeomorphisms in topological spaces, *International Journal of Math. Sci*. 1 (2007), 72-75.
16. Garg M., Agarwal S. and Goel C.K.: On ψ–homeomorphism in topological spaces, Reflection De Era-JPS 4 (2010), 9-24.

17. Garg M., Chauhan A. and Agarwal S.: New generalization of homeomorphism in topological spaces, Ultra Sci., 20 (2) M, 455-462.
18. Garg M. and Agarwal S.: Some new types of homeomorphism in topological spaces, *Antarctica J*. Math, 5(1-2), 2008.
19. Garg M. and Agarwal S.: $\hat{G}GS$ - homeomorphism and $GS\hat{G}$ - homeomorphism in topological spaces, Jour. *Int. Acd. Phy. Sci*.12(2008), 89-96.

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